UMTIK 2016

17th International Conference on Machine Design and Production

CONFERENCE PROGRAMME AND BOOK OF ABSTRACTS

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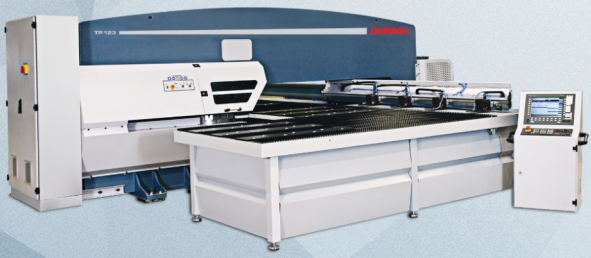

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PREFACE

UMTIK 2016 Conference organization was started right after UMTIK 2014 which was organized in Izmir, in order to be timely to follow the schedule set for the organizing activities. The city where the conference would be organized was already fixed as Bursa, after having some consultation with the participants during UMTIK 2014, due to its very active industry with a wide spectrum of sectors all well above the Turkish average in terms of technology level.

We had quite a few choices for the conference venue to select from and finally we decided to have the conference at Kervansaray Thermal Hotel in Çekirge, which is located at the skirts of Uludağ, where you can still breathe fresh air in such an industrial city. Another reason for preferring Kervansaray Hotel was that the authentic Turkish Hamam in the historical Old Hot Springs is located within its premises.

A number of tragic events in Turkey caused our potential participants decided not to participate in the conference and to cancel three special sessions which had already been announced at our web site. That caused considerable delay in our announcements and our preparatory activities. We would like to express our sincere gratitude to our colleagues and friends from abroad who did not hesitate to participate in our conference not to leave us alone in these difficult days.

Although we don't adopt a theme for UMTIK conferences; keynote papers, special sessions, scope of the panel and even the papers in the regular sessions are either directly or somehow related with some aspect of Industry 4.0. Hence, we can say that the theme of this conference came out to be "Industry 4.0 and its Implementation".

The panel "Industry 4.0 and Deployment of "Internet of Things" Technology In Production" is organized and will be moderated by Professor Orhan Alankuş of Okan University and will host five panelists from five leading organizations/companies: Fraunhofer Institute of Production Technology, General Electric Turkey, Siemens Turkey, Bosch Turkey, Tofaş R&D Center, which have already started implementing Industry 4.0.

There are three prominent Keynote speakers: Professor Altintaş of the University of British Columbia, Professor Zaeh of the Technical University of Munich and Professor Barnes of University of Warwick, who will deliver their speeches in the morning sessions of the first three days of the conference; namely, on "Digital Machining", "Next Generation High Performance Machine Tools" and "Ultrasonic Assisted Machining" respectively.

8 papers will be presented in the First Day (Machining Day), 62 papers (22 in Turkish language) will be presented in the regular sessions and 22 papers will be presented in the three special sessions. Special session "Industry 4.0 for Machine Tools in Taiwan" with 6 papers is organized by ITRI (Industrial Technology Research Institute) of Taiwan, special session "Additive Manufacturing (3-D Printing) Technologies" with 7 papers is organized by a group of professors

from the TOBB University of Economics and Technology and special session “Cryogenic Machining” with 10 papers is organized by Professor Kaynak of Marmara University.

About 25% of the papers to be presented in the conference are either outcome of a joint project between university and industry or of a research project conducted by an industrial company alone. This is a good sign of the growing interest of the industry to the UMTIK conferences. We hope that there will be more contributions from industry to our conferences in the future.

In addition to the special and regular sessions of UMTIK 2016, there will be a Student Symposium and the Industry 4.0 Turkey Brokerage Event on the last day (15th June 2016) of the conference. 9 innovative project ideas realised by the undergraduate students of the three universities (Middle East Technical University, Uludağ University, Atılım University) will be presented by the students. Brokerage Event is jointly organized by the Technology Transfer offices of Sabancı and Uludağ universities.

Special sessions and the regular sessions will be conducted in three parallel sessions. The First Day program, keynote presentations and the sponsor sessions; however, will be organized as plenary sessions in order that all the participants can attend.

We highly acknowledge the Honorary Chair Persons of the Conference: Presidents of the three universities, Professor Ahmet Acar of the Middle East Technical University, Professor Yıldırım Üçtuğ of Atılım University and Professor Yusuf Ulcay of Uludağ University for their kind support. We would like to thank the Honorary Keynote Speaker, Professor Yusuf Altıntaş, keynote speakers, Professor Zaeh and Professor Barnes, panel organizer Professor Orhan Alankuş, special session organizers, session chair persons, authors and all participants for their valuable contributions. Our Scientific Secretary Dr. Orkun Özşahin is gratefully acknowledged for his tremendous time and effort he spent in every aspect of the conference organization; he, Dr. Besim Baranoğlu and Dr. Bahram Lotfi Sadigh for their great contributions in editing the Conference Proceedings and the Abstracts Book.

Last, but not the least, we would also like to thank our main sponsor Durmazlar, TUBITAK, “The Scientific and Technological Research Council of Turkey”, Turkish Machinery Exporters Union, sponsors, the International Program Committee Members, the reviewers, our conference secretariat, ORIGIN, and all those who contributed to the success of UMTIK 2016.

We wish all the participants a highly memorable time during their stay in Bursa.

The Organizing Committee

UMTIK 2016, 12-15 July 2016

Bursa, Türkiye

DURMAZLAR HALL	*JULY 12, 2016 - TUESDAY*
8:00- 9:00	**REGISTRATION**
9:00-10:30	**OPENING SESSION**
10:30-11:15	**(I1) Honorary Keynote Speaker:** Prof. Dr. Yusuf ALTINTAŞ "DIGITAL MACHINING"
11:15-11:30	**COFFEE BREAK**
11:30-13:30	**(I2) PANEL** **INDUSTRY 4.0 AND DEPLOYMENT OF "INTERNET OF THINGS" TECHNOLOGY IN PRODUCTION** Moderator: Prof. Dr. Orhan ALANKUŞ
13:30-14:30	**LUNCH**
14:30 – 16:10	**A0 MACHINING DAY SESSION 1** **GENERAL MACHINING PROCESS SIMULATION SOFTWARE** Z. Murat KILIÇ, Yusuf ALTINTAŞ, Byron REYNOLDS **MULTI-DIMENSIONAL MODELLING OF CHATTER STABILITY IN PARALLEL TURNING OPERATION** Milad AZVAR, Erhan BUDAK **STABILITY OF ASYMMETRIC MILLING CUTTERS IN ROTATING COORDINATES** Alptunç ÇOMAK, Orkun ÖZŞAHİN, Yusuf ALTINTAŞ **ADAPTIVE MANUFACTURING WITH METROLOGY FEEDBACK** Recep KARADAYI
16:10- 16:30	**COFFEE BREAK**
16:30 – 18:10	**B0 MACHINING DAY SESSION 2** **IN-PROCESS TOOL WEAR MONITORING IN INTERNAL BROACHING** Jokin MUNOA, Iñigo BEDIAGA, Christian RAMIREZ, Kepa HUERTA, Christian KRELLA, Gabor STEPAN **AN EXPERIMENTAL STUDY ON THE DEFORMATION BEHAVIOR OF THIN-WALLED WORKPIECES** Johannes LOEHE, Sepp WIMMER, Michael HAIRER, Micheal F. ZAEH **COMPARISON OF COATING MATERIALS AND SURFACE FINISHING TECHNIQUES IN HIGH PERFORMANCE MILLING OF AEROSPACE GRADE TITANIUM ALLOYS** Mohammad AKMAL, S. Ehsan LAYEGH K, İsmail LAZOĞLU, Ali AKGÜN, Çağlar YAVAŞ **DETERMINATION OF TOOL POINT FRF OF MICRO TOOLS UNDER OPERATIONAL CONDITIONS USING ANALYTICAL METHODS** Orkun ÖZŞAHİN
20:00	**WELCOME COCKTAIL**

JULY 13, 2016 - WEDNESDAY			
9:00- 9:45	**DURMAZLAR HALL** **(I3) Keynote Speaker:** Prof. Dr.-Ing. Michael F. ZÄH "NEXT GENERATION HIGH PERFORMANCE SMART MACHINE TOOLS"		
	Hall 1	**DURMAZLAR HALL**	**Hall 3**
9:45-11:15	**A1** **Automotive Engineering I** 10, 18, 102	**B1** **Special Session: Industry 4.0 for Machine Tools in Taiwan I** ST1, ST2, ST3	**C1** **Use of New Concepts in Manufacturing** 22, 47, 66, 86
11:15- 11:30	**COFFEE BREAK**		
	Hall 1	**DURMAZLAR HALL**	**Hall 3**
11:30- 13:00	**A2** **Automotive Engineering II** 17, 19, 54, 105	**B2** **Special Session: Industry 4.0 for Machine Tools in Taiwan II** ST4, ST5, ST6	**C2** **Intelligent Systems** 36, 38, 39, 100
13:00-14:00	**LUNCH**		
14:00- 14:45	**(I4) SPONSORS SESSION**		**DURMAZLAR HALL**
	Hall 1	**DURMAZLAR HALL**	**Hall 3**
14:45-16:15	**A3** **Otomotiv Mühendisliği I** 15, 50, 51	**B3** **Special Session: Additive Manufacturing (3-D Printing) Technologies I** SAM1, SAM2, SAM3	**C3** **Modeling and Simulation and their Applications in Industry** 28, 29, 30,104
16:15- 16:30	**COFFEE BREAK**		
	Hall 1	**DURMAZLAR HALL**	**Hall 3**
16:30- 18:00	**A4** **Otomotiv Mühendisliği II** 61, 62, 83	**B4** **Special Session: Additive Manufacturing (3-D Printing) Technologies II** SAM4, SAM5, SAM6, SAM7	**C4** **Machining and Non-Traditional Machining Processes** 01, 68, 74, 81
20:00	**COCKTAIL PROLONGE**		

JULY 14, 2016 - THURSDAY			
9:00- 9:45	**DURMAZLAR HALL** **(I5) Keynote Speaker:** Assoc. Prof. Dr. Stuart BARNES " ULTRASONIC ASSISTED MACHINING"		
9:45-11:15	**Hall 1**	**DURMAZLAR HALL**	**Hall 3**
	A5 **Methodology for Machine Design** 06, 40, 46, 101	**B5** **Special Session: Cryogenic Machining I** CM1, CM2, CM3, CM4	**C5** **Metal Forming** 02, 21, 99
11:15- 11:30	**COFFEE BREAK**		
11:30-13:00	**Hall 1**	**DURMAZLAR HALL**	**Hall 3**
	A6 **Design of Machines and their Applications I** 34, 41, 44, 48	**B6** **Special Session: Cryogenic Machining II** CM5, CM6, CM7	**C6** **Malzeme Karakterizasyonu** 43, 45, 57
13:00-14:00	**LUNCH**		
14:00-14:45	**(I6) SPONSORS SESSION**		**DURMAZLAR HALL**
14:45-16:15	**Hall 1**	**DURMAZLAR HALL**	**Hall 3**
	A7 **Design of Machines and their Applications II** 72, 73, 80, 97	**B7** **Special Session: Cryogenic Machining III** CM8, CM9, CM10	**C7** **Material Characterization** 37, 89, 94
20:00	**CONFERENCE DINNER**		

JULY 15, 2016 - FRIDAY			
	Hall 1	**DURMAZLAR HALL**	**Hall 3**
9:45-11:15	**A8** **Makina Tasarımı ve Uygulamaları** 23, 24, 35	**B8** **STUDENTS SYMPOSIUM Session I** S_SYMP_1, S_SYMP_2, S_SYMP_3, S_SYMP_4, S_SYMP_5	**C8** **Talaşlı Imalat I** 13, 25,32
11:15- 11:30	**COFFEE BREAK**		
	Hall 1	**DURMAZLAR HALL**	**Hall 3**
11:30-13:00	**A9** **Endüstriyel Uygulamalar** 14, 31, 60	**B9** **STUDENTS SYMPOSIUM Session II** S_SYMP_6, S_SYMP_7, S_SYMP_8, S_SYMP_9,	**C9** **Talaşlı Imalat II** 27, 63, 71
13:00-14:00	**LUNCH**		

July 12, 2016 (Tuesday), Machining Day

(I1) Keynote Lecture **DURMAZLAR HALL** **10:30 – 11:15**

***Chaired by**: Prof. Dr.-Ing. Michael F. ZÄH*

"DIGITAL MACHINING"
Keynote Speaker: Prof. Dr. Yusuf ALTINTAŞ

(I2) Panel **DURMAZLAR HALL** **11:30 – 13:30**

Organized and Moderated by : Prof. Dr. Orhan ALANKUŞ

INDUSTRY 4.0 AND DEPLOYMENT OF "INTERNET OF THINGS" TECHNOLOGY IN PRODUCTION

(A0) SESSION 1 **DURMAZLAR HALL** **14:30 – 16:10**

Chaired by: Prof. Dr. İsmail Lazoğlu

GENERAL MACHINING PROCESS SIMULATION SOFTWARE
Z. Murat KILIÇ, Yusuf ALTINTAŞ, Byron REYNOLDS

MULTI-DIMENSIONAL MODELLING OF CHATTER STABILITY IN PARALLEL TURNING OPERATION
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STABILITY OF ASYMMETRIC MILLING CUTTERS IN ROTATING COORDINATES
Alptunc COMAK, Orkun OZSAHIN, Yusuf ALTINTAŞ

ADAPTIVE MANUFACTURING WITH METROLOGY FEEDBACK
Recep KARADAYI

(B0) SESSION 2 **DURMAZLAR HALL** **16:30 – 18:10**

Chaired by: Prof. Dr. Erhan Budak
IN-PROCESS TOOL WEAR MONITORING IN INTERNAL BROACHING
Jokin MUNOA, Iñigo BEDIAGA, Christian RAMIREZ, Kepa HUERTA, Christian KRELLA, Gabor STEPAN

AN EXPERIMENTAL STUDY ON THE DEFORMATION BEHAVIOR OF THIN-WALLED WORKPIECES
Johannes LOEHE, Sepp WIMMER, Michael HAIRER, Micheal F. ZAEH

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Mohammad AKMAL, S. Ehsan LAYEGH K, İsmail Lazoğlu, Ali AKGÜN, Çağlar YAVAŞ

DETERMINATION OF TOOL POINT FRF OF MICRO TOOLS UNDER OPERATIONAL CONDITIONS USING ANALYTICAL METHODS
Orkun Özşahin

(I3) Keynote Lecture **DURMAZLAR HALL** **9:00 – 9:45**

Chaired by: Prof. Dr. Yusuf ALTINTAŞ

"NEXT GENERATION HIGH PERFORMANCE SMART MACHINE TOOLS"
Keynote Speaker: Prof. Dr.-Ing. Michael F. ZÄH

(A1) Automotive Engineering I **HALL 1** **9:45 – 11:15**

Chaired by: Dr. İsmail Durgun

APPLICATION OF FEM METHOD ON DESIGN AND MANUFACTURING OF MACHINES FOR SELF CLINCHING OF NUTS DURING STAMPING FOR AUTOMOTIVE SIDE PANEL INTERIOR PARTS (Paper 10)
Uygar KARATAŞ, Güçlü ARIKAN, Kerem DAĞDELEN, Bülent EKİCİ

FATIGUE PROPERTIES OF ABS THERMOPLASTICS USED IN EXTERIOR LIGHTING (Paper 18)
Samet ÇALIŞKAN, Hüseyin LEKESİZ, Ahmet Abdullah KARACA, Ali Rıza YILDIZ

SHEET LAMINATED DIES: AN ALTERNATIVE TO FAST PROTOTYPING IN FORMING OF SHEET METAL PARTS (Paper 102)
Hakan KALKAN, Yiğit UĞURLU, S. Serpil ERDÖNMEZ, Besim BARANOĞLU, Vildan ÇORUMLU, Bihter BİLGİN, Canberk MERMER, İsmail DURGUN

(B1) Special Session: Industry 4.0 for Machine Tools in Taiwan I **DURMAZLAR HALL** **9:45 – 11:15**

Organized by: Dr. Tzou Liang Lou, Dr. Shuo Peng Liang, Prof. Dr. Yung-Chou Kao, Assoc. Prof. Dr. Ming-Chyuan Lu, Assoc. Prof. Dr. Shean –Juinn Chiou

Chaired by: Dr. Racy Cheng
TOWARDS PRODUCTIVITY 4.0 (ST1)
Jiun CHEN

PREDICTION OF THIN WALL DYNAMICS FOR CHATTER STABILITY BY USING LASER DOPPLER VELOCIMETRY (ST2)
Chung-Yu TAI, Yi-Hsuan CHEN, Chi-Cheng LIN, Ci-Rong HUANG, Ta-Jen PENG, Tzuo-Liang LUO

A PROCESS STABILITY ENHANCED MACHINE TOOL DESIGN METHOD INTEGRATED DYNAMIC STIFFNESS TOPOLOGY OPTIMIZATION (ST3)
Tzuo-Liang LUO, Chia-Pei WANG, Shuo-Peng LIANG

(C1)	**Use of New Concepts in Manufacturing**	**HALL 3**	**9:45 – 11:15**

Chaired by: Mr. Fatih Pıtır

AN INVESTIGATION INTO POWER AND ENERGY REQUIREMENTS FOR THE AUXILIARY COMPONENTS OF A CNC LATHE (Paper 22)
M. Ural ULUER, H. Özgür ÜNVER, Metin AKKÖK, S. Engin KILIÇ

DESIGN OF FLEXIBLE MANUFACTURING SYSTEMS (Paper 47)
Mete YILMAZ, Fatih PITIR, Rasim YALCIN, Erdal CEYLAN, Halefsan SUMEN

DEVELOPMENT OF A CONTROL SYSTEM FOR AUTOMATED STORAGE AND RETRIEVAL SYSTEMS (Paper 66)
Özgür KORKMAZ, S. Engin KILIÇ

AUTONOMOUS MOBILE ABRASIVE WATERJET CUTTING VEHICLE (Paper 86)
Uğur ŞİMŞİR, Süleyman BAŞTÜRK

(A2)	**Automotive Engineering II**	**HALL 1**	**11:30 – 13:00**

Chaired by: Asst. Prof. Dr. Besim Baranoğlu

A NEW DESIGN FOR TILTABLE AND TELESCOPIC STEERING COLUMN WITH HIGH PRESSURE DIE CASTING TECHNOLOGY AND SPECIAL ALLOY MAGSIMAL 59 FOR AGRICULTURE MACHINES (Paper 17)
Bülent EKİCİ, Halil BİLGİN

AN ANALYSIS OF LOAD INCOMPATIBILITY IN CENTRAL IN-LINE COLLISIONS OF VEHICLES USING LUMPED-MASS MODELLING (Paper 19)
Selçuk HİMMETOĞLU

STRUCTURAL OPTIMIZATION USING META-HEURISTIC ALGORITHMS IN AUTOMOTIVE INDUSTY (Paper 54)
Betül Sultan YILDIZ, Hüseyin LEKESIZ, Ali Rıza YILDIZ

CARDBOARD BICYCLE (Paper 105)
C. Merih ŞENGÖNÜL, Tolga AKIŞ, S. Serpil ERDÖNMEZ, İzzet ÖZDEMİR

(B2) Special Session: DURMAZLAR HALL 11:30 – 13:00
Industry 4.0 for Machine Tools in Taiwan II

Organized by: Dr. Tzou Liang Lou, Dr. Shuo Peng Liang, Prof. Dr. Yung-Chou Kao, Assoc. Prof. Dr. Ming-Chyuan Lu, Assoc. Prof. Dr. Shean –Juinn Chiou

Chaired by: Assoc. Prof. Dr. Ming-Chyuan Lu

CHALLENGE AND PRACTICES FOR WIRELESS SENSOR NETWORK DEPLOYMENT IN MACHINING ENVIRONMENT (ST4)
Yun-Yen CHEN, Hsiao-Hui LEE, Racy CHENG

DEVELOPMENT OF SOUND BASED TOOL WEAR MONITORING SYSTEM FOR THE MILLING OF INCONEL 718 (ST5)
Chen-Yu LIANG, Ming-Chyuan LU, Shean-Juinn CHIOU

A POSTPROCESSOR FOR HYBRID FIVE-AXIS MACHINE TOOLS BASED ON INVERSE KINEMATIC WITH JACOBIAN MATRIX IMPLEMENTATION (ST6)
Tzuo-Liang LUO, Chien_Chih LIAO, Zi_Gui CHAO, Yuan-Lung LAI

(C2) Intelligent Systems HALL 3 11:30 – 13:00

Chaired by: *Asst. Prof. Dr. Mustafa Özdemir*

A CONDITIONAL COVERAGE PATH PLANNING METHOD FOR AN AUTONOMOUS LAWN MOWER (Paper 36)
Ardıç KAROL, E. İlhan KONUKSEVEN, A. Buğra KOKU, Serkan ÇİÇEK

FUZZY IMPERIALIST COMPETITIVE ALGORITHM BASED SOLUTION TO OPTIMIZE THE PID CONTROLLER SYSTEM (Paper 38)
Samad DADVANDIPOUR, Laszlo DUDÁS

ACTIVE COMPLIANCE CONTROL STRUCTURE DESIGN FOR A ROBOTIC-GRINDING MACHINE USING A PIEZO ACTUATOR (Paper 39)
Abdulhamit DONDER, E. İlhan KONUKSEVEN

ROSE STEM BRANCH POINT DETECTION AND CUTTING POINT LOCATION FOR ROSE HARVESTING ROBOT (Paper 100)
Cahit GÜREL, M. Hassan G. ZADEH, Abdulkadir ERDEN

(I4) Sponsors Session DURMAZLAR HALL 14:00–14:45

Chaired by: Prof. Dr. M. Cemal Çakır

(A3) Otomotiv Mühendisliği I HALL 1 14:45- 16:15

Chaired by: *Mr. Nusret Atik*

TOPLU TAŞIMA ARAÇLARININ DEVRİLME GÜVENLİĞİ İÇİN ECE R66 REGÜLASYONUNU SAĞLAYABİLECEK SANAL MÜHENDİSLİK KABİLİYETİ GELİŞTİRİLMESİ (Paper 15)

Özgün KÜÇÜK, Sercan SUNAR, Mertcan KAPTANOĞLU

YENİ NESİL OTOKORKULUK SİSTEMLERİNİN ÇARPIŞMA ANALİZLERİ VE SEZGİSEL OPTİMİZASYON YÖNTEMLERİ KULLANILARAK GELİŞTİRİLMESİ (Paper 50)

Enes KURTULUŞ, Ali Rıza YILDIZ

YENİ NESİL YÜKSEK MUKAVEMETLİ MALZEMELERİN FARKLI GEOMETRİLERDEKİ ENERJİ YUTUCULARIN ÇARPIŞMA PERFORMANSINA ETKİSİNİN İNCELENMESİ (Paper 51)

Emre DEMİRCİ, Ali Rıza YILDIZ

(B3) Special Session: Additive Manufacturing (3-D Printing) Technologies I DURMAZLAR HALL 14:45- 16:15

Organized by: Asst. Prof. Dr. H. Özgür Ünver, Prof. Dr. Nuri Durlu, Prof. Dr. Osman Eroğul

Chaired by: Asst. Prof. Dr. H. Özgür Ünver

AN AMF BASED MULTI-COLOR / MULTI-MATERIAL ADDITIVE MANUFACTURING SYSTEM (SAM1)

Tahir FİDAN, S. Engin KILIÇ

DEVELOPMENT AND INVESTIGATION OF SHAPED METAL DEPOSITION PROCESS USING TIG ARC HEAT SOURCE IN ADDITIVE LAYERED MANUFACTURING (SAM2)

Oğuzhan YILMAZ, Adnan A. UGLA

PROCESS LIMITS OF DIRECT METAL LASER SINTERING (DMLS) IN TERMS OF MINIMUM HOLE AND BOSS DIAMETERS WITH VARYING ASPECT RATIOS (SAM3)

Ezgi UĞUR SOLAKOĞLU, Rifat YILMAZ, Soner ÖREN, Güray AKBULUT, Özgür POYRAZ, Dr. Evren YASA

(C3)	Modeling and Simulation and their Applications in Industry	HALL 3	14:45- 16:15

Chaired by: *Asst. Prof. Dr. Uğur Şimşir*

THERMAL MODELING OF HEAT AFFECTED ZONE OF A LOW CARBON STEEL IN GAS METAL ARC AND LASER WELDING (Paper 28)
Yiğit F. KUŞÇU, Atakan ATAY, Barış ÇETİN, Halim MEÇO, Barbaros ÇETİN

DESIGN OF ACTIVE DISTURBANCE REJECTION BASED CONTROLLER FOR A MOBILE ASSEMBLY POSITIONER (Paper 29)
Fatma Nur ŞEN, Erhan TURAN, Barış CETİN, Kutluk Bilge ARIKAN, Ali Emre TURGUT, Besim BARANOĞLU

TOPOLOGY OPTIMIZATION OF A MOBILE ASSEMBLY POSITIONER BY CO-SIMULATION APPROACH (Paper 30)
Fatma Nur ŞEN, Özgür ÖZKAN, Ramazan KULAÇOĞLU, Barış ÇETİN, Kutluk Bilge ARIKAN, Besim BARANOĞLU

APPLICATION OF BOUNDARY ELEMENT – FINITE ELEMENT METHOD COUPLING FOR ELASTOPLASTIC ANALYSIS (Paper 104)
Tuğçe ÇEKİLLİ, Besim BARANOĞLU

(A4)	Otomotiv Mühendisliği II	HALL 1	16:30- 18:00

Chaired by: *Asst. Prof. Dr. Selçuk Himmetoğlu*

OTOMOBİLLERDE KULLANILAN DARBE EMİCİLERİN ŞEKİLLENDİRME GEÇMİŞİ DİKKATE ALINARAK YENİ NESİL SEZGİSEL YÖNETEMLER İLE OPTİMUM TASARIMI (Paper 61)
Selçuk KARAGÖZ, Ali Rıza YILDIZ

YENİ NESİL SEZGİSEL ALGORİTMALAR KULLANILARAK TAŞIT ELEMANLARININ OPTİMUM TASARIMI (Paper 62)
Betül Sultan YILDIZ, Ali Rıza YILDIZ

YENİ MODEL BİR BİNEK ARACI İÇİN BAGAJ KAPAĞI AÇMA KAPAMA MEKANİZMASININ TASARIMI VE TEST SÜRECİ (Paper 83)
Osman KOPMAZ, Ahmet YILDIZ, Nusret ATİK

(B4)	**Special Session: Additive Manufacturing (3-D Printing) Technologies II**	**DURMAZLAR HALL**	**16:30- 18:00**

Organized by: Asst. Prof. Dr. H. Özgür Ünver, Prof. Dr. Nuri Durlu, Prof. Dr. Osman Eroğul

Chaired by: ***Prof. Dr. Osman Eroğul***

DEVELOPMENT OF CAR REAR LIGHTING GROUP WITH 3D PRINTING METHODS (SAM4)
İsmail DURGUN, Davut BAŞARAN, Utku DEMİRKAN

A COMPARATIVE STUDY OF ENERGY CONSUMPTION OF SELECTIVE LASER SINTERING AND TURN-MILL MACHINING (SAM5)
Müge KAHYA, Gökberk SERİN, H. Özgür ÜNVER, Nuri DURLU, Osman EROĞUL, Osman DEMİR, Erbil OĞUZ

A REVIEW OF ADDITIVE MANUFACTURING TECHNOLOGIES (SAM6)
Gökberk SERİN, Müge KAHYA, Hakkı Özgür ÜNVER, Yavuz GÜLEÇ, Nuri DURLU, Osman EROĞUL

ADDITIVE MANUFACTURING OF TITANIUM ALLOYS (SAM7)
Ahmet Murat ÖGE, Nuri DURLU, Hakkı KIZILOK, Hakkı Özgür ÜNVER, Ayhan KILIÇ, Osman EROĞUL

(C4)	**Machining and Non-Traditional Machining Processes**	**HALL 3**	**16:30- 18:00**

Chaired by: *Assoc Prof. Dr. Stuart Barnes*

SURFACE ROUGHNESS IN MILLING OF AISI 430 STAINLESS STEEL BY MQL METHOD USING MWCNT REINFORCED VEGETABLE CUTTING FLUID (Paper 01)
Alper UYSAL

INFLUENCE OF MACHINING STRATEGIES ON SURFACE ROUGHNESS DURING WIRE ELECTRICAL DISCHARGE MACHINING OF TUNGSTEN CARBIDE (Paper 68)
Samad NADIMI BAVIL OLIAEI, Yiğit KARPAT

DEVELOPMENT OF A DESKTOP SIZE ELECTROCHEMICAL MACHINE FOR MICRO/MACRO MANUFACTURING (Paper 74)
Hasan DEMIRTAŞ, Oguzhan YILMAZ, Bahattin KANBER

THE EFFECTS OF HIGH-PRESSURE COOLANT ON PROGRESSIVE TOOL WEAR IN MACHINING STAINLESS STEEL (Paper 81)
Armin GHARIBI, Yusuf KAYNAK

(I5) Keynote Lecture **DURMAZLAR HALL** **9:00-9:45**

Chaired by: *Prof. Dr. Ulvi Şeker*

"ULTRASONIC ASSISTED MACHINING"
Keynote Speaker: Assoc. Dr. Stuart BARNES

(A5) Industrial Applications **HALL 1** **9:45 - 11:15**

Chaired by: *Prof. Dr. Ali Ünüvar*

METHOD FOR RATING AND CONVERTING TEXT BOOK SPUR GEAR DESIGN RESULTS TO ISO GEAR STANDARDS (Paper 06)
Çağrı UZAY, Necdet GEREN

A SENSITIVITY-BASED METHOD TO OPTIMIZE DESIGN SPACE FOR MECHANICAL DESIGN OPTIMIZATION (Paper 40)
Murat MAYDA

DESIGN, ASSEMBLY AND ACCURACY OF CNC MACHINING CENTERS (Paper 46)
H. Orhan YILDIRAN

IMPLEMENTATION OF FUNCTION STRUCTURE HEURISTICS FOR MODULAR DESIGN OF AN EDUCATIONAL MECHATRONIC PRODUCT FAMILY (Paper 101)
Emre AYHAN, Zühal ERDEN

(B5) Special Session: Cryogenic Machining I **DURMAZLAR HALL** **9:45 - 11:15**

Organized and Chaired by: *Assoc. Prof. Dr. Yusuf Kaynak*

INVESTIGATION OF THE EFFECTS OF HOLDING TIMES AT CRYOGENIC TEMPERATURES ON SURFACE ROUGHNESS AND CUTTING FORCES IN MACHINING OF STAINLESS STEEL (CM1)
Nursel ALTAN ÖZBEK, Adem ÇİÇEK, Mahmut GÜLESİN, Onur ÖZBEK

THE EFFECTS OF LIQUID NITROGEN AND CARBON DIOXIDE CRYOGENIC COOLANTS ON PROGRESSIVE TOOL WEAR (CM2)
Armin GHARIBI, Erkin DUMAN, Melih ÖZKÜTÜK, Yusuf KAYNAK

A HYBRID FE AND CFD MODEL TO PREDICT THE TOOL TEMPERATURE DISTRIBUTION IN CO2 ASSISTED CGI DRILLING (CM3)
A. Taner KUZU, Kaveh RAHİMZADEH BERENJİ, Mustafa BAKKAL

DRILLING OF CARBON FIBER REINFORCED PLASTICS UNDER THE DRY AND CRYOGENIC MACHINING CONDITIONS (CM4)
Uğur KÖKLÜ, Sezer MORKAVUK

(C5) Metal Forming	HALL 3	9:45 - 11:15

Chaired by: *Assoc. Prof. Dr. Samad Dadvandipour*

ANALYTICAL AND NUMERICAL INVESTIGATION OF SPRINGBACK ANGLE ON PUSH ROLLING TUBE BENDING PROCESS (Paper 02)
Engin Metin KAPLAN, Kemal YAMAN

INVESTIGATION OF THE EFFECT OF SERVO-PRESS FORMING IN SPRINGBACK AND MINIMUM BENDING RADII OF ULTRA HIGH STRENGTH STEELS (Paper 21)
Eren BILLUR, Goksel DURKAYA, Baris CETİN, Murat Mutlu YILMAZ, Anil ATAY, Ali Gokhan OGUZ, Oguzhan ONAYLI, Utku Can YALAZI, Ebru KILCI

IMPLICIT FINITE ELEMENT SIMULATION OF INCREMENTAL SHEET FORMING PROCESS (Paper 99)
Hosein KHALATBARI, Ismail LAZOGLU, Ismail DURGUN

(A6) Design of Machines and their Applications I	HALL 1	11:30- 13:00

Chaired by: *Mr. Orhan Yıldıran*

A SOFTWARE FOR PICK AND PLACE ROBOT MOVEMENTS FROM MARBLE MOSAIC PATTERN CONFIGURATION DESIGNED BY CAD (Paper 34)
Alp İMREK, Ali ORAL

EXPERIMENTAL ANALYSIS OF EXTERNAL GEAR PUMPS WITH SYMMETRIC AND ASYMMETRIC SPUR GEARS (Paper 41)
Erdem EVYAPAN, Sadık OLGUNER, İ. Hüseyin FİLİZ

KANSEİ MÜHENDİSLİĞİ VE MAKİNE TASARIMI (Paper 44)
İsmail RIDVAN, Erdal CEYLAN, Ercan EREN

A MACRO-MICRO MECHANISM DESIGN FOR LASER CUTTING PROCESS (Paper 48)
Mehmet İsmet Can DEDE, Gökhan KİPER, Emre UZUNOĞLU

(B6)	Special Session: Cryogenic Machining II	DURMAZLAR HALL	11:30- 13:00

Organized and Chaired by: *Assoc. Prof. Dr. Yusuf Kaynak*

INVESTIGATION OF THE EFFECTS OF VARIOUS COOLING AND LUBRICATING TECHNIQUES IN MICRO MILLING PROCESS OF NITI SHAPE MEMORY ALLOY (CM5)
İrfan UCUN, Yusuf KAYNAK, Kubilay ASLANTAŞ, Mustafa PERÇİN

THE EFFECTS OF DRILLING PARAMETERS ON DIMENSIONAL ACCURACY AND ROUNDNESS ERROR OF HOLES IN THE DRILLING OF Al/B_4C COMPOSITES WITH CRYOGENICALLY TREATED HSS DRILLS (CM6)
Ali Riza MOTORCU, Ergün EKİCİ

EFFECT OF CRYOGENIC TREATMENT APPLIED TO TUNGSTEN CARBİDE DRILLS ON THE THRUST FORCE AND TORQUE IN DRILLING OF Ti-6Al-4V ALLOY (CM7)
Turgay KIVAK, Ulvi ŞEKER

(C6)	Malzeme Karakterizasyonu	HALL 3	11:30- 13:00

Chaired by: *Asst. Prof. Dr. Merih Şengönül*

BORAKS ve WOLLASTONITE KATKILI FREN BALATALARININ BAZI FİZİKSEL ÖZELLİKLERİNİN İNCELENMESİ (Paper 43)
Gülşah AKINCIOĞLU, İlyas UYGUR, Hasan ÖKTEM, Hasan ÖKTEM

AL MATRİSLİ B4C TAKVİYELİ METAL MATRİSLİ KOMPOZİT MALZEMEYE AĞIRLIKÇA %3 İLAVE EDİLEN TAKVİYE ELEMANI GRAFİTİN AŞINMA ÜZERİNE ETKİSİNİN İNCELENMESİ (Paper 45)
Engin NAS, Hasan GÖKKAYA

TİTANYUM SAC MALZEMELERİN ŞEKİLLENDİRME SINIR DİYAGRAMLARININ DENEYSEL OLARAK BELİRLENMESİ (Paper 57)
Remzi Ecmel ECE, Fahrettin ÖZTÜRK

(I6)	Sponsors Session	DURMAZLAR HALL	14:00 – 14:45

Chaired by: *Assoc. Prof. Dr. Ali Oral*

(A7)	**Design of Machines and their Applications II**	**HALL 1**	**14:45–16:15**

Chaired by: *Asst. Prof. Dr. Zuhal Erden*

TRAJECTORY PLANNING OF PLANAR THREE-DEGREE-OF-FREEDOM 2-RRR PARALLEL MANIPULATORS FOR PASSING THROUGH SINGULAR CONFIGURATIONS IN THE PRESENCE OF UNKNOWN PAYLOADS (Paper 72)
Mustafa ÖZDEMİR

DESIGN OPTIMIZATION OF HEAVY DUTY INTERNAL COMBUSTION ENGINE MOUNT BRACKET (Paper 73)
Umud Esat ÖZTÜRK

COATING EQUIPMENT FOR MACHINE FROM VINYL ESTERS POLYMERS USING REDOX PEROXY/AROMATIC AMINE INITIATOR (Paper 80)
Farouk DEHMCHI, Farhi HALAIMIA, Tahar CHELLOUFI, Djamel DAKHMOUCHE

DYNAMIC BEHAVIORS OF CRYOGENIC TREATED SHAFTS SUPPORTED BY DEFECTED ROLLING ELEMENT BEARINGS (Paper 97)
Menderes KAM, Hamit SARUHAN

(B7)	**Special Session: Cryogenic Machining III**	**DURMAZLAR HALL**	**14:45–16:15**

Organized and Chaired by: *Assoc. Prof. Dr Yusuf KAYNAK*

INVESTIGATION OF THE EFFECTS OF CRYOGENIC COOLING ON TURNING OF AA6082-T6 (CM8)
Birhan IŞIK

EVALUATION OF THE EFFECTS OF CRYOGENIC TREATMENT APPLIED TO THE TOOL IN THE DRILLING OF MIXED COMPOSITES ON SURFACE ROUGHNESS (CM9)
Ergün EKİCİ, Ali Rıza MOTORCU

MILLING OF CARBON FIBER REINFORCED PLASTICS IN DRY AND CRYOGENIC MACHINING CONDITIONS (CM10)
Sezer MORKAVUK, Uğur KÖKLÜ, Mehmet BAĞCI

(C7) Material Characterization HALL 3 14:45–16:15

Chaired by: *Asst. Prof. Dr. Eren Billur*

OPTIMIZATION OF PROCESS PARAMETER OF BORONIZED AISI 1050 STEEL USING THE TAGUCHI ANALYSIS (Paper 37)
Mete Han BOZTEPE, Melih BAYRAMOĞLU

ELECTRIC CONDUCTIVITY AND RESISTIVITY OF ALUMINUM ALLOYS FOR THE APPLICATION OF ELECTRIC COUNTERS (Paper 89)
Prof. Dr. M. Oktay ALNIAK, İpek YAZICIOĞLU

PROGRESSIVE FAILURE ANALYSIS OF LAMINATED COMPOSITE PLATES UNDER LOW VELOCITY IMPACT (Paper 94)
Recep GÜNEŞ, Muhsin ALÇI, Mevlüt HAKAN

(A8) Makina Tasarımı ve Uygulamaları **HALL 1** **9:45 – 11:15**

Chaired by: Prof. Dr. M. Oktay Alnıak

BAĞIMSIZ ÇENELİ HİDROLİK AYNA TASARIMI VE PROTOTİP İMALATI (Paper 23)
Recep DÖNMEZ, Oktay ÇELENK, Hüseyin BÜLBÜL

L PROFİL (KÖŞEBENT) KESME, DELME VE MARKALAMA İŞ İSTASYONU TASARIM VE İMALAT SÜRECİ (Paper 24)
Ali ULU, Oktay ÇELENK, Hüseyin BÜLBÜL

YÜKSEK HIZLI, ESNEK 6 EKSEN CNC İŞLEME MERKEZİ PROTOTİPİ GELİŞTİRİLMESİ (Paper 35)
Muhammet ÖZSOY, Şamil ÖZOĞUL, M.Nedim GERGER, Ali ORAL

(B8) STUDENTS SYMPOSIUM Session I **DURMAZLAR HALL** **9:45 – 11:15**

Chaired by: Prof. Dr. Metin Akkök

MECHATRONIC DESIGN, MANUFACTURING AND CONTROL OF A REACTION WHEEL INVERTED PENDULUM (RWIP) SETUP (S_SYMP_1)
Yavuz TUZCU, Yiğit ACARBAY, Barış GÜNGÖR, Tuna ÖRDEN
Advisor: Asst. Prof. Dr. Bülent İRFANOĞLU

THE DESIGN OF AN INNOVATIVE LOADING AND UNLOADING MECHANISM FOR PRESS MACHINE AUTOMATION (S_SYMP_2)
Ayberk GÖKÇE, Birsel ÇAVUŞOĞLU, Furkan GÜÇ
Advisor: Prof. Dr. M. Cemal ÇAKIR

CHASIS DESIGN AND ANALYSIS FOR A GOLF CAR WITH SIX SEATERS (S_SYMP_3)
Yunus DEMİR, Ayberk AYDIN
Advisor: Assoc. Prof. Dr. Fatih KARPAT

SPIDER ROBOT DESIGN AND PROTOTYPE PRODUCTION FOR LASER MARKING (S_SYMP_4)
Ali KARASLAN
Advisors: Prof. Dr. M. Cemal ÇAKIR, Prof. Dr. İbrahim YÜKSEL

LABORATORY BUILT DC MAGNETRON SPUTTERING MACHINE (S_SYMP_5)
Taha KIZILTAŞ, Tunç Safa ALTUNSARAY, Alpay Kürşat POYRAZ, Hakan KALKAN
Advisor: Dr. Şakir BAYTAROĞLU

(C8) Talaşlı İmalat I	**HALL 3**	**9:45- 11:15**

Chaired by: *Dr. İsmail Çakırgöz*

PİSTONLU KOMPRESÖRLEDE HONLAMA YÖNTEMİ İLE SİLİNDİR YÜZEY PÜRÜZLÜLÜKLERİNİN DENEYSEL İNCELENMESİ (Paper 13)
Senai YALÇINKAYA, Şaban YILMAZ

KOMPAKT LAMİNAT KOMPOZİTİN DELİNMESİNDE YÜZEY PÜRÜZLÜLÜĞÜNÜN DEĞERLENDİRİLMESİ (Paper 25)
Tuncay BİLGE, Ali Riza MOTORCU, Aleksandar IVANOV

SANDVİÇ KOMPOZİTLERİN DELİNMESİNDE DELAMINASYON OLUŞUMUNUN TAGUCHİ METODU VE GRİ İLİŞKİSEL ANALİZ İLE DEĞERLENDİRİLMESİ (Paper 32)
Ergün EKİCİ, Abdil KUŞ, İsmail DURGUN

(A9) Endüstriyel Uygulamalar	**HALL 1**	**11:30- 13:00**

Chaired by: Dr. Umud Esat Öztürk

SANTRİFÜJ POMPALARDA AŞINMANIN PERFORMANSA ETKİSİNİN DENEYSEL İNCELENMESİ (Paper 14)
Senai YALÇINKAYA, Okan CEBECİ

ÜRETİM PLANLAMADA DOĞRUSAL PROGRAMLAMA MODELLERİ METODU'NUN ÇORAP ÖRME MAKİNESİ ÜZERİNDE UYGULANMASI VE OPTİMUM ÇÖZÜMÜN ELDE EDİLMESİ (Paper 31)
Senai YALÇINKAYA

BİLGİSAYAR DESTEKLI TASARIM YAZILIMI İLE SÜRDÜRÜLEBİLİR TASARIM UYGULAMALARI (Paper 60)
Mustafa TİMUR, Sinan SAVAŞ, M.Mert KISASÖZ

(B9) STUDENTS SYMPOSIUM Session II **DURMAZLAR HALL** **11:30 - 13:00**

***Chaired by**: Prof. Dr. Abdülkadir Erden*

MULTI PURPOSE, ENVIRONMENT ORIENTED HYBRID UNDERWATER VEHICLE DESIGN & HYDRODYNAMIC ANALYSIS (S_SYMP_6)
Sinan Şahin CANDAN, Mert DEMİREL, Enes COŞKUN, Burakcan ÇELİK, Onur ASLAN, Kaan KAYA

THE COMPANION (S_SYMP_7)
Emre OSMANOĞLU, Ahmet KARACA, Barış ALTUN, Furkan HAŞİMOĞLU, Şener YILMAZ

CARDBOARD BICYCLE (S_SYMP_8)
Yekta Özden ÇELEBİ, Azize KOCAMAN, Özgün ÖĞRETMEN, Barışcan AKSU, Arda AKMAN, Şafak ÖZDEN, Kaan İNAM, Burak BAĞCI, Koray KASIMOĞLU, Korhan ÜNLÜ, Yeliz ÜNAL
Advisors: Assoc. Prof. Dr. Tolga AKIŞ, Asst. Prof. Dr. C.Merih ŞENGÖNÜL, Res. Asst. S. Serpil ERDÖNMEZ

DESIGN MANUFACTURING AND TESTING OF AN APPARATUS FOR LASER MICROLITHOGRAPHY (S_SYMP_9)
Nehir YAPAR, Yiğit ACARBAY, Tevfik AKÖZ, Tuğçe CEHRI, Korcan KOÇ
Advisors: Asst. Prof. Dr. Besim BARANOĞLU, Asst. Prof. Dr. Efe ESELLER

(C9) Talaşlı İmalat II **HALL 3** **11:30-13:00**

***Chaired by:** Dr. Z. Murat Kılıç*

JANT TORNALAMA SÜRECİNDE TAKIM YOLU DEĞİŞİKLİĞİ İLE ÇEVRİM SÜRELERİNİN İYİLEŞTİRİLMESİ (Paper 27)
İsmail ÇAKIRGÖZ, Mehmet DAĞ, Uğur AYBARÇ, Ali KARA

ELEKTRİK AKIMI KULLANARAK ISITMA İLE TESTEREDE KESMEDE KESME PARAMETRELERİNİN ETKİLERİNİN İNCELENMESİ (Paper 63)
Ali ÜNÜVAR, Esra SARIASLAN

MOBİL IoT 4.0 PLATFORMU İLE FREZELEMEDE KABLOSUZ KESİCİ TAKIM DURUM İZLEME (Paper 71)
Oğuz ÇOLAK, Okan ORAL

KEYNOTE PAPERS

NO	TITLE	AUTHOR
I1	**Digital Machining**	**Yusuf ALTINTAŞ**
I3	**Next Generation High Performance Smart Machine Tools**	**Michael F. ZÄH**
I5	**Ultrasonic Assisted Machining**	**Stuart BARNES**

About The Speaker

Prof. Dr. Yusuf Altıntaş

Dr. Cau-Budapest, Hon.Dr. Ing. (Stuttgart)
Fellow of Royal Society of Canada, EC, CAE, CIRP, ASME, SME, ISNM, P&WC, Tokyo Univ.
NSERC – P&WC Industrial Research Chair Professor in Virtual Machining

Professor Altintas obtained his Bachelor from Istanbul Technical University (1975), M.Sc. (1980) and Ph.D. (1987) in Canada. He worked as a machine tool manufacturing engineer in Turkey (1977-1978), process development engineer in Pratt & Whitney Canada in Montreal (1980-1981), and the principal engineer of Canadian Institute of Metalworking in Hamilton (1981-1982). He joined University of British Columbia and founded Manufacturing Automation Laboratory in 1986. He conducts research on metal cutting, machine tool vibrations, control and virtual machining. He has published 141 archival journal and 95 conference articles with over 12300 citations with h index of 60 (Google Scholar), and a widely used "Manufacturing Automation: Principals of Metal Cutting Mechanics, Machine Tool Vibrations and CNC Design. 1st ed. 2000, 2nd ed.:2012. His research laboratory created advanced machining process simulation (CUTPRO), virtual part machining process simulation (MACHPRO) and open-modular 5 axis CNC system (Virtual CNC), which are used by over 180 companies and research centers in the field of machining and machine tools worldwide.

Professor Altintas is the fellow of Royal Society of Canada, CIRP, ASME, SME, CAE, EC, Tokyo University, P&WC, AvH and ISNM. He received Pratt & Whitney Canada's (P&WC) university partnership (1997), APEG BC's Meritorious Achievement (2002), APEG BC R.H. McLachlan (2010), UBC Killam Teaching Prize of Engineering (2011), Gold Medal of Engineers Canada (2011), SME Albert M. Sergent Progress Award (2012), NSERC Synergy Award, ASME Blackall Machine Tool and Gage best journal paper award, and the special scientific award of Republic of Turkey in Science and Engineering (2013). He holds an Honorary Doctorate Degrees from Stuttgart University (2009) and Budapest University of Technology (2013).

He currently directs NSERC CANRIMT Machining Research Network across Canada. He holds the NSERC – P&WC Industrial Research Chair Professorship to develop next generation Virtual High Performance Machining Technology since 2002.

DIGITAL MACHINING

An overview of digital machining of parts in virtual environment will be presented. The tool – part intersection along the tool path is evaluated at discrete steps to predict force, torque, power and vibrations. The trajectory generation dynamics of the CNC system are considered in predicting the federate which affects the chip thickness, hence the process loads. The feeds are automatically optimized by considering the tool breakage, spindle torque-power, and tool deflection limits set by the process planner. The virtual machining system can be used independently or as an integral part of CAM systems such as Siemens NX. Sample applications of the virtual high performance machining system in aerospace industry are presented.

About The Speaker

Prof. Dr.-Ing. Michael F. ZÄH

Institut für Werkzeugmaschinen und Betriebswissenschaften (*iwb*)
Technische Universität München

The research activities of Professor Zäh (b. 1963) focus on machine tools and generative production methods, production technology and cognition for engineering systems.

Professor Zäh graduated in mechanical engineering from TUM, where he also earned his doctorate degree in 1993 under the supervision of Professor Milberg, at the Institute for Machine Tools and Industrial Management (IWB). From 1994 to 1995, he was Chief Engineer and Department Head for Machine Tools and Production Technology under the direction of Professor Reinhart. In 1996, he switched over to the private sector, working for a manufacturer of machine tools used for gear wheel machining, where he held various management positions. In 2002, Professor Zäh accepted the Chair of Machine Tools and Production Technology at TUM and has held the position of Director of the IWB since then.

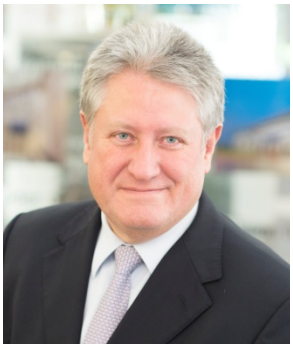
NEXT GENERATION HIGH PERFORMANCE SMART MACHINE TOOLS

The next generation machine tools, though in appearance almost the same as today´s, will change significantly. There are new approaches such as parallel kinematics and robots replacing classical machine tools in some applications. The technological development manifests itself in many different aspects of the machine. Machine tools will be cyber-physical systems in the future. This paper outlines these trends and uses examples out of the author´s personal research interests.

About The Speaker

Assoc. Prof. Dr. Stuart Barnes, CEng FIMMM

Director of Research Degrees
WMG, International Manufacturing Centre
University of Warwick, Coventry, UK



Dr Stuart Barnes is a metallurgist by profession; he graduated from the University of Birmingham in 1988 with a PhD in metal cutting, is a Chartered Engineer and a Fellow of the Institute of Materials, Minerals and Mining. He joined WMG (formerly Warwick Manufacturing Group), University of Warwick in 1992 to research conventional and laser machining of composite materials, having spent 13 years in industry with GKN Technology and NEI Thompson. Dr Barnes then worked on WMG's teaching programmes in the UK and overseas and in 2002 was made Director of Professional and Executive Programmes. Although heavily involved in the teaching activities, Dr Barnes maintained his involvement in machining research via MSc and PhD students.

In May 2013, Dr Barnes changed role to that of Director of Research Degrees with responsibility for all research degrees offered within WMG. Current research student numbers are in excess of 200. He also took on the leadership of WMG's Net-Shape Manufacturing group and increased the number of research students that he personally supervises in the UK and Hong Kong. Current areas of research include ultrasonic assisted machining (UAM), cryogenic machining and the development of new cutting fluids for "difficult-to-machine" materials such as titanium alloys and carbon fibre composites. In 2013, Dr Barnes led WMG's input to a successful Technology Strategy Board bid (now Innovate UK) to develop the next generation of cutting fluids (HiPAdd). He also works closely with BAE Systems on the machining of carbon fibre composites for military aerospace applications. In 2016, Dr Barnes worked with Teer Coatings Ltd, Kyocera (cutting tools division) and BAE Systems to win funding from the National Aerospace Technology Exploitation Programme (NATEP) for the development of cutting tools specifically designed for UAM. Dr Barnes presented at UMTIK 2014, is on the International Organising Committee for the UMTIK 2016 conference and has authored / co-authored over 70 publications during his time at WMG.

ULTRASONIC ASSISTED MACHINING

The continuous drive to develop materials with enhanced mechanical and physical properties has resulted in significant improvements in the materials available to design engineers. Examples of such developments range from high performance steels and aluminium alloys, to complex high-temperature superalloys and carbon fibre composites. However, some of these advances in performance also present an additional challenge to the manufacturing engineer when it comes to machining these materials. Improved mechanical properties can also result in reduced machinability.

In response to these challenges, tool materials and coatings have been improved and various adaptions of the conventional machining processes have been developed in order to allow economically viable machining of what are often described as “difficult-to-machine” materials. One such adaption is that of Ultrasonic Assisted Machining (UAM) which has been demonstrated to have a positive effect on certain aspects of machining, with several laboratory scale facilities being developed by researchers. However, the equipment being used at WMG is a purpose-built, commercially available, 5-axis machine tool provided by DMG MORI, the Ultrasonic 65. The availability of production equipment has enabled UAM to be investigated in order to understand the fundamental aspects of the technique as well as the practical implications of its use from the point of view of the machinist.

The work conducted to date has shown that UAM is an interesting and complex field for machining research. From the practical point of view, some variables that need to be considered in UAM such as how to hold the cutting tool, how much the tool should protrude from the holder, the mass of the tool etc., are far more important than in a conventional machining operation. Tool wear has also been found to reduce the advantages of UAM, which would be an important factor in a production process. In order to maximise the benefits of UAM, it is clear that there is a significant amount of work which needs to be done to understand how to operate the process from a practical point of view. In terms of a scientific understanding of the process, there is also much research that needs to be conducted. For example, the effect of ultrasonic oscillation on the mechanisms which take place in the cutting zone are complex and not easy to study directly. This is especially the case with materials such as CFRP, due to the heterogeneous nature of the material and absence of chips to study. However, the machining of metals provides the opportunity to study the machining mechanisms in relation to accepted metal cutting theory and develop a UAM modification of that theory. Therefore, the challenge is to continue developing a fundamental understanding of the process and its practical application so that it can be applied appropriately to improve the machinability of difficult-to-machine materials.

ABSTRACTS

GENERAL MACHINING PROCESS SIMULATION SOFTWARE

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A machine tool structure design method which combines structural topology optimization and process stability simulation is proposed in this paper. The performance of process stability is directly relevant to the dynamic stiffness of tool center point. In order to enhance the process stability, a structural topology optimization method, which the design objective is the dynamic stiffness of tool center point, is proposed in this paper. Through this design method, the dynamic stiffness can be ensured an optimal result. In the next step, process stability of machine tool is simulated to verify that the machining performance is truly improved. A practical machine tool design case is carried out to demonstrate the proposed design process. And the result indicates that the machining performance is better than traditional design method.

Keywords: Metal cutting, process simulation, arbitrary tool geometry, parallel machining.

MULTI-DIMENSIONAL MODELLING OF CHATTER STABILITY IN PARALLEL TURNING OPERATION

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Recently, use of parallel turning operations has been increasing due to the potential they offer for improved material removal rate using multiple cutting tools. However, chatter vibrations resulting from process instability may limit the productivity in these operations. In order to determine favourable conditions for increased stability, dynamics of parallel turning operations must be modelled. Herein dynamics and stability of parallel turning operations including both cutter and workpiece flexibility is studied. Frequency and time domain models for multi-dimensional parallel turning have been developed where effects of process parameters on chatter behaviour are investigated.

Keywords: Parallel turning operation, Chatter stability, Cutting process modelling.

STABILITY OF ASYMMETRIC MILLING CUTTERS IN ROTATING COORDINATES

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High speed machining is widely used in industry to increase productivity of the process without violating the machine tool limits and produced part quality. High speed machine tools have both stationary and rotating components. While spindle housing, column and table have stationary dynamics, rotating parts may have both symmetric (i.e. spindle shaft and tool holder) and asymmetric dynamics (i.e. two fluted end mill) due to uneven geometry in two principal directions. This paper presents a stability model of dynamic milling operations considering rotation dependent dynamics. Periodic dynamic system is solved in time domain and the proposed model is experimentally validated. It is concluded that the stability pockets differ significantly when the rotating dynamics of the asymmetric tools are considered.

Keywords: Milling stability; Asymmetric end mills; Rotating dynamics

ADAPTIVE MANUFACTURING WITH METROLOGY FEEDBACK

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Manufacturing high precision parts at lower costs and higher efficiency requires integration of complex dimensional measurement within the manufacturing system. This presentation discusses how a manufacturing machine can be made to perform complex dimensional measurements traditionally done on coordinate measuring machines and how this metrology information can be used to achieve adaptive manufacturing and automation. Different case studies and examples will be presented from aerospace and automotive applications using touch probe sensors as well as non-contact laser sensors.

Keywords: Adaptive Manufacturing, On Machine Measurement, In Process Measurement

IN-PROCESS TOOL WEAR MONITORING IN INTERNAL BROACHING

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In this work, an “in process” tool wear prediction system for broaching process is presented based on a cutting force analysis. The aim is to link the changes in the measured force with the tool wear. Once the broaching cycles have been performed, different strategies have been analyzed including the evolution of the maximum peak force and the evolution in the used broaching energy per section. Finally, the results of the analysis and the main conclusions are presented.

Keywords: Broaching, monitoring, tool wear.

AN EXPERIMENTAL STUDY ON THE DEFORMATION BEHAVIOR OF THIN-WALLED WORKPIECES

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During milling of thin-walled structures deformations of the workpiece can be observed. These deformations are particularly critical for the finishing process and negatively affect the manufacturing quality. Previous works have shown that for an end milling finishing process, the measured in-process deformations can be separated in a static and dynamic part, respectively. Within this paper an enhanced method to measure those in-process deformations is presented. Moreover, the differentiation between static and dynamic deformation is discussed and an interpretation is given regarding the influence of a wide range of process parameters.

Keywords: End milling, measurement, thermal and mechanical deformations

COMPARISON OF COATING MATERIALS AND SURFACE FINISHING TECHNIQUES IN HIGH PERFORMANCE MILLING OF AEROSPACE GRADE TITANIUM ALLOYS

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Titanium alloys, especially Ti6Al4V, are established engineering materials for use in the aerospace, medical, automotive, oil and gas, power generation and sports related industries. The outstanding corrosion resistance and strength efficiency besides the in general best all-round performance has made Ti6Al4V the most widely used titanium alloy. The Ti6Al4V alloy is considered as a hard-to-machine material. This titanium alloy exhibits high mechanical strength for elevated temperatures, low stiffness, low thermal conductivity and high chemical reactivity. Notably, the last two properties are responsible for the threat of potentially catastrophic, titanium fires. This study evaluates the dry slot milling of Ti6Al4V using solid carbide end-mills. The end-mills have been coated with two different materials, AlTiN and AlCrN, and produced with three different surface finishing techniques, finishing with magnetic powder (FPM), friction finishing (FF) and wet sandblast finishing. The evaluation is performed by investigating cutting forces and workpiece condition.

Keywords: Ti6Al4V, milling, surface finishing

DETERMINATION OF TOOL POINT FRF OF MICRO TOOLS UNDER OPERATIONAL CONDITIONS USING ANALYTICAL METHODS

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Chatter vibrations can be avoided using stability diagrams for which tool point frequency response function (FRF) must be determined accurately. Unlike classical machine tools that performed at macro scale, tool point FRFs for micro tools cannot be measured using impact testing and modal analysis. In addition, micro machining operations are performed at high spindle speeds and due to the gyroscopic moments and centrifugal forces tool point FRF changes during machining operations. Therefore, for accurate stability predictions of machining operations, effects of operational conditions on machine tool dynamics should be considered in calculations.In this study first, micro tools are modeled analytically including the fluted geometry of the tool. Then, spindle-holder assembly will be modeled analytically and coupled with the micro tool dynamics using receptance coupling technique. Moreover, for the machining centers where spindle geometry is unknown, a new coupling method is proposed which enables to couple experimentally obtained idle spindle dynamics with analytically calculated rotating holder-tool dynamics. Since existing experimental methods require expensive and complicated measurement setups, outputs of this study will bring an important advantage in applications that enable the calculation of micro machine tool dynamics analytically.

Keywords: Mico tools, Tool point FRF, receptance coupling

TOWARDS PRODUCTIVITY 4.0 (ST1)

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With the challenges of labor shortages and aging labor forces, Taiwan's Ministry of Economic Affairs has lunched "Productivity 4.0" to transform the current industry for optimization, efficiency and flexibility in manufacturing sector. Built upon automation in production with IT technology, internet, sensing, big data and clouding storage for smart functionality, the Productivity 4.0 initiative in Taiwan aims for exemplifying industries like machine tools, metal processing in aerospace and automobile, and consumer electronics. The presentation is to cover topics of the explanation in common framework of "Productivity 4.0" consisting three layers, sensing, network and application layers in which key technologies would be advised to develop and cooperate for establishing the complete system.

Keywords: Productivity 4.0, sensor, big data, automation, machine tools.

PREDICTION OF THIN WALL DYNAMICS FOR CHATTER STABILITY BY USING LASER DOPPLER VELOCIMETRY (ST2)

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Workpiece chatter, especially for the thin-walled workpiece, is caused by natural vibration of the structure where stiffness and mass of the thin-walled workpiece is smaller than the cutting tool. Owing to the mass effect of the thin-walled structure which is too small and vulnerable to external influence, characteristics of thin-walled structure should be analyzed. In order to having an accurate prediction of cutting stability, laser Doppler velocimetry (LDV) is used for measuring exact FRFs in the proposed method. Differences of FRFs and stability lobe diagrams are compared with experiments. Characteristics of the measuring method are also discussed.

Keywords: Thin wall chatter, Stability lobe diagram, Laser Doppler Velocimetry

A PROCESS STABILITY ENHANCED MACHINE TOOL DESIGN METHOD INTEGRATED DYNAMİC STİFFNESS TOPOLOGY OPTIMIZATION (ST3)

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A machine tool structure design method which combines structural topology optimization and process stability simulation is proposed in this paper. The performance of process stability is directly relevant to the dynamic stiffness of tool center point. In order to enhance the process stability, a structural topology optimization method, which the design objective is the dynamic stiffness of tool center point, is proposed in this paper. Through this design method, the dynamic stiffness can be ensured an optimal result. In the next step, process stability of machine tool is simulated to verify that the machining performance is truly improved. A practical machine tool design case is carried out to demonstrate the proposed design process. And the result indicates that the machining performance is better than traditional design method.

Keywords: Process stabilitysimulation, Structural topology optimization, Dynamic stiffness optimization, Bi-direction evolutionary structural optimization

CHALLENGE AND PRACTICES FOR WIRELESS SENSOR NETWORK DEPLOYMENT IN MACHINING ENVIRONMENT (ST4)

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Cyber-Physical System is applied to optimize manufacturing process by integrating equipment and software via communication between factory's information and operations. To improve the performance in machining environments, working conditions and machine operating parameters are collected for analysis. Therefore, a reliable communication system is essential. Applying wireless communication to factory is under researching. In this paper, we discuss the issues of deploying wireless communication in a machining factory. A robust solution to deal with hostile factory environments is proposed after plant tests. By using dual-area network architecture, IP routings and physical bands, our solution demonstrated its superior over traditional ones.

Keywords: Industrial wireless sensor network, Wi-Fi Mesh network, IEEE 802.15.4

DEVELOPMENT OF SOUND BASED TOOL WEAR MONITORING SYSTEM FOR THE MILLING OF INCONEL 718 (ST5)

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A sound based tool wear monitoring system was developed in this study for the milling of Inconel 718. Two types of microphones, a traditional free field microphone and a MEMS microphone were implemented for the system development. To develop this system, an experiment was conducted first on a three axis machining center to collect the sound signal during machining for signal and feature analysis, as well as building the classifier by training a backpropagation neural network system with collected data. After the development of the system, an evaluation experiment was conducted to confirm the performance of developed system. The results show that selected frequency domain feature of sound signal provide a close relationship with the tool wear, and 100% classification rate can be obtained in the evaluation test for MEMS microphone based system.

Keywords: Tool wear monitoring, Audible sound, Inconel 718,

A POSTPROCESSOR FOR HYBRID FIVE-AXIS MACHINE TOOLS BASED ON INVERSE KINEMATIC WITH JACOBIAN MATRIX IMPLEMENTATION (ST6)

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Equipped with an orientable-spindle machine, a prior study is directly applicable to generate smooth tool-paths proceeding across singular positions by inverse kinematics. This paper presents a modular method to construct the postprocessor system for a novel hybrid five-axis machine tool. The hybrid parallel-serial mathematical model was introduced to analyze a structural configuration of singularities by Jacobian matrix. The proposed modified D-H notation is used for coordinate conversion procedure and then an algorithm for developing the inverse kinematics of five-axis machines was carried out. The feasibility of solutions is dependent on the surface normal along the tool-path satisfying certain orientation constraints. This algorithm can be a transition between cutter contact (CC) path and cutter location (CL) code and be implemented on computerized CAD/CAM systems.

Keywords: Five-axis machine tools, Jacobian matrix, Inverse kinematics, Postprocessor.

AN AMF BASED MULTI-COLOR/MULTI-MATERIAL ADDITIVE MANUFACTURING SYSTEM (SAM1)

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Additive Manufacturing (AM) technologies may use; liquid/solid/powder-based material types to fabricate polymer, ceramic and metal parts. Apart from material types or technologies used, AM systems utilize software tool chains starting from CAD, CAM and host software to firmware on the controller electronics. Data flow in between these software is facilitated by the use of STL (CAD to CAM) and G-code (CAM to firmware) file formats. Even though the STL has been the de-facto industry standard for two decades, it has no provisions for representing color, textures, materials, lattice/mesh structures, units and other properties of the part. The new XML-based AMF standard file format is jointly adopted as an industry standard. In the scope of this paper, an AMF based AM system which will be capable of manufacturing multi-color/multi-material final products is proposed.

Keywords: Additive Manufacturing, 3D Printing, 3D Printer, Fused Deposition Modeling (FDM), Additive Manufacturing File Format (AMF)

DEVELOPMENT AND INVESTIGATION OF SHAPED METAL DEPOSITION PROCESS USING TIG ARC HEAT SOURCE IN ADDITIVE LAYERED MANUFACTURING (SAM2)

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The shaped metal deposition (SMD) method would be an alternative way to traditional manufacturing methods, especially for complex featured and large scale solid parts manufacturing and it is particularly used for aerospace structural components, manufacturing and repairing of die/molds and middle-sized dense parts. This paper presents the constructing and controlling of an additive manufacturing (AM) system using TIG plus wire based shaped metal deposition (TW-SMD) method. The aim of the current study is to design and develop an integrated system which is able to reduce time consuming and boring task of deposition process. The developed additive system is ready to fabricate near net components of sizes not exceed 400 mm in three axes directly from CAD drawing. The results showed that the developed system succeeded to produce error-free depositions for various features of SS308LSi components with good metallurigical bonding between the deposited layers. The developed system is also capable of reducing the buy-to-fly ratio from 5 to 2 by reducing waste material from 1717gr to 268 gr for the sample components.

Keywords: Shaped metal deposition, Additive Layered Manufacturing, TIG Welding

PROCESS LIMITS OF DIRECT METAL LASER SINTERING (DMLS) IN TERMS OF MINIMUM HOLE AND BOSS DIAMETERS WITH VARYING ASPECT RATIOS (SAM3)

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Direct Metal Laser Sintering (DMLS), an additive manufacturing process for producing fully functional metallic parts, inhibits some design constraints due to the inherent nature of layered manufacturing. These constraints, which need to be taken early into consideration in the mechanical design phase, span from minimum hole diameter, overhang surface angle and support structures to minimum wall thickness. This study aims at investigating manufacturability of 360 different holes and bosses with different aspect ratios. In the process, optimized parameters for high density are utilized with UNS N06625 powder, which is preferred for combustor parts in aero-engines for maintaining its mechanical properties at elevated temperatures. The obtained results show that as the aspect ratio increases, the producible minimum-diameter is decreased. Independent from the depth, the minimum hole produced on a flat surface shall have a diameter bigger than 0,5 mm. On the other hand, the mechanical contact with the powder coater makes it difficult to build slender bosses with a diameter smaller than 0,8 mm independent from the height.

Keywords: Additive manufacturing, direct laser metal sintering, design constraints

DEVELOPMENT OF CAR REAR LIGHTING GROUP WITH 3D PRINTING METHODS (SAM4)

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Automotive product development process, although numerical analysis methods and programs have been developed, though there is still a need for physical verification. This verification from someone in, especially developed plastic parts geometric verification and assemblability on the vehicle body is carried out in physical. In this validation phase, the plastic parts to be verified are performed with the prototypes manufacturing methods, because it is not mold. It must be selected appropriate prototype methods, according to the material hardness and the required dimensional accuracy. Sometimes a piece of one production method is not sufficient. In this case, the parts must be produced using multiple production processes. In this study, complete rear lighting group that one of such parts are produced by different manufacturing methods and assembly of these parts are taken together to rear lighting group was obtained. In addition, this part is manufactured to be used in aesthetic validation study. Deviation values that dimensional for the obtained part has the complete are given

Keywords: 3D Printer, FDM, SLS, PolyJet, SiliconeMolding

A COMPARATIVE STUDY OF ENERGY CONSUMPTION OF SELECTIVE LASER SINTERING AND TURN-MILL MACHINING (SAM5)

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Additive manufacturing is an emerging manufacturing technique with two main subcategories based on the material it uses; polymer and metal. Selective laser sintering is the most widely used additive manufacturing technique which binds metallic powders with the use of laser power, and builds complex parts by adding layer by layer. As additive manufacturing produces net shape or near net shape parts with almost zero material waste, it is considered to be a promising clean manufacturing technique. In this study, energy consumption evaluation and comparison of manufacturing of Ti-6Al-4V based metal parts manufactured with selective laser sintering and machining. As a machining method, turn-milling processes are used in order to test complex shapes.

Keywords: Selective laser sintering, Energy consumption, Machining, Ti-6Al-4V

A REVIEW OF ADDITIVE MANUFACTURING TECHNOLOGIES (SAM6)

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Since last decade, additive manufacturing technology has been improved rapidly to fulfil the needs of people and various industries. Additive manufacturing is a growing new technology to manufacture more complex parts with lower energy costs and shorter manufacturing time. Additive manufacturing also enables to manufacture complicated product that is impossible with traditional manufacturing methods. Additive manufacturing is layer-by-layer building technology. It is powder-based technology that is custom-designed, high value. Also it is more efficient than machining. Additive manufacturing technology includes several technologies such as selective laser sintering, selective laser melting and electron beam melting. Despite these processes are very similar, they differ from one another due to materials used, melting point, melting ratio and type of beam. There are several limitations of additive manufacturing technology such as porosity, shrinkage, dimensional accuracy, support structure and surface quality. The aim of the this study is to review about optimizing process parameters such as

scan speed, scan spacing, laser power, powder layer thickness and temperature of the machine bed. Optimizing process parameters provides to overcome limitations.

Keywords: Additive manufacturing, Selective laser sintering, Selective laser melting, Electron beam melting, Optimization of process parameters, Topological optimization, Porosity, Shrinkage

ADDITIVE MANUFACTURING OF TITANIUM ALLOYS (SAM7)

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Additive manufacturing technologies introduce many new economic advantages compared to conventional subtractive manufacturing methods in prototyping and low production volume. Thus in many high technology industries like aerospace or biomedical industries additive manufacturing has become a topic of high interest. Additive manufacturing of Titanium alloys has become an important field of study because many Titanium alloys are expensive and hard to form with conventional manufacturing methods. Ti-6Al-4V alloy extensively used in aerospace and biomedical industries. Recently many studies has focussed on manufacturing and enhancing the mechanical properties of Ti-6Al-4V with additive manufacturing techniques. In this study a short review on additive manufacturing of Ti-6Al-4V alloys has been given.

Keywords: Additive Manufacturing, Titanium, Ti-6Al-4V, Power Bed Fusion-Laser, Powder Feed Direct Laser Deposition, Wire Feed Direct Laser Deposition, Heat Treatment.

INVESTIGATION OF THE EFFECTS OF HOLDING TIMES AT CRYOGENIC TEMPERATURES ON SURFACE ROUGHNESS AND CUTTING FORCES IN MACHINING OF STAINLESS STEEL (CM1)

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This study investigated the effects of holding times at cryogenic temperature of carbide cutting tools on surface roughness, cutting forces and tool wear in machining stainless steel. In this context, uncoated tungsten carbide inserts were cryogenically treated for 24 h and 48 h and a number of turning tests were performed under dry cutting conditions. AISI 316 austenitic stainless steel was selected as the workpiece material. Experimental results showed that the inserts treated for 24 h exhibited superior performance in terms of surface roughness, while the untreated inserts were better in terms of cutting forces. In addition, it was determined that cryogenic treatment led to additional increases in the carbide percentage and hardness of the inserts. The maximum increases were observed in the inserts treated for 24 h.

Keywords: Stainless steel, surface roughness, cutting forces, micro-hardness, eta carbides

THE EFFECTS OF LIQUID NITROGEN AND CARBON DIOXIDE CRYOGENIC COOLANTS ON PROGRESSIVE TOOL WEAR (CM2)

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Compared to conventional machining processes, cryogenic machining is being considered as environmentally friendly and suitable for machining of difficult-to-cut material. Liquid nitrogen and carbon dioxide have been used as cryogenic coolants in cryogenic machining applications. This study presents the comparison of the effects of liquid nitrogen and carbon dioxide cryogenic coolants on progressive tool wear in machining process. Obtained results from these two cryogenic coolants were also compared with the results obtained from dry machining. This experimental study illustrates that liquid nitrogen shows much desirable results in compared with carbon dioxide and dry machining by substantially reducing progression of tool wear including flank wear, nose wear and notch wear.

Keywords: Cryogenic coolant, Progressive tool wear, Liquid nitrogen, Carbon dioxide

A HYBRID FE AND CFD MODEL TO PREDICT THE TOOL TEMPERATURE DISTRIBUTION IN CO_2 ASSISTED CGI DRILLING (CM3)

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The drill temperature distribution in CO_2 assisted CGI drilling is studied in this paper. Finite element method is conducted to predict tool temperature during cutting process. The amount of heat transfer to drill due to the friction between tool and chip is estimated based on the predicted friction force and the chip velocity. Cutting force components are calculated using mechanistic model based on the drill geometry. The heat transfer coefficient of chilled CO_2 is analytically calculated by using fluid dynamics for four different distance from tool tip. The inlet temperature of CO_2 (cooled due to the Joule-Thomson effect) is predicted as 241 K while regulating from 50 bar to 6 bar. The velocity and the pressure of CO_2 inside of the cooling holes (which are required to calculate heat transfer coefficients) is calculated using ANSYS CFX. The developed thermal model was verified by using embedded thermocouples and good agreements are obtained between experimental and predicted temperature results. The peak temperature of the drill reaches 521 K and 639 K at 750 rpm and 1500 rpm rotation speed, respectively.

Keywords: FEM, Drilling, CO_2 internal cooling, CFX

DRILLING OF CARBON FIBER REINFORCED PLASTICS UNDER THE DRY AND CRYOGENIC MACHINING CONDITIONS (CM4)

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Even if Carbon Fiber Reinforced Plastics (CFRP) is produced near the net shape, drilling of CFRP will be inevitable operation for assembly. This study brings a novel approach to cryogenic machining that become popular especially in recent years. According to this approach, CFRP was dipped into liquid nitrogen (LN_2) and drilled inside LN_2. By using same input parameters, experiments were made under the dry conditions and results were compared with each other. Machining performance of CFRP was determined according to forces occurred during machining, delamination damage and surface quality occurred after machining. According to the results, thrust forces occurred under the cryogenic condition were greater than those in the dry condition. While delamination damage increased with the increasing of feed rate under dry condition, it did not tend to rise under cryogenic condition. In addition to these results, the study revealed that cryogenic drilling conditions present better results in terms of hole surface quality.

Keywords: Cryogenic Drilling, Carbon Fiber Composite

INVESTIGATION OF THE EFFECTS OF VARIOUS COOLING AND LUBRICATING TECHNIQUES IN MICRO MILLING PROCESS OF NITI SHAPE MEMORY ALLOY (CM5)

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Due to the unique properties, shape memory alloys widely used in the biomedicalindustry. In addition to the various manufacturing techniques implemented to produce product made of Niti alloy, machining processes are also prefered. In the present study, effect of different cooling and lubrication strategies (dry, MQL, ethanol, and cryogenic CO2) on the cutting performance were investigated in micro-milling of shape memory alloys. The performance of each strategy were evaluated in terms of tool wear, cutting force, surface roughness and burr formation. The obtained results showed that ethanol and MQL significantly reduced the tool wear. At the selected cutting speed, the cryogenic cooling showed low performance in terms of tool wear, cutting forces and burr formation. But, the lowest surface roughness values were obtained with cryogenic machining processes as compared to the other strategies implemented in this study.

Keywords: Micro milling, Shape memory alloy, Surface roughness, Burr formation

THE EFFECTS OF DRILLING PARAMETERS ON DIMENSIONAL ACCURACY AND ROUNDNESS ERROR OF HOLES IN THE DRILLING OF Al/B_4C COMPOSITES WITH CRYOGENICALLY TREATED HSS DRILLS (CM6)

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In this study, dimensional accuracy (Da) and roundness error (Re) was evaluated through Taguchi Method (TM) in the drilling of the high density Al/B_4C particle reinforced composites, which were produced through hot pressing method, with cryogenically treated and non-treated high speed steel (HSS) drills. Cutting tool type (Ct: non-treated HSS drill and cryogenically treated high speed steel (HSS) drills), cutting speed (Vc:17, 21 and 26 m/min) and feed rate (f:0.06, 0.08 ve 0.10 mm/rev) were used as the control factors. Feed rate was more effective than cutting speed on the dimensional accuracy and roundness error. Dimensional accuracy value is increased and roundness error value are decreased with increasing the cutting speed and feed rate. Significant effect has not been determined of cryogenic treatment applied to drill bits on dimensional accuracy and roundness error of the holes.

Keywords: Cryogenically treated HSS drill, Al/B_4C composite, Dimensional accuracy, Roundness error, Taguchi Method

EFFECT OF CRYOGENIC TREATMENT APPLIED TO TUNGSTEN CARBİDE DRILLS ON THE THRUST FORCE AND TORQUE IN DRILLING OF Ti-6Al-4V ALLOY (CM7)

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This study investigated the effects of cryogenic treatment applied to tungsten carbide drills on the thrust force and torque during the drilling of a Ti-6Al-4V alloy under dry and wet cutting conditions. Drilling tests were carried out using untreated, cryogenically treated and cryogenically treated and tempered tungsten carbide drills. The holes were drilled along 15 mm with using four different cutting speeds (15, 20, 25, 30 m/min) and three feed rates (0.04, 0.06 and 0.08 mm/rev). At the end of the drilling tests, it was seen that the use of a coolant increased the thrust force and torgue. Among the three tools, the best results in terms of the thrust force and torque were obtained with the KİT tool.

Keywords: Ti-6Al-4V, tungsten carbide, cryogenic treatment, thrust force, torque

INVESTIGATION OF THE EFFECTS OF CRYOGENIC COOLING ON TURNING OF AA6082-T6 (CM8)

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In this study, the aging process applied AA6082 material was machined using different cutting parameters. Here the tool geometry (tip radius and rake angle), cutting speed, feed rate factor is used as the main variable. Boron oil and 134a refrigerant are used for cooling. Thus, it is conducted to determine the difference between the cryogenic cooling and conventional boron oil used for cooling. The cooling methods occurs the expected results of wear on the tool. In addition, surface roughness measurements and making observations chip morphology has been studied to determine the most appropriate cutting parameters. As a result, it was decided to determine the best cutting conditions with optimal cutting parameters.

Keywords: AA6082 T6, Machinability, Cryogenic cooling, Surface roughness

EVALUATION OF THE EFFECTS OF CRYOGENIC TREATMENT APPLIED TO THE TOOL IN THE DRILLING OF MIXED COMPOSITES ON SURFACE ROUGHNESS (CM9)

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In this study, effects of cryogenic treatment applied to HSS drill on the surface roughness were examined in the hole drilling of Al/B_4C-Gr hybrid composites. Machinability tests were carried out in three different cutting speed (V_c: 17, 21 and 26 m/min), three different levels of feed rate (f:0.06, 0:08 and 0.1 mm/rev) and under dry drilling conditions using cryogenically non-treated (CNT), cryogenically treated (CT) and cryogenically treated+tempered (CTT) tools. Effects of drilling parameters and cryogenic treatments applied to drills on R_a surface roughness value of holes were evaluated via scanning electron microscope (SEM) images and elemental analysis of the cutting tools' microstructures, SEM images of cutting tool wear. The surface roughness increases with increasing cutting speed and feed rate. Among the tools used, CTT drills showed the best performance with regard to the surface roughness. The primary wear mechanism includes abrasive and adhesive wear of the flank face.

Keywords: Hybrid composite, Drilling, Cryogenic treatment, Surface roughness

MILLING OF CARBON FIBER REINFORCED PLASTICS IN DRY AND CRYOGENIC MACHINING CONDITIONS (CM10)

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There are many studies investigated the effect of cutting parameters such as spindle speed, feed rate, cutting depth and cutting conditions such as dry, MQL, cryogenic on machining quality and performance. Among cutting conditions, the cryogenic machining come into prominence especially in recent years. In this paper, milling performance of Carbon Fiber-Reinforced Plastics (CFRP) that is a significant engineering material, was experimentally investigated in dry and cryogenic conditions and results were compared each other. Dipped cryogenic machining technique, which is a new method among cryogenic machining techniques, was used in the experiments. According to this approach, CFRP was dipped into the liquid nitrogen (LN_2) and it was milled within the cryogenic coolant directly. In order to implement this technique, a fixture with thermal insulating material was designed and manufactured. Machinability of the CFRP was evaluated according to output parameters such as milling forces, torque, delamination factor, surface profile roughness and surface area roughness.

Keywords: Dipped Cryogenic Cooling, Carbon Fiber Reinforced Plastics, Milling Delamination.

APPLICATION OF FEM METHOD ON DESIGN AND MANUFACTURING OF MACHINES FOR SELF CLINCHING OF NUTS DURING STAMPING FOR AUTOMOTIVE SIDE PANEL INTERIOR PARTS (PAPER 10)

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The objective of this study is to eliminate the nut welding processes in metal sheet forming dies by means of self-clinching technology in order to reduce the process time and cost. This study is focused on to reach this goal or at least have some improvements in this direction. Therefore a finite element model is developed to find the necessary press forces and analyze self-clinching deformation process. The results are used in the self-clinching feeding system and die design for selected nut and sheet part. This sheet part is a real automotive side panel interior panel manufactured by Toyotetsu A.Ş.

Keywords ; Self clinching nuts, automotive sheet parts.

FATIGUE PROPERTIES OF ABS THERMOPLASTICS USED IN EXTERIOR LIGHTING (PAPER 18)

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Thermoplastic materials are widely used in vehicles especially in exterior lighting due to their low density and high formability. These materials used in lighting should present durability against fatigue due to vibrations. In this study, Wöhler (S-N) curve for ABS (Akrilonitril Butadien Stiren) thermoplastic is obtained according to ASTM D7791. S-N data is used for life prediction of a testing plate with a hole. A real life fatigue tests of the testing plate are executed and cycles to failures are compared with predictions. A good match between prediction and tests is achieved and therefore reliability of S-N data is verified.

Keywords: Fatigue of Plastics, Finite Element Method, Uniaxial Fatigue Test, Thermoplastics

SHEET LAMINATED DIES: AN ALTERNATIVE TO FAST PROTOTYPING IN FORMING OF SHEET METAL PARTS (PAPER 102)

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Design and manufacturing of sheet-laminated deep drawing dies, which presents a suitable option for prototype manufacturing, are studied. The surface geometries of the dies are discretized from the solid model using CATIA and the discretized forms are viewed from side. These side views are then transferred to dxf drawings that are programmed to a laser-cutting machine. The dies are cut from ST40 sheets that are commonly used in automobile industry. Aluminum sheets are formed in deep drawing using the laminated dies. In practice, the method proves to perform well for fast manufacturing of prototyping dies in sheet metal forming.

Keywords: prototype manufacturing, sheet metal forming, laminated dies

AN INVESTIGATION INTO POWER AND ENERGY REQUIREMENTS FOR THE AUXILIARY COMPONENTS OF A CNC LATHE (PAPER 22)

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Energy consumed for manufacturing processes involves theoretical energy and auxiliary energy. This paper focuses on finding the average power rating values for each auxiliary component. A generic CNC lathe involves 5 main systems as auxiliary components: (1) Spindle assembly, (2) servo motors for axis movements, (3) cutting fluid system, (4) lubrication system for lubricating axis slideways, (5) hydraulic system for clamping, turret and tailstock assembly movements. In order to find the energy consumed by each of those 5 components, controlled measurements were taken, revealing only the effect of the investigated component.

Keywords: Power consumption, Auxiliary energy, CNC lathe

DESIGN OF FLEXIBLE MANUFACTURING SYSTEMS (PAPER 47)

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Acceleration of change, fast diversification of consumer requirements, and improvement of power balance for the favor of customer increased competition's dimensions and difficulties in the World of industrial equipments. In those harsh conditions, investing in right Technologies play a crucial role for surviving. Flexible Manufacturing Systems is the meeting point for borh efficiency and quality and even product diversity. Consisting from programmable devices and equipments, those systems additionaly providing precision, speed and compatibility, thus giving significant advantages to their users. In this article the structure, features, historical developments, and advantages of flexible manufacturing systems are explained and successful examples of flexible manufacturing systems from sheet metal provessing industry are introduced.

Keywords: Flexible Manufacturing System, Flexible Configuration, Machine Design, Sheet Metal Processing Systems

DEVELOPMENT OF A CONTROL SYSTEM FOR AUTOMATED STORAGE AND RETRIEVAL SYSTEMS (PAPER 66)

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In this study, an embedded system and control software developed for Automated Storage and Retrieval Systems (AS/RS). The main objective is AS/RS related control rules can be applicable to the developed test system. The secondary objective is determined as developing the control system in a flexible way that allows adding new equipments to the system and configuring parts of the system. To do these, two types of control board are manufactured and also boards' firmware and a control software are developed. These two boards communicate with a computer one at a time. Control software includes some AS/RS related control rules. According to these rules the control software assigns tasks to the related board. Also, it records necessary information for measuring the performance of the AS/RS. In order to show reliability of the control system, two experiments are designed and run on the physical system. Different control rules applied to each of the experiment. Experiment results put forth the control system was quite successful in meeting the objectives.

Keywords: Automated Storage and Retrieval Systems, Control Software for AS/RS, Physical Simulation in Production Management

AUTONOMOUS MOBILE ABRASIVE WATERJET CUTTING VEHICLE (PAPER 86)

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The autonomous mobile waterjet cutting system has been designed to be used safely in potentially dangerous cutting operations such as cutting the tanks of petrol and flammable and explosive gases and ammunition destruction. In cutting with waterjet, especially while cutting metal materials, there is no thermal effect, which occurs in hot cutting methods such as oxyacetylene or plasma cutting method. For this reason, without any danger of burning or explosion, the cutting is executed in cold way. In processes such as cutting the sheet material of petrol tanks that should be renewed due to the deformation or in ammunition, the waterjet cutting, which is a cold method, can be preferred. Even though the risk of explosion is minimized with waterjet cutting system, this risk factor is totally removed by using this method. In addition, it is prevented for the human operator from poisonous gases leaking between the sheet metals that have been cut. The autonomous mobile waterjet cutting system was safely utilized in cutting the basement sheets, which are deformed and need to be replaced, of petrol tanks with 100m of diameter.

Keywords: Waterjet system, autonomous system, mobile system, waterjet cutting

A NEW DESIGN FOR TILTABLE AND TELESCOPIC STEERING COLUMN WITH HIGH PRESSURE DIE CASTING TECHNOLOGY AND SPECIAL ALLOY MAGSIMAL 59 FOR AGRICULTURE MACHINES (PAPER 17)

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This paper aims to outline the results of a new design for tiltable and telescopic steering column. We obtain a cost effective part which is superior in ductility, strength, energy absorption and vibration damping by replacing U joint needle bearing system with this design that uses high pressure die casting technology with the special material Magsimal 59.

Keywords: Steering column, Magsimal 59, High pressure die casting, Magmasoft analysis.

AN ANALYSIS OF LOAD INCOMPATIBILITY IN CENTRAL IN-LINE COLLISIONS OF VEHICLES USING LUMPED-MASS MODELLING (PAPER 19)

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Cars can perform well in consumer crash tests but they may perform poorly in real-world accidents due to a lack of good compatibility. This study describes the physics behind incompatible collisions between vehicles using a lumped-mass modelling approach. In this paper, the emphasis is on load incompatibility which occurs due to the differences in the masses and the structural stiffnesses of colliding vehicles. The formulation presented in this paper is part of an ongoing project aimed at creating a useful and simple tool which provides the hand computation and analysis of vehicle and occupant dynamics in order to explain the principles of crash safety and investigate the feasibility of new design concepts.

Keywords: Automotive safety, compatibility, lumped-mass modelling

STRUCTURAL OPTIMIZATION USING META-HEURISTIC ALGORITHMS IN AUTOMOTIVE INDUSTY (PAPER 54)

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Designing of light-weight structures are very important for fuel and cost efficiency in automotive industry. In this research, a hybrid gravitational search optimization algorithm(HGSA) is used for solving structural design optimization problems. The algorithm is applied to the structural design optimization of a vehicle component. Results show that the HGSA is very effective to find optimal structural designs in automotive industry.

Keywords: Structural design, Gravitational search, Hybrid Optimization

CARDBOARD BICYCLE (PAPER 105)

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In this research project, we manufactured an eco-friendly, low cost, green bicycle made out of 80% by volume recycled materials. Cardboard and knitted hemp together with epoxy resin were used as the main composite material combinations throughout the bicycle body. In the main body of the bicycle, tubular cardboards while in the wheels corrugated cardboards adhered to each other by wood glue were used and eventually they were impregnated by the epoxy resin. Sackcloth patches knitted out of hemp fibers were selected as joining components for tubular cardboards. Finally, the force distribution of the main body was analyzed by a commercially available software and the results were compared with the strength values obtained from mechanical tests.

Keywords: Cardboard bicycle, composite material, cardboard, hemp, epoxy

A CONDITIONAL COVERAGE PATH PLANNING METHOD FOR AN AUTONOMOUS LAWN MOWER (PAPER 36)

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Randomized and deterministic coverage path planning methods are widely used in autonomous lawn mowers. Random planning can not guarantee a complete coverage, whereas, many deterministic techniques are either not solely eligible for unstructured outdoor environments or demands expensive sensor hardware. A novel, Conditional Coverage Path Planning (CCPP) method, which satisfies full coverage with a low computational requirement, is presented in this work. For implementation, a state-of-art autonomous lawn mower is designed and manufactured. Extensive simulations and tests performed to visualize CCPP advantages over widely used coverage methods. Results revealed that CCPP significantly increased coverage performance, when compared with conventional coverage algorithms.

Keywords: Coverage Path Planning, Complete Coverage Method, Autonomous Lawn Mower, Autonomous Outdoor Navigation

FUZZY IMPERIALIST COMPETITIVE ALGORITHM BASED SOLUTION TO OPTİMİZE THE PID CONTROLLER SYSTEM (PAPER 38)

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The paper purposes application of fuzzy logic to theimperialist competitive algorithm to control an automatic voltage regulator (AVR).For the stabilization of the (AVR) a proportional-integral-derivative controller (PID) was used. The fuzzy imperialist competitive algorithm (FICA) is the combination of the imperialist competitive algorithm (ICA) and fuzzy logic to determine the optimal coefficients of the proportional-integral-derivative controller (PID). The new algorithm solves the main problems of the imperialist competitive algorithm (ICA), which entrapped in local optimum points and low-speed convergence. This way, the control of the effective parameters of the (ICA) likes as the assimilation coefficient, and the cost of colonies result with high accuracy and speed. We will show that the results obtained with the proposed intelligent algorithm (FICA), have higher convergence rate and more accuracy in comparison with the other algorithms.

Keywords: Optimization, PID controller, Fuzzy logic,Imperialist competitive algorithm**.**

ACTIVE COMPLIANCE CONTROL STRUCTURE DESIGN FOR A ROBOTIC-GRINDING MACHINE USING A PIEZO ACTUATOR (PAPER 39)

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Grinding operation has the advantage of precise form shaping in machining process. However, if the surface profile is not known before the machining process, it is hard to obtain an accurate surface profile using a grinding operation. In this paper we present a method to compensate the form shaping errors in grinding operations due to the lack of pre-knowledge of the surface profile by applying active compliance force control. The compliance force control is implemented by means of admittance control in 1 DoF using a piezo actuator, which is fixed to the work-piece holder. The desired force interaction between the tool and the work-piece was achieved by imposing an offset from the preset depth of cut. Using the proposed active compliance admittance control, the surface form was machined with the desired tolerance with higher surface quality. The proposed controller was tested on a robotic grinding setup and the experimental results are discussed.

Keywords: Grinding;Active Compliance; Active Force Control; Admittance Control; Piezo Actuator; Precision Machining; Precise Force Control; Negative Compensation;; Hysteresis control

ROSE STEM BRANCH POINT DETECTION AND CUTTING POINT LOCATION FOR ROSE HARVESTING ROBOT (PAPER 100)

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The primary objective of the study is to develop a method that can locate the proper location of cutting point of rose stem for robotic rose harvesting. The cutting point has a vital importance for cut rose harvesting in greenhouse which affects the efficiency of new shoot from the cut stem. In agricultural process, the cutting point depends on thickness of stem and eyes on stem. If stem is thick, then cutting is at the third eye and if stem is thin then cut at the second eye above stem branch. Locating eyes on stem is difficult by image processing and not feasible thus another relation for cut point estimation should be performed. The relation between thickness and cut length of stem from branch point can lead to relation for cut point estimation. 239 samples of cut length and stem diameter of harvested roses are collected from a greenhouse. The data reveal linear relationship between diameter and cut length. The branch point location algorithm was developed for the robot to evaluate cut point location from branch point. The proposed algorithm has three steps: branch point detection; thickness calculation; and cutting length estimation. The algorithm for branch detection performs quite well to detect and locate the position of the point when there occurs no overlapping. The results of branch point detection are adequate for implement on the robot.

Keywords: robot, harvest, branch, stem, cut point, locate, rose

DEVELOPMENT OF A VIRTUAL ENGINEERING ABILITY TO IMPLEMENT ECE R66 REGULATION FOR ROLLOVER SAFETY OF VEHICLES USED FOR PUBLIC TRANSPORTATION (PAPER 15)

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Bus rollover is one of the most serious types of accident as compared to other modes of bus accidents. In the European countries, the certification of sufficient deformation strength when overturning is compulsory for the approval of a coach according to the ECE R66 regulation. According to the said regulation, the certification can be gained either by full-scale vehicle testing, or by calculation techniques based on advanced numerical methods (i.e. non-linear explicit dynamic finite element analysis). In this paper, same bus rollover sections will be compared between deformation characteristics of physical bus section rollover test and computational rollover simulation for correlation purposes according to ECE R66 regulation.

Keywords: ECE R66, Rollover Crashworthiness, Explicit dynamics, FEM

DEVELOPMENT OF NEW AGE GUARDRAIL SYSTEMS USING CRASH ANALYSES AND HEURISTIC OPTIMIZATION METHODS (PAPER 50)

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In this study, crash tests of a guardrail system, which has H1 containment level, were simulated and new designs were performed to improve the crash performance. Guardrail systems were designed with 25 different post sections with different design variables and the distance between the posts was designed as 2.00 m for the analysis. TB11 and TB42 crash analysis were performed with RADIOSS software according to EN 1317 standards. 25 different designs were evaluated according to weight, guardrail's working width and acceleration severity index (ASI). The optimum design has been tried to obtain using gravitational search algorithm, which is one of the heuristic optimization methods. As a result of optimization, an optimum design was obtained which has minimum weight and acceleration severity index value (ASI).

Keywords: Crash analysis, EN 1317, Guardrails, Optimization

INVESTIGATION THE EFFECT OF NEW GENERATION HIGH STRENGTH MATERIALS ON CRASH PERFORMANCE OF ENERGY ABSORBERS WITH DIFFERENT GEOMETRY (PAPER 51)

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In recent years, there have been lots of studies in automotive industry to improve safety (crash) and fuel economy of vehicles. Advanced high-strength steels (AHSS) are new generation steels that provide extremely high strength for crash safety. Also, AHSS contribute to produce lightweight cars with their characteristic of usability with thinner sheet thickness than conventional steels. In this study, different crash box geometries used as passive safety systems in vehicles were analyzed numerically by using conventional and new generation steels. As a result of the analysis, crash performance parameters such as energy absorption and reaction forces were compared for different materials.

Keywords: Crash analysis, Crash box, Advanced high-strength steels

THERMAL MODELING OF HEAT AFFECTED ZONE OF A LOW CARBON STEEL IN GAS METAL ARC AND LASER WELDING (PAPER 28)

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Gas metal arc welding (GMAW) is one of the widely-used joining techniques in industrial applications. It is also a very common operation for large-structural welding in defense industry. The condition of the welding operation strongly influences the final mechanical properties and quality of the product. Therefore, the simulation of GMAW is essential to be able to predict the effect of some operation parameters on the material properties. To be able to predict phase transformations, thermal strains, residual stresses and distortions within the material, the simulation of the heating and cooling history of the heat affected zone is the key step. For this purpose, the heat equation needs to be solved with respect to the heat input supplied by the welding arc. In this study, the results of a thermal simulation of a low carbon steel is presented. The heat equation together with temperature dependent material properties is computed using COMSOL Multiphysics simulation environment.

Keywords: GMAW, laser welding, double ellipsoidal heat source

DESIGN OF ACTIVE DISTURBANCE REJECTION BASED CONTROLLER FOR A MOBILE ASSEMBLY POSITIONER (PAPER 29)

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For defense industry where the large structural welding process is a commonly-used operation, heavy-duty positioners have a wide range of usage. This specific equipment could be used in rotating, tilting or lifting of the huge workpieces. Manipulation of the workpiece is often a compulsory task in order to assure the accessibility, weldability, ergonomics and safety regulations, etc. Due to the abovementioned concerns, a project has been initiated at FNSS Defense Systems Co. Inc. and supported by TÜBİTAK-TEYDEB to design a mobile assembly positioner. In this contribution, control system design for the rotary motion of a chassis coupled to the positioner is revealed. Due to the change in the inertial properties of the chassis during the assembly, controller must provide certain amount of robustness to maintain a safe and predictable motion. A linear active disturbance rejection control (L'ADRC) system is designed for this purpose. The need for such a robust topology and performance of the designed control system are presented by using model based simulations.

Keywords: Positioner, Motion control, L'ADRC

TOPOLOGY OPTIMIZATION OF A MOBILE ASSEMBLY POSITIONER BY CO-SIMULATION APPROACH (PAPER 30)

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For defense industry where the large structural welding processes are commonly used operations, heavy-duty positioners play a significant role in manufacturing. This specific equipment could be used in rotating, tilting or lifting of the huge workpieces. In order to satisfy the needs of several simultaneous projects, mobile positioners present good engineering solutions to fast switching and location changing problems. A mobile positioner may provide important advantages in flexible manufacturing especially in layout studies. However, to be mobile, it is obvious that the heavy-duty positioner should also possess the property of lightweight, i.e., it has to be a very effective in overall weight - payload ratio. Thus a topology optimization is compulsory for this specific design process. In this study, topology optimization efforts of a mobile assembly positioner are presented within an ongoing project at FNSS Defense Systems Co. Inc. supported by TÜBİTAK-TEYDEB.

Keywords: Positioner, Topology optimization, Lightweighting

APPLICATION OF BOUNDARY ELEMENT – FINITE ELEMENT METHOD COUPLING FOR ELASTOPLASTIC ANALYSIS (PAPER 104)

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Boundary element method is a well-defined and accurate method for the solution of linear and homogenous partial differential equations, but is not commonly used and/or not very practical to be used with non-homogenous and non-linear problems. Finite element method, on the other hand is a very widely used method in almost all engineering problems, yet, loses effectiveness for large-domain problems and problems with complex geometry due to the need for domain discretization and element compatibility. Many problems in metal forming have large elastic domains with localized plastic zones. Some examples are sheet-rolling, extrusion, wire drawing, etc., where the plastic deformation is generally localized at the region close to the die (or dies), and the rest of the deformation zone is elastic. In such problems, a coupled analysis where the large elastic zone is solved by the boundary element method and the local plastic zone is solved by the finite element method.

In this study, a parallel algorithm for such a coupled analysis is presented. The plastic zone is solved by a commonly used package program, Abaqus, and the elastic zone is solved by a boundary element code written in MATLAB. The analysis is done in 3D where on the boundary-element side constant triangular elements on the boundary are used and on the finite-element side quadratic hedrahedral elements are employed, which presents the same triangular mesh on the interface surface. A forward-explicit time integration is used in the analysis along with an updated-Lagrangian scheme assuming small displacements and small strains.

The coupling of the two methods is achieved through a displacement-based boundary condition and force based comparison. The solution on the boundary element side of the interface presents tractions which are then integrated over the elements to obtain forces. These forces are

compared with the forces obtained from the finite element side of the interface and through this comparison a new displacement estimate is imposed as boundary condition to both sides of the interfaces. This iterative procedure is repeated until convergence on the forces at each time increment. This interfacing algorithm is programmed in MATLAB which retrieves the forces from the output file of the Abaqus program and than rewrites the input file with the newly assigned boundary conditions. The presented algorithm proves to work well with effective parallel solution of the elastoplastic problems.

The presented work is supported under the TUBITAK ARDEB 1001 projects fund with Project no: 213M632.

Keywords: Boundary element method, Finite Element Method, Coupling, Elastoplastic analysis

OPTIMUM DESIGN OF THIN-WALLED TUBES USED AS ENERGY ABSORBERS IN CARS USING NEW AGE HEURISTIC METHODS CONSIDERING THEIR FORMING HISTORY (PAPER 61)

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In this paper, metamodeling and recent optimization techniques have been used to improve crash performance of an automobile thin-walled tube considering influence of the forming history. In the optimization study, weight and amount of the energy absorption of the thin-walled tubes are chosen as objective function and constaint, respectively. The forming and crash simulations are carried out by using Hyperworks Radioss. The performance of recent optimization algorithms which are genetic algorithm, gravitational search algorithm and charged system search algorithm was investigated to find the optimal the thin-walled tube design.

Keywords: Sheet metal forming, crash box, optimum design

OPTIMUM DESIGN OF VEHICLE COMPONENTS USING NEW GENERATION METAHEURISTIC ALGORITHMS (PAPER 62)

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Optimum design of the vehicle components are very important for fuel and cost efficiency in automotive industry. In this paper, a hybrid optimization approach is proposed for solving structural design optimization problems. The proposed algorithm is used for optimization of vehicle sliding bar.

Keywords: Structural optimization, optimum design

DESIGN AND TESTING OF THE OPEN/CLOSE MECHANISM OF THE BOOT LID FOR A NEW MODEL CAR (PAPER 83)

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This work is on the design and testing of the open/close mechanism of the boot lid for a new model car. At first, a four bar open/close mechanism, which is driven by torsion bars, were designed. The mechanism was then installed on a boot lid to conduct rigorous tests based on finding the manual force required to open and close the lid and the speed pattern of the lid during closing in order to improve the design. In the designed mechanism, the manual forces required for the lid to open after the first stable point and closing while it was in the second stable point were found to be in the acceptable range. As a result, a low cost new open/close mechanism of the boot lid was successfully designed and approved to be used in the new model cars of the company.

Keywords: Boot lid, Open/close mechanism, Torsion bar mechanism

SURFACE ROUGHNESS IN MILLING OF AISI 430 STAINLESS STEEL BY MQL METHOD USING MWCNT REINFORCED VEGETABLE CUTTING FLUID (PAPER 01)

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Machining operations were applied to stainless steel materials in many fields such as automotive, aviation, medical industries etc. and these materials are classified as hard-to-cut materials due to their work-hardening tendency and low thermal conductivity. However, competition resulting from technological developments requires continuous improvements on surface quality of these materials, especially in micro part manufacturing. In this study, AISI 430 ferritic stainless steel parts were machined and surface roughness was investigated. The milling experiments were conducted under dry, MQL (Minimum Quantity Lubrication) with vegetable cutting fluid, and MQL with nanofluids conditions using uncoated carbide and TiN (Titanium Nitride) coated carbide cutting inserts. The nanofluids were prepared by reinforcing vegetable cutting fluid with MWCNT (Multi Walled Carbon Nanotube) at weight fraction of 0,1 %wt and 0,15%wt. According to the surface roughness measurements, MQL method reduced the surface roughness and better surfaces were observed by using nanofluids.

Keywords: Surface roughness, MQL, MWCNT, ferritic stainless steel

INFLUENCE OF MACHINING STRATEGIES ON SURFACE ROUGHNESS DURING WIRE ELECTRICAL DISCHARGE MACHINING OF TUNGSTEN CARBIDE (PAPER 68)

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Wire electric discharge machining (WEDM) have been accepted as an efficient method of fabricating micro cutting tools made from ultra-fine grain tungsten carbide (grain size ≤ 0.7 μm). Owing to its non-contact nature, very small diameter cutting tools can be fabricated with this technique. In WEDM process, a series of rough, semi-finish and finish passes are used to obtain the desired dimensional requirements together with high surface quality. The aim of this paper is to investigate the influence WEDM strategy in terms of number of passes and wire offset values on the surface roughness of tungsten carbide (WC). The results show that processing times of WEDM can be significantly reduced without sacrificing the surface quality through experimental investigations.

Keywords: Wire EDM, Surface roughness, Machining Strategy

DEVELOPMENT OF A DESKTOP SIZE ELECTROCHEMICAL MACHINE FOR MICRO/MACRO MANUFACTURING (PAPER 74)

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Electrochemical machining (ECM) is one of the non-traditional machining processes and it has been used for specific areas where they require high-performances. In this paper, development of a desktop size EC machine is presented for micro/macro manufacturing. In order to verify the capabilities of the developed machine, the process experiments were conducted and discussed in this paper. With the developed EC machine, ECM parameters like electrolyte flow rate, temperature, concentration, voltage, current, short circuit, feed rate and initial gap can be controlled. The experimental results are compared with literature. They show that voltage is the most effective ECM parameter.

Keywords: ECM, Micro, Macro, Voltage

THE EFFECTS OF HIGH-PRESSURE COOLANT ON PROGRESSIVE TOOL WEAR IN MACHINING STAINLESS STEEL (PAPER 81)

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This study provides an experimental result of machining process of 316L stainless steel. The aim of this study is to determine the effect of high-pressure coolant (HPC) for increasing tool life in machining process of 316L stainless steel. Turning experiments were conducted at constant cutting parameters under various conditions including high-pressure coolant, dry, and flood cooling. The recorded output parameters were progressive flank wear, nose wear, and surface quality of machined sample. The measured outputs obtained from high-pressure coolant assisted machining were compared with the results obtained from dry and flood cooled machining taken progressive tool wear and surface quality of work materials into account. This study demonstrates that high-pressure coolant substantially increases tool life as compared to dry and flood cooling condition in machining 316L stainless steel.

Keywords: 316L stainless steel, machining, progressive tool wear, high-pressure coolant

METHOD FOR RATING AND CONVERTING TEXT BOOK SPUR GEAR DESIGN RESULTS TO ISO GEAR STANDARDS (PAPER 06)

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This paper firstly compares and rates three design approaches: ISO 6336 Standard and two machine design textbooks which are the most commonly used. Then it introduces ISO Conversion Factors (CFs) for the textbooks approaches. The CFs allow users to perform a simple spur gear design approach available in textbooks, and then convert the design outputs of module and face width to most accurate ISO Standard with minor error. The method given is generic and provides simplicity to students for spur gear design and also can be applied in between any gear standard and text book approaches for gear design.

Keywords: spur gear design, relative comparison, conversion factors, gear rating, simplification, engineering education

A SENSITIVITY-BASED METHOD TO OPTIMIZE DESIGN SPACE FOR MECHANICAL DESIGN OPTIMIZATION (PAPER 40)

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In this work, a novel sensitivity-based method to stochastically optimize design space for mechanical design optimization is developed, based on Holdback Input Randomization Method (HIPR-Method). In other words, the proposed method is an extension to the HIPR method, and an improvement for the design optimization process involving knowledge-intensive tasks. This proposed method is applied to a mechanical design problem. The case study illustrates that this method provides an opportunity to practically achieve more feasible and computationally inexpensive design space, compared with deterministic case and Monte-Carlo method.

Keywords: Design space optimization, Sensitivity analysis, Mechanical design.

DESIGN, ASSEMBLY AND ACCURACY OF CNC MACHINING CENTERS (PAPER 46)

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Design of CNC Machining Centers may vary from design to design. Common number of axis for machining centers are 3-5. In the market there are 6-axis machining centers. As the complexity of the part increases the number of axis increases to obtain precise parts. Many errors of CNC machine tools have an effect on the accuracy and repeatability of part manufacturing. Some of these errors can be reduced by controlling the machining process and environmental parameters. Machine tool accuracy and repeatability is one of the most important considerations for manufacturing parts with the required quality for consistent performance in their assemblies. Among them is the assembly operations. In this paper assembly operations are studied to obtain the given accuracy and repeatability of a CNC machine. Positioning accuracy and repeatability of the machine tool are core descriptors of a machine tool and indicate the machine's expected level of performance. There are a number of standards and guidelines how to evaluate machine tool positional accuracy and repeatability. In this paper technical information about components and complete 3-axis CNC machining center is given and emphasis is made for the assembly operations and for the standards that are used in the inspection of these machines.

Keywords: Machine Tool Design, Accuracy, Rails, Linear Bearings, Ball Nut and Screw, Assembly Design, Machine tool standards.

IMPLEMENTATION OF FUNCTION STRUCTURE HEURISTICS FOR MODULAR DESIGN OF AN EDUCATIONAL MECHATRONIC PRODUCT FAMILY (PAPER 101)

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Function structure heuristics is one of the important modularity methods for product design, and it has been developed and applied mainly for the design of mechanical product families. This study aims at implementing function structure heuristics to the modular design of a mechatronic product family. In the presented implementation, an educational mechatronic product family is selected to be used for the sophomore mechatronics design course in the Mechatronics Engineering Department of Atılım University. This study includes implementation of the function structure heuristics for the conceptual design of the mechatronic product family, as well as its physical design and manufacturing.

Keywords: Function Structure Heuristics, Modular Product Design, Educational Mechatronic Product, Mechatronic Product Family

ANALYTICAL AND NUMERICAL INVESTIGATION OF SPRINGBACK ANGLE ON PUSH ROLLING TUBE BENDING PROCESS (PAPER 02)

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Springback angle prediction by numerical methods would shorten the time and reduces the cost of the pre-determination of springback. The objective of this study is to develop a springback angle database on push rolling tube bending techniques which is rarely found in the literature by using finite element method (FEM). For this purpose, technological background and design parameters of push rolling tube bending process, which are commonly used in CNC machines, are reviewed. Tube bending and springback simulation for SS 304 tube models for these bending processes is developed, and the simulation results are validated with the experimental and analytical results.

Keywords: CNC Tube Bending, Springback, Numerical Simulation, Push Rolling Bending

INVESTIGATION OF THE EFFECT OF SERVO-PRESS FORMING IN SPRINGBACK AND MINIMUM BENDING RADII OF ULTRA HIGH STRENGTH STEELS (PAPER 21)

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Forming of ultra-high strength steels (UHSS) is one of the major processes in the production of armored combat vehicles. Furthermore, bending of UHSS is a challenging task due to the high springback tendency in UHSS and the relatively large minimum bending radii values. Especially in the design of a large structural component, sharper bending radii values result in reasonably optimized volume usage. In other words, a decrease in bending radius enables more light-weight and volume-optimized designs. On the other hand, sufficient information in estimation and compensation of springback provides important advantages in project schedules by means eliminating a lot of trial and error studies. Because of these facts, in this study, the effects of servo-press application in bending of UHSS plates are investigated by simulation and experimental studies. Some basic material characterization tests are done to obtain the material properties for simulation purposes.

Keywords: UHSS, Bending radii, Spring-back

IMPLICIT FINITE ELEMENT SIMULATION OF INCREMENTAL SHEET FORMING PROCESS (PAPER 99)

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For over a decade, die-less forming by application of Incremental Sheet Forming (ISF) has been receiving a great deal of attention from the universities and research communities. ISF offers some advantages over conventional sheet forming technologies, namely better formability of sheet, more flexibility in the process and lower production cost. This process also suffers from some drawbacks such as relatively poor dimensional accuracy and surface finish of the sheet component and sensitivity of the process to large forming angles. In order to remedy the deficiencies of ISF and further develop the industrial applications of the process, a profound knowledge of the mechanism of incremental sheet deformation is required. Considering complexities resulting from the localized nature of deformation in ISF, Finite Element Analysis (FEA) provides a unique opportunity for understanding the process. This paper aimed at performing a preliminary implicit FEA of the process. The acquired forming forces from FEA were compared with those of forces experimentally recorded. In conclusion, the necessary precautions to be taken to ensure the accuracy of FEA of ISF process were highlighted.

Keywords: Incremental Sheet Forming, Forming Forces, Finite Element Simulation, Aluminum, Anisotropic.

A SOFTWARE FOR PICK AND PLACE ROBOT MOVEMENTS FROM MARBLE MOSAİC PATTERN CONFİGURATİON DESİGNED BY CAD (PAPER 34)

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Creating mosaic patterns can be obtained by combining together small pieces of stone, glass, wood, and glazed tiles to make pictures or illustrations. These patterns have been carried out manually for thousand years. This study aims to develop a software with C# which generates suitable Point-to-Point NC data for the pick and place robot movements from an exported DXF file of a marble mosaic pattern configuration designed by CAD. DXF file also contains the setup of the working area. Tiles are classified into two categories according to their position, the “feeder tiles” and the “pattern tiles”. Two groups are compared with their shape, size and angle features. The angle of rotation is amount of rotation of a feeder tile to be placed at matching pattern tile. The centroids of matching tiles are used to generate the route of gripper. The validity of developed software is examined by marble mosaic medallion compositions designed by CAD.

Keywords : Mosaic tiling, marble mosaics, mosaic automation, feature extraction

EXPERIMENTAL ANALYSIS OF EXTERNAL GEAR PUMPS WITH SYMMETRIC AND ASYMMETRIC SPUR GEARS (PAPER 41)

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This paper presents an experimental study for the comparison of flow characteristics and dynamics of gear pumps with symmetric and asymmetric spur gears. Effects of drive side pressure angle have been investigated through the experiments. The experiments have been carried out with a specific gear pump available in the market and used for different applications. By using Electro Discharge Machining method (EDM), both symmetric and asymmetric gears have been manufactured based on the models generated by an automated program. One set of symmetric gear and one set of asymmetric gears (30^o drive side pressure angle) are assembled into external gear pump and both configurations are tested for three different rotational speeds. Volumetric flowrate, noise, vibration and power consumption of the motor are measured and flowrate fluctuation is calculated for all cases. It was seen that asymmetric gears provide less vibration, less power consumption with respect to symmetrical gears. Flow rates seemed to be not changed but flow rate fluctuations have been reduced considerably.

Keywords: External gear pump, Asymmetric gear profile, Volumetric flowrate, Flowrate fluctutation, Noise, Vibration, Power Consumption

KANSEI ENGINEERING AND MACHINE DESIGN (PAPER 44)

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Increase of competitiveness and intense technological developments also increase the importance of addressing to customer's aesthetic expectations in recent years. Although in the previous decades people were mainly paying attention to functionality, safety, cost and efficiency, today, importance of aesthetics and ergonomics are increased. Today integrating Kansei Engineering Methodology into engineering design processes brings to products both some sensual and feeling dimensions. It is possible to create products with unique features thanks to Kansei Engineering approach. Thus emotional link created with customers and users can be strengthened. This emotional connection is created by reflecting customer's desires and ideas in their minds. Consequently companies which are willing to get competitive advantage are directed in a significant manner towards Kansei Engineering. Ermaksan A.Ş. is recently perceived the importance of Kansei Engineering and put the related methodologies into the design process of its three machines. The ways of implementations on sheet metal machinery product development and results obtained is presented in this article.

Keywords: Kansei Engineering, Machine Design, Industrial Design, Ergonomy

A MACRO-MICRO MECHANISM DESIGN FOR LASER CUTTING PROCESS (PAPER 48)

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This paper is organized to provide the novel approaches during the design of a machine to shorten the laser cutting process. Macro-micro manipulation concept is employed for the design of this machine both in the mechanical design and in devising the trajectory planning algorithm. Micro-mechanism design along with its calibration process are also explained since they involve novel approaches in this application domain. Trajectory planning algorithms, which are developed in this work, are discussed based on their applicability to CNC system architecture. Finally, experimental results based on a benchmark workpiece are given and the system design is discussed with respect to these results.

Keywords: Macro-micro manipulation, laser cutting, trajectory planning, kinematic redundancy, mechanism calibration

INVESTIGATION OF SOME PHYSICAL CHARACTERISTICS OF BRAKE PADS CONTAINING BORAX AND WOLLASTONITE (PAPER 43)

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There are more than ten dust materials in the context of the brake pad which is the most important parts of the car security system. Brake pads are produced by powder metallurgy method using such materials. Ideally the brake pads have a wear-resistant and must have a high friction coefficient. It is also important to be environmentally friendly brake pads.Therefore, in the production of brake pads, instead of dust that damage to the environment and human health, natural powders are used. In this study two different natural powder (4.5% wollastonite and 7% boraks) brake pads produced using natural additives are used. The brake pads were kept in the water and the oil. After this treatment, hardness, density, weight, dimensional change and some physical properties of the pad are discussed. The samples soaked in water, compared to waiting in oil, more hardness decrease was observed. Borax added pads have suffered a loss hardness of more than wollastonite added lining.

Keywords: Brake pads, natural dusts physical properties.

THE STUDY OF EFFECTS OF THE SUPPLEMENTARY ELEMENT GRAPHITE TO WHICH 3% BY WEIGHT IS ADDED MATRIX B_4C REINFORCED METAL MAATRIX COMPOSITES MATERIALS ON WEARING (PAPER 45)

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In this study, two different types of metal matrix composite materials Al/B_4C/Gr was produced by means of hot pressing technique, a powder metallurgy method, by keeping the reinforcement element B_4C fixed 8% by weight and adding the reinforcement element Gr at different rate by weight (3%). The wearing experiments of the hybrid reinforced composite materials were carried out at a fixed dry sliding speed (0,8 m/s), with four different loads (10, 20, 30 and 40 N), under dry sliding conditions and by getting over four different ways (300, 600, 900 and 1200 m) on a pin-on disc testing machine according to ASTM:G99. The results of wearing experiment showed these the lowest wearing loss was 0,0010 g with the hybrid reinforced composite material coded as K_1 under 10 N load and in 300 m sliding distance and the highest wearing loss was 0,0152 g under with the hybrid reinforced composite material coded as K_2 40 N load and in 1200 m sliding distance.

Keywords: Metal Matrix Composites, Powder Metallurgy, Hot Press, Wear

EXPERIMENTAL DETERMINATION OF FORMING LIMIT DIAGRAMS OF SHEET METAL TITANIUM ALLOYS (PAPER 57)

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Forming limit diagram (FLD) is an important tool for evaluating the formability of sheet metals. In this study, the procedures for determination of FLDs are summarized briefly and experimental FLDs are determined for two different grades; CP2 and CP4 pure titanium sheets, and Ti-6Al-4V alloy. Experimental results indicate that CP2 and CP4 have sufficient formability at room temperature. However, the formability of Ti-6Al-4V is found to be quite low and necking stages for Ti-6Al-4V alloy are not observed clearly. In addition, the methods are developed to determine the FLD of Ti-6Al-4V at room temperature.

Keywords: CP2, CP4, Ti, Titanyum, Ti6Al4V, Ti64, FLD

TRAJECTORY PLANNING OF PLANAR THREE-DEGREE-OF-FREEDOM 2-RRR PARALLEL MANIPULATORS FOR PASSING THROUGH SINGULAR CONFIGURATIONS IN THE PRESENCE OF UNKNOWN PAYLOADS (PAPER 72)

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In order to enable parallel robots to pass through type II singular configurations, it is well known that the dynamic model should be made consistent at these configurations by a proper trajectory planning. However, this trajectory planning approach requires an exact knowledge of the manipulator and payload parameters. Unfortunately, in most of the real world situations, the payload is unknown, or not precisely known. In this paper, focusing on a 2-RRR planar parallel manipulator, a novel trajectory planning method is proposed for satisfying the consistency of the dynamic equations at type II singularities while an unknown payload is being carried.

Keywords: Parallel robot, Planar parallel robot, Singularity, Type II singularity, Payload handling, Trajectory planning

DESIGN OPTIMIZATION OF HEAVY DUTY INTERNAL COMBUSTION ENGINE MOUNT BRACKET (PAPER 73)

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Heavy duty internal combustion engine mount development requires multidisciplinary approach to achieve the optimum design. The proposed method calculates the loads on the engine mount brackets considering the whole engine and transmission assembly in a practical way. Topology optimization procedure was performed for the engine mount bracket using the output of the whole assembly analysis. 12% weight reduction was achieved while satisfying the durability and vibration targets. This approach can be applied successfully for design optimization of other engine and vehicle components.

Keywords: Engine mount, Finite element analysis, Topology optimization, Durability analysis, Vibration analysis

COATING EQUIPMENT FOR MACHINE FROM VINYL ESTERS POLYMERS USING REDOX PEROXY/AROMATIC AMINE INITIATOR (PAPER 80)

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Polyvinyl alcohol APV is one of very few high molecular weight commercial polymers that are water soluble, the basic properties of PVA such as water solubility depend on the degree of replacement of acetate groups by hydroxyl groups (degree of hydrolysis) and the degree of polymerization. Vinyl ester resins have been widely recognized as materials with excellent resistance to a wide variety of commonly encountered chemical environments. Vinyl ester resins are used to fabricate a variety of reinforced structures or mechanical equipments .The resin is issued from bulk,solution,or suspension polymerization of a vinyl monomer,vinyl acetate .It has now been found that the use of an initiator system, the hydroxyl-containing aromatic amines and a diacyl peroxide includes, can significantly reduce the odor and, on the basis of the available data, toxicity of the resulting slurry of the beads.

Keywords : Polyvinyl acetate PVAc ,Polyvinyl alcohol APV, peroxy/amine catalyst saponification, coating.

DYNAMIC BEHAVIORS OF CRYOGENIC TREATED SHAFTS SUPPORTED BY DEFECTED ROLLING ELEMENT BEARINGS (PAPER 97)

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Rotating machinery systems such as turbo machines, generators, compressors, pumps, steam and gas turbines used nowadays work under many harsh conditions with heavy load and high speed. These systems are complex and have numerous components that could potentially fail. One of these components is shaft supported by rolling element bearings. One way to increase operational reliability of these systems is to use proper materials. Most of breakdowns in these systems are due to failure of the shaft materials. Therefore, using and analyzing of cryogenic treated shaft materials would be the main purpose of this study. Thus, the dynamic behaviors of cryogenic untreated and cryogenic treated shafts supported by defected ball and normal state of rolling element bearings for different running speeds were experimentally studied, analyzed, and compared.

Keywords: Shaft, Cryogenic treatment, Rolling element bearing, Vibration analysis

OPTIMIZATION OF PROCESS PARAMETER OF BORONIZED AISI 1050 STEEL USING THE TAGUCHI ANALYSIS (PAPER 37)

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In this study, the effect of boronizing processes parameters on the layer thickness and hardness of boronized AISI 1050 steel specimens were investigated. The experiments were carried out at temperatures of 800 °C, 850 °C and 900 °C for 3, 6 and 9 hours.The surface hardness, diffusion depth and microstructure were observed on samples subjected to pack boronizing process by using Ekabor 2 powder. The optimal setting of the boronizing parameters were identified by Taguchi based S/N ratios analysisto improve the surface quality**.**

Keywords: boronizing, surface hardness, boride layer thickness, Taguchi method, optimization

ELECTRIC CONDUCTIVITY AND RESISTIVITY OF ALUMINUM ALLOYS FOR THE APPLICATION OF ELECTRIC COUNTERS (PAPER 89)

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The energy lost in electric usage is an important issue. Due to the resistance of materials deformation occurs in the electric wires. One of the reasons that are not fully tightened the screw terminals and is also used for relaxation over time. In the first part, properties and deformation of the aluminium (aluminium) alloy was examined. In the second part, copper plating of the selected 1000 series aluminum alloy have been made. In the third part, and 1000 series aluminum wire, but features aluminum alloy coated type constant current through resistance over copper wires of different thickness were measured. The results of keeping constant the current flowing through the wire, which vary depending on the torque of the change in resistance was observed torque increases resistance decreases.

Keywords: Aluminum Alloys, Electrical Conductivity, Electrical Resistivity, Electric Counters, Tightening Torque

PROGRESSIVE FAILURE ANALYSIS OF LAMINATED COMPOSITE PLATES UNDER LOW VELOCITY IMPACT (PAPER 94)

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This study investigates the delamination damage induced by low velocity impact in a laminated composites using numerical and experimental techniques. Experimental tests were performed using a drop-weight impact test system. Numerical simulations were carried out using finite element software LS-DYNA with implemented material model MAT162 which is ability to predict the force-time history for low velocity impact on composite plate and afterwards its ability to predict both orientation and shape of delamination. Good agreement with the experimental result was observed, especially for shape and orientation of the delaminations.

Keywords: Laminated composite plates, low velocity impact, explicit finite element method.

DESIGN AND PROTOTYPE MANUFACTURING OF A HYDRAULIC INDEPENDENT CHUCK (PAPER 23)

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Tube Laser Cutting Machines to cut of special profiles are not produced in Turkey. With this machines can be produced most important profiles which must fix with sensitive tools as lathe chuck. The hydraulic controlled chucks must calculate exactly, scientifically and must be systematically designed. Under the process of the chuck design and its prototype manufacture with the use of modern engineering calculation techniques are intended to be designed in a systematic way.

Keywords: Hydraulic Chuck, Design, Prototype Manufacturing

DESIGN AND MANUFACTURING OF A WORK STATION FOR MARKİNG DRILLING AND CUTTING OF L-PROFILES (PAPER 24)

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A special machine capable of drilling and marking operations in a single process for standard L profiles has been designed and manufactured. This special machine in this context produced the first time in Turkey. The special knowledge in different areas and requires a long process of engineering calculations are presented in this paper prepared by the manufacturing steps of this machine.

Keywords: Angle, Cutting, Drilling, Workstation, Design, Manufacturing

DEVELOPMENT OF A PROTOTYPE 6-AXIS CNC MACHINING CENTER (PAPER 35)

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Industry of aviation, defense, automotive and die mold have recently devoloped rapidly. Machining demand of more complex geometry, larger size and heavier workpiece have increased day by day. With ever increasing demand, multiaxes machine tools are utilized at aviation, automotive and die mold industry. This project introduces 6 axis, high speed CNC machining center which will be use at die mold industry. It features X,Y,Z and Z1 axises as linear axis, A and B axises as rotating axis. In order to machine steel workpiece that has dimension with 1500X1500X1000 mm rotating axis and feed drive system have been considered. Additionally, modal and static analysis have been conducted within FEM methods. Manufacturing process of 6 axis CNC machining center is still in progress.

Keywords: 6 axis CNC, Finite element analysis

AN EXPERIMENTAL STUDY ON THE SURFACE ROUGHNESS OF SINGLE RECIPROCATING COMPRESSOR BY HONING METHOD (PAPER 13)

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This paper presents a new and comprehensive strategy for honing technique which is one of surface treatment techniques. The parameters for affecting the surface precision of a cylinder surface of a Single Reciprocating Compressor were determined to find out the best conditions for cylinder honing process by the experimental study. There are three honing parameters which are honing stone, honing fluid and federate of the honing machine. Each of these parameters were tested and recorded sparely for this experimental study. The measurements of surface roughness were taken out from the test cylinder by a calibrated surface roughness measuring device. The obtained data were interpreted to determine the most optimal conditions for the surface treatment of reciprocating compressor cylinders with honing technique.

Keywords: Piston compressors, cylinder surface, honing stone, honing fluid, Surface Roughness

EVALUATION OF SURFACE ROUGHNESS IN THE DRILLING OF COMPACT LAMINATE COMPOSITE (PAPER 25)

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Tool wear also affects the surface quality of workpieces. In this study, the effects of drilling parameters on Ra surface roughness of holes in drilling of compact laminate composites (CLC) using new (T_1) and worn (T_2) high speed steel (HSS) drills. Drilling type (Dt), the cutting speed (Vc) and feed rate (f) were used as control factors. Optimum levels of the control factors is determined via Taguchi method (TM) and the effects of each control factor on surface roughness is examined with analysis of variance (ANOVA). Optimal levels of parameters for minimum surface roughness are determined as; Vc:178 m/min cutting speed, f:0.07 mm/rev feed rate and peck drilling operations with both tools. T_1 tools are provided 75 % more performance compared to T_2 tools. In this study, also, the first order predictive equations via linear regression analysis were developed for prediction of surface roughness in the drilling process using T_1 and T_2 cutting tools and the correlation coefficients of the equations (R^2) were calculated as 0.949 and 0.71, respectively.

Keywords: Compact laminate composite, Surface roughness**,** HSS drill, Taguchi method.

EVALUATION OF DELAMINATION FORMATION IN DRILLING OF SANDWICH COMPOSITES USING TAGUCHI METHOD AND GREY RELATIONAL ANALYSIS (PAPER 32)

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In this paper, delamination in the entry and exit zone in drilling of composite sandwiches were evaluated by using Taguchi method and grey relational analysis (GİA). Experiments were carried out with uncoated carbide drilling tools with different point angles 118° and 140° in 6,35 mm and 8 mm diameters with dry drilling conditions. The cutting tool point angle, cutting speed and feed rate are selected as the control factors and, L16 (4^1x2^2) orthogonal array were selected as the experimental design. The entry and exit zone delamination factors (Fd) for the optimum parameter combinations are determined respectively $A_2B_2C_1$ and $A_3B_2C_1$. In addition for the drilling hole entry and exit delamination factor %50.45 and % 81.26 contribution rate respectively drilling diameter and point angle were determined the most effective parameters according to the variance analysis (ANOVA) results carried out %95 confidence level factor. The second order equations obtained for the entry and exit zone delamination.

Keywords: Sandwich composites, Drilling, Delamination factor, Taguchi method, Grey relational analysis.

THE EXPERIMENTAL INVESTIGATION OF WEAR MECHANISMS OF CENTRİFUGAL PUMPS (PAPER 14)

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İt was given information about the wear mechanisms which occur in centrifugal pumps in operation. A worn pump performance test was carried out in experimental studies which examined the effect of centrifugal pump wear mechanism. The experimental studies were shown that the three-element emerges abrasive wear condition of centrifugal pumps. Hard particles mixed with liquid inside, wear rings, shaft sleeve and three elements entering the region, such as was found to perform abrasive wear. It was seen to penetrate the three membered abrasive wear to shaft bushing, wear ring, and the contact surface of the wedge by the liquid which was mixed of hard particles. The extent of corrosion occurring on the pump materials depends on the hardness of the material, the amount carbon and the characteristics of particles. The particle characteristic also depends on size, shape, and the rigidity and mass. At the end of the experiment measurements, it was measured the efficiency of the original wheel and the damaged wheel. It was investigated that may be encountered due to wear ring gap and particle size

Keywords: Centrifugal pump, Corrosion Mechanism, the pump impeller, wear rings, abrasive wear, surface contact,

OPTIMIZATION OF PRODUCTION PLANNING FOR A SOCK KNITTING MACHİNE USİİNG LINEAR PROGRAMMING METHOD (PAPER 31)

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Linear Programming techniques are very useful in production planning. The aim of this study to find an optimum solution to a real case production problem by the application of a linear programming method. Due to the nature of production, static linear programming model was used. Lindo / PC 91 package program has been used to solve and active the maximum profit which has been derived the optimum production value. The result of which this study is the most useful in the market.

Keywords: Production planning, linear programming, sock knitting machine, maximization

SUSTAINABLE DESIGN APPLICATIONS USING COMPUTER-AIDED DESIGN SOFTWARE (PAPER 60)

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Sustainability is a strategic advantage, providing critical role to play in the debate ceased, it has become a real phenomenon. In fact, many corporate professionals, not to comply with the just laws of the sustainability of the company or to act in good faith, but also successful and products in order to stay in an institution who as technology and processes to make them more sustainable envisages that forces you to think again about business models. CAD softwares' Sustainability tool is fully integrated into the CAD software design environment, the four main areas (carbon footprint, total energy consumed, impacts on water and air) provides real-time feedback. In this study, sustainable companies design requirements, how and where of a product's life cycle environmental damaging effects throughout, CAD Sustainability Environment database applications and automated environmental reporting are mentioned in sustainable design process of product development practices.

Keywords: Sustainability, SolidWorks 2014, Environment and Design, Life Cycle Assessment.

THE IMPROVEMENT OF CYCLE TIME DURING WHEEL TURNING PROCESS BY TOOL PATH MODIFICATION (PAPER 27)

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Machining process is one of the main and functional process steps of wheel manufacturing and an improvement obtained in the machining cycle time directly affects the cost of the final product. This study aims to improve machining cycle time of wheel turning process by modifying the tool path. In the course of the study, the turning process on cast surface of wheels is investigated. This process was applied by tools having different tool geometries for different sections of the wheel. In this study, the process times of different tools were brought closer by the modifications of tool geometry and as a result optimized geometry of two different tools mounted on the turret resulted in the decrease in waiting time of tools. Therefore the meaningless excessive waiting times were decreased.

Keywords: Turning, Cycle Time, Al alloy wheel, Machining process.

INVESTIGATION OF EFFECTS OF CUTTING PARAMETERS IN SAWING USING ELECTRIC CURRENT HEATING (PAPER 63)

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In this study, the effects of cutting parameters were experimentally investigated in sawing using electric current heating. workpieces made in c1040 material were cut using different cutting parameters and heating currents in according with experimental plan in band sawing. Also thrust forces and main cutting forces were measured for different cutting parameters and heating currents. The effects on tool life and cutting force of cutting parameters and heating current were evaluated. It was observed that as heating current increases, tool life increases up to a optimum value, hereafter as heating current continue to increase tool life decreases

Keywords: Hot machining, Tool life, Sawing

WIRELESS MONITORING OF CUTTING TOOLS IN MILLING USING MOBILE IOT 4.0 PLATFORM (PAPER 71)

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Hard machining conditions, cutting forces that occur in the processing of excessively high cutting speeds and high metal removal rates and causes irregular tool vibrations. The resulting vibrations cutting tool breakage during processing, it may cause deterioration of the stability and quality of processing. Cutting tool vibration monitoring must be develop for stable machining strategy. Safe and more cost-effective solution for condition monitoring applications in industrial areas where wired communication is impossible the use of the use of wireless systems. Wireless condition monitoring systems to be made available in the industry, production costs, product quality, product quantity, machine tool stability, tool selection and analysis of cutting parameters will be able to make significant contributions in their fields. Internet of Things (Internet of Things, IoT), a variety of communication protocols of all the objects and detection methods to interact with defining each other through, is defined as a technology consisting of intelligent network can be the Internet.In this study a tool condition monitoring system is develop to simultaneously monitor the cutting tool vibrations in milling. The system transfers the vibration values gained through MEMs acceleration where is embedded the cutting tool. IoT 4.0 wireless tool vibration software and hardware designed for cutting tool monitoring for Mobile Platforms. Time domain and Frequency domain of cutting tool vibration can be monitored real time in a Mobile Platform. In order to detect the vibration Micro Electro Mechanical Systems (MEMS) accelerometer sensor, ZigBee technology is used for the detection of the data to be transmitted in a wireless environment. In the study developed desktop software is installed on a server. Wireless environments Simultaneously received vibration data in wireless environments, published in the internet under the IOT with these servers can be monitored on mobile platforms. Tool vibrations can be observed in the case of

the machining process can be easily passed in front of the monitoring and analysis system used by the industry in bringing the case material and financial losses.

Keywords: Machining, The MEMS Accelerometer, Zigbee, Internet of Things (IoT), Mobile Teknology.

TÜRKÇE BİLDİRİ ÖZETLERİ

ABSTRACTS OF PAPERS IN TURKISH

TOPLU TAŞIMA ARAÇLARININ DEVRİLME GÜVENLİĞİ İÇİN ECE R66 REGÜLASYONUNU SAĞLAYABİLECEK SANAL MÜHENDİSLİK KABİLİYETİ GELİŞTİRİLMESİ (PAPER 15)

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Otobüs devrilme kazaları, önden ve yandan çarpma kazalarına nazaran diğer kaza türlerine göre en önemli kaza tipidir. Avrupa ülkelerinde, otobüslerin devrilme durumundaki deformasyon dayanımını sağlamaları ECE R66 regülasyonu ile zorunlu hale getirilmiştir. Regülasyonun belirttiği üzere, sertifikasyon hem araç bazında gerçek bir devrilme testiyle hem de ileri nümerik metotlara dayanan hesaplama teknikleri ile alınabilir (örn., doğrusal olmayan eksplisit dinamik sonlu elemanlar yöntemi). Bu makalede, aynı otobüs kesitinin deformasyon karakteristikleri fiziksel devrilme testi ile bilgisayar destekli devrilme simülasyonu arasında ECE R66 regülasyonuna göre korelasyon amaçlı karşılaştırılacaktır.

Anahtar Kelimeler: ECE R66, Devrilme Güvenliği, Eksplisit Dinamik, SEM

YENİ NESİL OTOKORKULUK SİSTEMLERİNİN ÇARPIŞMA ANALİZLERİ VE SEZGİSEL OPTİMİZASYON YÖNTEMLERİ KULLANILARAK GELİŞTİRİLMESİ (PAPER 50)

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Bu çalışmada H1 koruma sınıfına sahip bir otokorkuluk sisteminin bilgisayar ortamında çarpışma testleri simüle edilmiş ve çarpışma performansını arttırmaya yönelik tasarımlar oluşturularak sonuçlar incelenmiştir. Analizler için farklı tasarım değişkenleriyle tasarlanmış 25 farklı kesite sahip dikme profili oluşturulmuş, dikme aralıkları 2.00 m alınmış ve otokorkuluk sistemleri buna göre tasarlanmıştır. EN 1317 standardında belirtilen çarpışma testlerinden TB11 ve TB42'ye göre çarpışma simülasyonları RADIOSS ile gerçekleştirilmiştir. Oluşturulan 25 farklı tasarım; ağırlık, otokorkuluk çalışma genişliği ve çarpma şiddetine (ASI) göre değerlendirilmiştir. Sezgisel optimizasyon metotlarından yerçekimsel arama algoritmasıyla en uygun tasarım elde edilmeye çalışılmıştır. Optimizasyon sonucunda çarpışma şiddeti derecesi (ASI) ve ağırlık minimum olacak şekilde bir optimum tasarım elde edilmiştir.

Anahtar Kelimeler: Çarpışma Analizi, EN1317, Optimizasyon, Otokorkuluk

YENİ NESİL YÜKSEK MUKAVEMETLİ MALZEMELERİN FARKLI GEOMETRİLERDEKİ ENERJİ YUTUCULARIN ÇARPIŞMA PERFORMANSINA ETKİSİNİN İNCELENMESİ (PAPER 51)

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Son yıllarda otomotiv endüstrisi bir yandan taşıt güvenliğini arttırmak bir yandan da yakıt tüketimini azaltmak için yoğun çaba sarf etmektedir. Bu kapsamda taşıtların hafifletilmesini sağlayacak yeni projelere önem verilmekte ve yeni malzemeler araştırılmaktadır. Yeni nesil yüksek mukavemetli çelikler sağladıkları yüksek dayanım sayesinde hem taşıt güvenliğinin arttırılmasını sağlamakta hem de geleneksel çeliklere göre daha ince sac kalınlıklarında kullanabildikleri için taşıtın hafifletilmesine katkıda bulunmaktadır. Bu çalışma kapsamında, taşıtlarda pasif güvenlik sistemi olarak kullanılan enerji yutucuların farklı geometrik kesitlerinin, geleneksel ve yeni nesil çelikler kullanılarak çarpışma analizleri yapılmıştır. Yapılan analizler sonucunda farklı malzeme türleri için enerji emilimleri ve reaksiyon kuvvetleri gibi çarpışma parametreleri karşılaştırılmıştır.

Anahtar Kelimeler: Çarpışma analizi, Enerji yutucu, Yüksek mukavemetli yeni nesil çelikler

OTOMOBİLLERDE KULLANILAN DARBE EMİCİLERİN ŞEKİLLENDİRME GEÇMİŞİ DİKKATE ALINARAK YENİ NESİL SEZGİSEL YÖNETEMLER İLE OPTİMUM TASARIMI (PAPER 61)

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Günümüzde insan sayısının artmasına bağlı olarak araç sayısındaki artış ve bunun sonucunda artması ile birlikte trafik kazalarındaki yükselen ivme, araçlarda kullanılan darbe emicilerin daha fazla geliştirilmesine yönelik yapılan çalışmalara ilgiyi artırmıştır. Darbe emicilerin geliştirilmesi için yapılan çarpışma analizlerinde, imalat sırasında oluşan incelme – kalınlaşmalar ve artık gerilmeler, sonlu elemanlar yöntemi ile yapılan çarpışma analizlerine dâhil edilmediğinde oluşturulan simülasyon eksik kalmakta ve gerçek durumu ifade etmemektedir. Bu araştırma çalışmasında otomobil ön gövdesinde kullanılan darbe emicilerin sac şekillendirme yöntemleri ile imalatında oluşan kalınlık değerinin değişimi ve oluşan artık gerilmeler dikkate alınarak çarpışma analizi sonlu elemanlar yöntemi ile yapılmış ve gerçeğe daha yakın sonuçlar elde edilmesi hedeflenmiştir. Yüklü sistem arama algoritması, yerçekimsel arama algoritması ve genetik algoritmaların kullanılması ile optimum tasarıma ulaşılması hedeflenmiştir.

Anahtar Kelimeler: : Saç metal şekillendirme, , enerji yutucusu,

YENİ NESİL SEZGİSEL ALGORİTMALAR KULLANILARAK TAŞIT ELEMANLARININ OPTİMUM TASARIMI (PAPER 62)

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Ürün tasarım adımının ürün maliyeti üzerinde doğrudan etkisi vardır. Bu nedenle, ürün tasarım sürecinde, optimum tasarımın elde edilmesi gerekmektedir. Böylece maliyetin azaltılması, kalitenin yükseltilmesi ve toplam ürün üretim zamanının azaltılması amaçlanmaktadır. Bu çalışmada taşıt sürgü kolunun optimum yapısal modelinin belirlenmesi çalışması yapılmıştır. Taşıt sürgü kolunun optimum yapısal modelinin belirlenmesi için yapılan optimizasyon çalışmasında sezgisel optimizasyon algoritmaları kullanılmıştır.

Anahtar Kelimeler: Yapısal optimizasyon, Optimum tasarım

YENİ MODEL BİR BİNEK ARACI İÇİN BAGAJ KAPAĞI AÇMA KAPAMA MEKANİZMASININ TASARIMI VE TEST SÜRECİ (PAPER 83)

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Bu çalışma yeni model bir binek aracı için bagaj kapağı açma kapama mekanizmasının tasarlanması ve testleri ile ilgilidir. Öncelikle dört çubuk mekanizması şeklinde, burulma çubuklarınca tahrik edilen bir açma-kapama mekanizması tasarlanmıştır. Daha sonra, bagaj kapağı ile birlikte prototip üretimi gerçekleştirilen mekanizma açma-kapama için gerekli el kuvvetleri ve kapağın kapanma hızının tayinine yönelik testlere tabi tutularak gerekli iyileştirmeler yapılmıştır. Tasarlanan mekanizmada kapağın ilk denge durumundan sonra açılması ve ikinci denge durumunda iken kapatılması için gerekli el kuvvetlerinin istenen değerler aralığında olduğu görülmüştür. Sonunda emsallerine göre düşük maliyetli yeni bir bagaj kapağı açma-kapama mekanizması tasarlanmış olup firmanın piyasaya sürdüğü yeni model sedan binek araçlarında kullanılmaktadır.

Anahtar kelimeler: Bagaj kapağı, açma-kapama mekanizması, burulma çubuklu mekanizma

BORAKS ve WOLLASTONITE KATKILI FREN BALATALARININ BAZI FİZİKSEL ÖZELLİKLERİNİN İNCELENMESİ (PAPER 43)

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Otomobil güvenlik sistemlerinin en önemli parçalarından biri olan fren balatalarının içeriğinde onlarca farklı toz malzeme bulunmaktadır. Fren balataları, bu malzemeler kullanılarak toz metalürjisi yöntemiyle üretilmektedirler. İdeal bir fren balatasının aşınmaya karşı dirençli olması ve yüksek bir sürtünme katsayısına sahip olması istenir. Ayrıca, fren balatalarının çevre dostu olması da önemlidir. Bu çalışmada, iki farklı doğal toz malzemesi ile (% 4.5 wollastonit ve % 7 boraks) üretilmiş asbestsiz fren balatası kullanılmıştır. Fren balataları, 24 saat suda ve yağda bekletildikten sonra balataların sertlik, yoğunluk, ağırlık ve boyutsal değişimleri incelenmiştir. Suda bekletilen numunelerde yağda bekleyenlere oranla daha fazla sertlik düşüşü gözlenmiştir. Boraks katkılı balatalar, wollastonite katkılı balatalara göre daha fazla sertlik kaybına uğramışlardır.

Anahtar Kelimeler: Fren balatası, doğal tozlar, fiziksel özellikler

AL MATRİSLİ B_4C TAKVİYELİ METAL MATRİSLİ KOMPOZİT MALZEMEYE AĞIRLIKÇA %3 İLAVE EDİLEN TAKVİYE ELEMANI GRAFİTİN AŞINMA ÜZERİNE ETKİSİNİN İNCELENMESİ (PAPER 45)

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Bu çalışmada, matris elemanı Alumix 13 olan alüminyum alaşımı içerisine ağırlıkça %8 B_4C takviye elemanı sabit tutularak ağırlıkça (% 3) Gr takviye elemanı ilave edilerek iki farklı Al/B_4C/Gr metal matrisli kompozit (MMK) malzeme, toz metalürjisi üretim yöntemlerinden sıcak presleme tekniği ile üretilmiştir. MMK malzemelerin aşınma deneyleri dört farklı yük (10, 20, 30 ve 40 N), dört farklı yol (300, 600, 900 ve 1200 m) ve sabit kayma hızı (0.8 m/sn) kullanılarak pin-on disk aşınma tezgahında ASTM:G99 a göre gerçekleştirilmiştir. Yapılan çalışmanın sonucunda, en az aşınma kaybı 10 N yük altında 300 m kayma mesafesinde B_4C içeren K_1 nolu kompozit malzemede, en fazla aşınma kaybının ise 40 N yük altında 1200 m kayma mesafesinde % 3 Gr içeren K_2 nolu kompozit malzemede oluştuğu tespit edilmiştir.

Anahtar Kelimeler: Metal Matrisli Kompozit Malzemeler, Toz Metalurjisi, Sıcak Presleme, Aşınma

TİTANYUM SAC MALZEMELERİN ŞEKİLLENDİRME SINIR DİYAGRAMLARININ DENEYSEL OLARAK BELİRLENMESİ (PAPER 57)

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Şekillendirme sınır diyagramı (ŞSD) sac metallerin şekillendirilmesinin değerlendirilmesinde kullanılan önemli bir araçtır. Bu çalışmada, ŞSD'nin elde edilme aşamaları lenmiş olup farklı kalitedeki iki farklı saf titanyum; CP2 ve CP4 sac malzemeler ile Ti-6Al-4V alaşımının şekillendirme sınır diyagramları deneysel olarak elde edilmiştir. Deneysel sonuçlardan CP2 ve CP4 titanyum sac malzemelerin oda sıcaklığında yeterli düzeyde şekillendirilebilirliğe sahip olduğu görülmüştür. Ti-6Al-4V alaşımının ise şekillendirilebilirliğinin oldukça düşük olduğu belirlenmiş olup boyun verme aşaması net olarak gözlemlenememiştir. Ayrıca oda sıcaklığında Ti-6Al-4V alaşımının ŞSD'sinin nasıl belirleneceğine yönelik yöntemler geliştirilmiştir.

Anahtar Kelimeler: CP2, CP4, Ti, Titanyum, Ti6Al4V, Ti64, ŞSD

BAĞIMSIZ ÇENELİ HİDROLİK AYNA TASARIMI VE PROTOTİP İMALATI (PAPER 23)

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Tube Laser Cutting Machine olarak isimlendirilen özel profil lazer kesim makineleri henüz ülkemizde üretilemeyen makinelerdir. Bu makinelerin hassasiyetlerini belirleyen en önemli parçaları da torna aynalarına benzeyen, kesilen parçanın bağlandığı bağımsız çeneli hidrolik bağlama aparatlarıdır. Çeneleri hidrolik olarak bağımsız şekilde kontrol edilen bu aynaların ülkemizde de imalatının tam olarak yapılabilmesi bilimsel yollarla hesaplanıp sistematik şekilde tasarlanmaları sürecinde yaşanan tecrübeler bu çalışmanın konusudur.

Anahtar Kelimeler: Hidrolik Ayna, Tasarım, Prototip İmalat

L PROFİL (KÖŞEBENT) KESME, DELME VE MARKALAMA İŞ İSTASYONU TASARIM VE İMALAT SÜRECİ (PAPER 24)

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Standart L profiller için kesme, delme ve markalama işlemlerini tek bir süreçte yapabilen özel bir makine tasarlanıp imal edilmiştir. Bu kapsamda ülkemizde ilk olarak üretilen bir makinedir. Oldukça farklı alanlarda bilgi birikimi ve uzun bir mühendislik hesap süreci gerektiren bu makinenin imalat aşamaları hazırlanan bildiride sunulmaktadır.

Anahtar Kelimeler: Köşebent, Kesme, Delme, İş İstasyonu, Tasarım, İmalat

YÜKSEK HIZLI, ESNEK 6 EKSEN CNC İŞLEME MERKEZİ PROTOTİPİ GELİŞTİRİLMESİ (PAPER 35)

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Günümüzde ülkemizin havacılık, savunma, otomotiv ve kalıpçılık sanayi hızla gelişmekte, daha karmaşık geometrili, daha büyük ebatlı, daha ağır tonajlı parçaların talaşlı üretimine yönelik ihtiyaç da her geçen gün artmaktadır. Bu artış ile birlikte havacılık, otomotiv ve kalıpçılık sektöründe karmaşık geometrilerin talaşlı imalatında çok eksenli tezgahlar kullanılmaktadır. Bu çalışmada kalıpçılık sektöründe kullanılacak olan 6 eksen yüksek hızlı CNC işleme merkezi tasarımı yapılmıştır. X, Y, Z ve Z1 doğrusal hareket, A ve B eksenleri dönme eksenleri olarak öngörülmüştür. 1500 X 1500 X 1000 mm boyutlarında çelik malzeme talaşlı imalatı yapılacak şekilde eksen hareket uzunlukları ve dönme eksenleri tasarlanmıştır. Ayrıca titreşim ve statik analiz yapılmış olup analizlerde sonlu elemanlar yöntemi ile tasarım doğrulaması yapılmıştır. 6 eksen CNC işleme merkezi imalat sürecine devam edilmektedir.

Anahtar Kelimeler : 6 eksen CNC, sonlu elemanlar analizi

PİSTONLU KOMPRESÖRLEDE HONLAMA YÖNTEMİ İLE SİLİNDİR YÜZEY PÜRÜZLÜLÜKLERİNİN DENEYSEL İNCELENMESİ (PAPER 13)

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Bu çalışmada yüzey işlem tekniklerinden biri olan honlama tekniği ile bir pistonlu kompresöre ait, silindir yüzeylerindeki yüzey hassasiyetini etkileyen parametreleri deneysel bir çalışma ile bularak, silindir honlama işlemi için ideal koşullar belirlenmeye çalışılmıştır. Yapılan deney çalışmasında honlama yöntemindeki bazı teknik parametreler; Honlama taşı, honlama sıvısı ve tezgâh ilerleme hızı değiştirilerek çoklu senaryoda silindir yüzey işlemede deney çalışması yapılmıştır. Kalibrasyonlu bir yüzey pürüzlülük ölçüm cihazıyla işlem görmüş deney silindirlerinden ölçümler alınmıştır. Elde edilen datalar yorumlanarak, pistonlu kompresör silindirlerinin honlama ile yüzey işleminde en optimum koşullar belirlenmeye çalışılmıştır.

Anahtar Kelimeler: Pistonlu kompresör, Silindir Yüzey, Honlama taşı, Honlama sıvısı, Yüzey Pürüzlülüğü,

KOMPAKT LAMİNAT KOMPOZİTİN DELİNMESİNDE YÜZEY PÜRÜZLÜLÜĞÜNÜN DEĞERLENDİRİLMESİ (PAPER 25)

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Takım aşınması işlenen parçaların yüzey kalitesini de etkilemektedir. Bu çalışmada, kompakt laminat kompozitlerin (KLK) yeni (T_1) ve aşınmış (T_2) yüksek hız çeliği (HSS) matkaplarla delinmesinde deliklerin Ra yüzey pürüzlülükleri üzerinde delme parametrelerinin etkileri araştırılmıştır. Kontrol faktörleri olarak; delme tipi (Dt), kesme hızı (Vc) ve ilerleme miktarı (f) alınmıştır. Taguchi metodu (TM) ile kontrol faktörlerinin optimum seviyeleri, varyans analizi (ANOVA) ile her bir kontrol faktörünün yüzey pürüzlülüğü üzerindeki etkileri belirlenmiştir. Her iki takımla delik delme işlemlerinde minimum yüzey pürüzlülüğü için parametrelerinin optimum seviyeleri; V:178 m/dk kesme hızı, f:0.07 mm/dev ilerleme miktarı ve kademeli delik delme olarak belirlenmiştir. T_1 takımlar T_2 takımlara göre % 75 daha iyi performans sergilemişlerdir. Bu çalışmada ayrıca, T_1 ve T_2 takımlarla delme işleminde Ra yüzey pürüzlülüğünün tahmini için Lineer Regresyon Analizi ile birinci dereceden tahminsel denklemler geliştirilmiş ve denklemlerin korelasyon katsayıları (R^2) sırasıyla 0.949 ve 0.71 olarak hesaplanmıştır.

Anahtar Kelimeler: Kompakt laminat kompozit, Yüzey Pürüzlülüğü, HSS matkap, Taguchi metodu.

SANDVİÇ KOMPOZİTLERİN DELİNMESİNDE DELAMINASYON OLUŞUMUNUN TAGUCHİ METODU VE GRİ İLİŞKİSEL ANALİZ İLE DEĞERLENDİRİLMESİ (PAPER 32)

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Bu çalışmada, sandviç kompozitlerin delinmesinde giriş ve çıkış bölgesinde oluşan delaminasyon Taguchi yöntemi ve gri ilişkisel analiz (GİA) yardımıyla değerlendirilmiştir. Deneyler 6.35 mm ve 8 mm çaplarındaki 118° ve 140° uç açılı kaplamasız karbür matkaplar ile kuru kesme şartlarında gerçekleştirilmiştir. Kontrol faktörleri olarak takım çap-uç açısı, kesme hızı ve ilerleme miktarı deneysel tasarım olarak ise L_{16} (4^1x2^2) ortogonal dizisi seçilmiştir. Giriş ve çıkış bölgesi delaminasyon faktörü (Fd) için optimum parametre kombinasyonları sırasıyla $A_2B_2C_1$ ve $A_3B_2C_1$ olarak belirlenmiştir. Ayrıca, %95 güven seviyesinde gerçekleştirilen varyans analizi (ANOVA) sonuçlarına göre delik giriş ve çıkış delaminasyon faktörü için sırasıyla %50.45 ve % 81.26 katkı oranları ile takım çap-uç açısı en etkili parametre olmuştur. Çalışma sonrasında giriş ve çıkış bölgelerindeki delaminasyon faktörü için ikinci dereceden denklemler geliştirilmiştir.

Anahtar kelimeler: Sandviç kompozitler, Delik delme, Delaminasyon faktörü, Taguchi metodu, Gri ilişkisel analiz

SANTRİFÜJ POMPALARDA AŞINMANIN PERFORMANSA ETKİSİNİN DENEYSEL İNCELENMESİ (PAPER 14)

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Çalışmada santrifüj pompalarda ortaya çıkan aşınma mekanizmaları hakkında bilgiler verildi. Deneyde aşınmış bir pompanın performans testi yapılarak aşınma mekanizmasının santrifüj pompaya etkisi incelendi Yapılan çalışmada Santrifüj pompalarda en çok üç elemanlı abrasif aşınma durumu karşımıza çıkmaktadır. Sıvı içerisine karışmış olan sert partiküller, aşınma halkası, mil burcu ve kamanın temas yüzeyi gibi bölgelere girerek üç elemanlı abrasif aşınma gerçekleştirdiği görüldü. Pompa malzemesi üzerinde gerçekleşen aşınmanın derecesi, malzemenin sertliğine, karbon miktarına ve partiküllerin karakteristiğine bağlıdır. Partikül karakteristiği ise; boyut, şekil, sertlik ve kütleye bağlıdır. Deneyde ölçümler sonunda orijinal çark ve hasarlı çark verimliliği ölçüldü. Ölçüm sonunda aşınma halkası boşluğu ve partikül boyutuna bağlı olarak karşılaşılabilecek durumlar incelendi,

Anahtar Kelimeler: Santrifüj Pompa, Aşınma Mekanizması, Pompa Çarkı, Aşınma Halkası, Abrasif Aşınma, Temas Yüzeyi,

ÜRETİM PLANLAMADA DOĞRUSAL PROGRAMLAMA MODELLERİ METODU'NUN ÇORAP ÖRME MAKİNESİ ÜZERİNDE UYGULANMASI VE OPTİMUM ÇÖZÜMÜN ELDE EDİLMESİ (PAPER 31)

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Üretim planlamada doğrusal programlama tekniklerinin kullanıldığı çalışmada üretim problemine Doğrusal Programlama yöntemi ile optimum bir çözüm bulunmuştur. Teknik, bir işletme uygulaması ile pratiğe aktarılmıştır. Uygulamada üretimin yapısı gereği, statik doğrusal programlama modeli kullanılmış ve bu model yardımı ile kârın maksimizasyonu amaçlanmıştır. Model çalışmasında Lindo / PC paket programı kullanılarak en uygun çözüm aranmış ve optimum üretim değerleri 25. iterasyon sonucunda Lindo programı ile elde edilmiştir.

Anahtar kelimeler: Üretim planlama, doğrusal programlama, çorap örme makinesi, maksimizasyon.

BİLGİSAYAR DESTEKLI TASARIM YAZILIMI İLE SÜRDÜRÜLEBİLİR TASARIM UYGULAMALARI (PAPER 60)

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Sürdürülebilirliğin stratejik avantaj sağlama konusunda oynadığı kritik rol artık bir tartışma konusu olmaktan çıkıp, gerçek bir olgu haline gelmiştir. Aslında birçok kurumsal uzman, sürdürülebilirliğin, şirketlerin sadece yasalara uyum sağlamak veya iyi niyetle hareket etmek değil, aynı zamanda başarılı ve yaşayan bir kurum olarak kalmak amacıyla ürünlerini, teknolojilerini ve süreçlerini daha sürdürülebilir hale getirecek şekilde iş modelleri hakkında tekrar düşünmeye zorladığını öngörmektedir. Bilgisayar Destekli Tasarım (BDT) Yazılımlarının sürdürülebilirlik (Sustainability) paketleri , BDT yazılımının tasarım ortamına tam entegre olduğundan, dört temel alan (karbon ayak izi, tüketilen toplam enerji, su ve hava üzerindeki etkiler) hakkında gerçek zamanlı geri bildirim sağlamaktadır. Bu çalışmada şirketler için sürdürülebilir tasarım gerekliliği, bir ürünün yaşam döngüsü süresince çevreye zarar verici etkilerinin neler olduğu, Sürdürülebilirlik Çevre Veritabanı uygulamaları ve otomatik çevre raporlarına, sürdürülebilir tasarım sürecinde ürün geliştirme uygulamalardan bahsedilmiştir.

Anahtar Kelimeler: Sürdürülebilirlik, Solidworks, Çevre, Tasarım, Yaşam Döngüsü Değerlendirmesi

JANT TORNALAMA SÜRECİNDE TAKIM YOLU DEĞİŞİKLİĞİ İLE ÇEVRİM SÜRELERİNİN İYİLEŞTİRİLMESİ (PAPER 27)

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Jant üretim süreçlerinde talaşlı imalat prosesi ana fonksiyonel işlem adımlarından birisi olup işlem sürelerinde elde edilecek iyileştirme direkt olarak nihai ürün maliyetleri üzerinde etki etmektedir. Bu çalışma jant tornalama sürecinde takım yolu değişikliği ile çevrim sürelerinin iyileştirilmesini amaçlamaktadır. Çalışma kapsamında, jant döküm yüzeyinde gerçekleştirilen tornalama işlemi ele alınmıştır. Bu işlem jant kesitinin farklı bölgelerinde farklı geometrideki takımlarla gerçekleştirilmektedir. Yapılan bu çalışmada iki ayrı tarete monte edilen takımların geometrileri üzerinde gerçekleştirilen modifikasyon sonucu elde edilen optimum geometri ile iki taretin işleme süreleri birbirine yaklaştırılmış ve dolayısıyla taretlerin boşta bekleme süreleri azaltılarak proses çevrim süresi iyileştirilmiştir. Böylece jant üzerinde katma değer yaratmayan bekleme süreleri bertaraf edilmiştir.

Anahtar Kelimeler: Tornalama, Çevrim süresi, Alüminyum alaşımlı jant, Talaşlı imalat

ELEKTRİK AKIMI KULLANARAK ISITMA İLE TESTEREDE KESMEDE KESME PARAMETRELERİNİN ETKİLERİNİN İNCELENMESİ (PAPER 63)

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Bu çalışmada elektrik akımı kullanarak ısıtma ile testerede kesme parametrelerinin kesmeye etkileri deneysel olarak incelenmiştir. Şerit testere ile Ç1040 iş malzemesi bir deneysel plana göre farklı kesme parametreleri ile kesilmiş ve takım ömürleri tayin edilmiştir. Ayrıca kesme esnasında kesme parametrelerinin ve ısıtma akımının etkisinde itme ve asıl kesme kuvvetleri ölçülmüştür. Kesme parametrelerinin ve elektrik akımının takım ömrü ve kesme kuvvetlerine etkileri değerlendirilmiştir. Akımdaki artışla bir optimum değere kadar takım ömründe artma, optimum nokta aşıldığında ömürde azalma görülmüştür.

Anahtar Kelimeler: Sıcak kesme, Takım ömrü, Testerede kesme

MOBİL IoT 4.0 PLATFORMU İLE FREZELEMEDE KABLOSUZ KESİCİ TAKIM DURUM İZLEME (PAPER 71)

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Talaşlı imalatta önemli bir alan olan frezeleme işlemleri çok yönlü bir imalat biçimi olup endüstride oldukça yaygın olarak kullanılmaktadır. Frezeleme esnasında zor parçalar işlenirken yüksek kesme hızlarında ve yüksek talaş kaldırma oranlarında oluşan kuvvetler kesici takımların aşırı şekilde düzensiz olarak titreşimine sebep olmaktadır. Oluşan titreşimler işleme esnasında kesici takımın kırılmasına, işleme kararlılığının ve kalitesinin bozulmasına sebep olabilmektedir. Kararlı bir işleme stratejisinin geliştirilebilmesi için takım titreşim durumunun izlenmesi gerekmektedir. Kablolu iletişimin kullanılmasının olanaksız olduğu endüstriyel sahalarda güvenli ve daha düşük maliyetli durum izleme uygulamaları için çözüm kablosuz sistemlerin kullanımıdır. Kablosuz durum izleme sistemlerinin endüstride kullanılabilir duruma getirilmesi, üretim maliyeti, ürün kalitesi, ürün miktarı, tezgâh kararlılığı, takım seçimi ve kesme parametrelerinin analizleri konularında önemli katkılar sağlayabilecektir. Nesnelerin İnternet'i (Internet of Things, IoT), tüm nesnelerin çeşitli haberleşme protokolleri ve algılama yöntemleri aracılığıyla tanımlanarak birbirleri ile iletişime geçebileceği, internet ortamına çıkabilecekleri akıllı ağlardan oluşan bir teknoloji olarak tanımlanmaktadır. Bu çalışmada, süper alaşım malzemelerinin çok eksenli talaşlı imalatı esnasında kesici takımda oluşan titreşimin IoT kapsamında kablosuz ortamda eş zamanlı olarak izlenmesi amaçlanmıştır. Titreşimin algılanabilmesi için Mikro Elektro Mekanik Sistem (MEMs) ivmeölçer sensör, algılanan bu verilerin kablosuz ortamda iletilebilmesi için ZigBee teknolojisi kullanılmıştır. Çalışma kapsamında geliştirilmiş masaüstü yazılım bir sunucuya kurulmuştur. Kablosuz ortamda eş zamanlı alınan titreşim verileri, bu sunucu ile IoT kapsamında internet ortamında yayınlanarak mobil platformlarda da izlenebilmektedir.

Anahtar Kelimeler: Talaşlı İmalat, MEMS ivmeölçer, Zigbee, Nesnelerin İnternet'i (IoT), Mobil Teknoloji.

Students Symposyum

(English and Turkish Abstracts of the Papers)

Öğrenci Sempozyomu

(İngilizce ve Türkçe Bildiri Özetleri)

MECHATRONIC DESIGN, MANUFACTURING AND CONTROL OF A REACTION WHEEL INVERTED PENDULUM (RWIP) SETUP

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ABSTRACT

A physical test setup for stabilization of an inverted pendulum using a reaction wheel, as a means for students to study embedded real time control of dynamic systems is developed. Reaction Wheel Inverted Pendulum (RWIP) system is considered in control systems engineering studies in many universities all around the world. In addition to academic studies, several engineering/industrial applications and products involve the underlying concepts of the RWIP system, such as inverted pendulum stabilization, attitude control using reaction wheels, and conservation of angular momentum, that can be found in missiles, satellites, flying robotic platforms, two wheeled personal transporters, etc. Mathematical model of the RWIP system is based on coupled mechanical and electrical governing differential equations that describe the system dynamics. Due to its nature, the governing equations are non-linear equations. Stabilization control of the RWIP system requires use of certain computer programs and firmwares for analysis, simulation, design, manufacturing purposes and physical realization of controller. The RWIP system needs precise manufacturing and assembly of components. The RWPI system is a mechatronic system, hence its modeling, analysis, design, manufacturing and integration requires mechatronics point of view and studies. This project is studied in MECE407/MECE408 Undergraduate Research Project I/II courses by a team of four students in the Department of Mechatronics Engineering of Atilim University and funded by LAP program of the university.

Keywords: Inverted pendulum, Reaction wheel, Stabilization control

TEPKİ TEKERLİ TERS SARKACIN MEKATRONİK TASARIMI, ÜRETİMİ VE KONTROLÜ

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ÖZET

Bu projede dinamik sistemlerin gerçek zamanlı gömülü kontrol çalışmalarına yönelik olarak, bir ters sarkacın bir tepki tekeri kullanılarak kararlı halde tutulması amacıyla fiziksel bir test düzeneği geliştirilmiştir. Tepki Tekerli Ters Sarkaç (RWIP) sistemi dünyada birçok üniversitede kontrol sistemleri mühendislik çalışmalarında ele alınmıştır. Akademik çalışmaların yanı sıra, çeşitli mühendislik/endüstri uygulamaları ve ürünleri RWIP sisteminin temel olarak dayandığı ters sarkacın kararlılığı, tepki tekerli yönelim kontrolü, açısal momentumun korunumu gibi konuları içermektedir; roketler, uydular, uçan platformlar, iki tekerlekli kişisel ulaşım araçları gibi ürünler bu konuların bulunabileceği ürünlere örneklerdir. RWIP sisteminin matematiksel modeli doğrusal olmayan, birbirleriyle etkileşimli mekanik ve elektriksel denklemlere dayanmaktadır. RWIP sisteminin kararlılık kontrolü analiz, benzetim, tasarım, üretim ve kontrolcünün fiziksel olarak gerçeklenmesi amaçlarıyla çeşitli programların ve yazılımların kullanımlarını gerektirmektedir. RWIP sistemi, alt birimlerin hassas imalatına ve montajına ihtiyaç gösterir. RWIP sistemi bir mekatronik sistemdir ve modellenmesi, analizi, tasarımı, üretimi ve entegrasyonu mekatronik bakış açısını ve çalışmalarını gerektirir. Bu proje, dört kişiden oluşan bir öğrenci grubu tarafından Atılım Üniversitesi Mekatronik Mühendisliği bölümünde MECE407/MECE408 Lisans Araştırma Projesi I/II dersleri kapsamında yapılan çalışma üniversitenin LAP programı tarafından ekonomik olarak desteklenmiştir.

Anahtar kelimeler: Ters sarkaç, Tepki tekeri, Kararlılık kontrolü

THE DESIGN OF AN INNOVATIVE LOADING AND UNLOADING MECHANISM FOR PRESS MACHINE AUTOMATION

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ABSTRACT

The mechanism designed in this project is an innovative arm-type loading and unloading system which graps the sheet metal using a vacuum system and transfers it to the transfer press via a four-bar mechanism. Loading and unloading mechanism is driven by a servomotor and a trigger belt that passes through the main arm. The main arm is attached to the transfer bar which moves centric and eccentric via a cam mechanism and follows the curve between the start and end positions. The mechanism works in two axis; the x-axis and z-axis, to take the part in or out of the press machine. Height adjustments are possible according to the height of the die.

Key Words: Loading and unloading mechanism, Pres automation

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PRES OTOMASYONU İÇİN YENİLİKÇİ BİR YÜKLEME VE BOŞALTMA MEKANİZMASI TASARIMI

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ÖZET

Bu projede tasarlanan mekanizma, ülkemizde üretimi olmayan kol tipi bir yükleme boşaltma mekanizmasıdır. Bu mekanizma, pnömatik bir sistem sayesinde hattan gelen sac metali vakum etkisiyle yakalar ve dört çubuk mekanizması mantığıyla çalışarak prese aktarır. Preslenen sac presten alınarak banta veya diğer prese aktarılır.
Mekanizma dört çubuk mekanizması mantığıyla çalışmaktadır. Tahriği servo motordan alarak kayış vasıtasıyla ana kola aktarır. Ana kolun bağlı olduğu ayrı bir taşıyıcı kol bulunmaktadır. Bu kol kam içerisinde hareket etmekte ve başlangıç ve bitiş konumları arasındaki yörüngeyi takip etmektedir. Mekanizma 2 eksende, x-ekseninde ve z-ekseninde çalışmakta; parçayı prese bırakırken veya presten alırken desteklendiği gövde içerisinde tek yönlü, z- ekseninde hareket etmektedir. Gövde içerisindeki kızaklar sayesinde pres içerisine alınan kalıbın yüksekliğine göre yükseklik ayarı yapılabilmektedir.

Anahtar Kelimeler: Yükleme-boşaltma mekanizması, Pres otomasyonu

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CHASIS DESIGN AND ANALYSIS FOR A GOLF CAR WITH SIX SEATERS

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ABSTRACT

During the last few decades, the development of computer accessories and scripts resulted for extensive involvement of computer-aided engineering methods in many industrial fields. These methods make shorten the time that is spent during designing and analysis.Hence, the designer gains flexibility throughout the design process. Using the feedback system this system provides optimization of design.

The main purpose of this study is design and analysis a chassis that use commonly.In this study, a six-seater golf chassis has been designed and analyzed for a static situation. Computer aided design and computer aided analysis methods used for to do it. The data that obtained has been presented comparatively.

Keywords: Chasis design, Golf car

ALTI KİŞİLİK BİR GOLF ARABASININ ŞASİ TASARIMI VE ANALİZİ

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ÖZET

Son yıllarda bilgisayar destekli mühendislik yöntemleri, bilgisayar donanımlarındaki ve mühendislik yazılımlarının her açıdan gelişimiyle sanayiinin pek çok dalında geniş yer tutmaya başlamıştır. Bu yöntemler tasarım ve analiz aşamasında harcanan zamanı kısaltmakta, tasarım parametrelerinin hızlı bir şekilde değiştirilmesini ve kontrolünü sağlamakta, tasarımcıya her açıdan esneklik kazandırmaktadır. Yapılan çalışmalar yardımıyla tasarım optimize edilerek daha da verimli şekilde çalışması sağlanabilir.

Bu çalışmanın ana amacı, kullanılan bir aracın şasisinin ele alınıp bütün aşamalarıyla bilgisayar desteğiyle modellenmesi ve analizi olarak açıklanabilir. Bu çalışmada altı kişilik ve iki insan ağırlığında yük taşıyabilecek bir golf arabasının şasisi bilgisayar destekli tasarım ile oluşturulmuş ve bilgisayar destekli analiz ile statik analizi yapılmıştır. Elde edilen sayısal sonuçlar bu çalışmada karşılaştırmalı olarak sunulmuştur.

Anahtar Kelimeler: Golf arabası, Şasi tasarımı ve analizi

.

SPIDER ROBOT DESIGN AND PROTOTYPE PRODUCTION FOR LASER MARKING

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ABSTRACT

In this project, it is aimed to draw a desired pattern or to write a text on the surface of various materials by a spider robot with laser marking. The prototype produced for this purpose will process the patterns prepared on computer according to the desired coordinates using a diode laser on and checked instantly by CNC logic. All over world, there are many machines or robots have different designs used for this kind of laser marking. However, in literature studies, there was no similar to the prototype planned to produce in this project.

Keywords: Laser marking, Spider robot

LAZERLE MARKALAMA İÇİN ROBOT ÖRÜMCEK TASARIMI VE PROTOTİP ÜRETİMİ

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ÖZET

Bu projede tasarlanacak lazerle markalama becerisine sahip robot örümcek ile birçok malzemenin yüzeyine istenilen desenin çizdirilmesi amaçlanmaktadır. Bu amaçla tasarlanan ve üretimi yapılan prototip, üzerinde bulunan diyot lazeri kullanarak, CNC mantığı ile anlık kontrol edilerek, bilgisayar ortamında hazırlanmış desen, motif veya yazıyı iş parçası üzerindeki verilen herhangi bir koordinata işleyecektir. Tüm dünyada bu tür markalama amaçlı kullanılan, farklı tasarımlara sahip lazer markalama makinaları/robotları bulunmaktadır. Ancak, yapılan literatür araştırmalarında projemizde üretimi planlanan prototipin bir benzerine rastlanmamıştır.

Anahtar Kelimeler: Lazerle markalama, Robot örümcek

.

LABORATORY BUILT DC MAGNETRON SPUTTERING MACHINE

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ABSTRACT

In this project, our aim was to design a coating machine based on the DC Magnetron sputtering process. Once attaining the vacuum, plasma was generated inside the sealed chamber where the substrate and the target material were located. Atoms separated from the target plate with the help of the ion plasma and the magnetic area were deposited and accumulated on the surface of the substrate by physisorption. The advantage of this coating technique is its high quality surfaces whose thickness can be controlled easily and have a relatively homogenous chemical composition. This project is made in Manufacturing processes laboratories of Manufacturing Engineering Department, Atılım University as part of the capstone graduation Project.

Keywords: Magnetron sputtering, Coating**,** Homogenous surface

LABORATUVARDA GELİŞTİRİLEN DC MAGNETRON SAÇTIRMA CİHAZI

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ÖZET

Bu projede DC Magnetron saçtırma yöntemine dayalı bir kaplama cihazı tasarlanması hedeflenmektedir. Söz konusu cihaz, bir vakum haznesi içinde oluşturulan plazma ve manyetik alan yardımıyla hedef plakadan kopartılan atomların alttaş malzemenin yüzeyine yapışmasını sağlayarak kaplama işlemini yapmaktadır. Bu kaplama tekniğinin en önemli avantajı, kalınlığı kontrol edilebilen ve kimyasal kompozisyonu oldukça homojen yüksek kaliteli yüzeyler oluşturabilmesidir. Projenin tasarımı bitirme projesi kapsamında Atılım Üniversitesi İmalat Mühendisliği laboratuvarında yapılmıştır.

Anahtar Kelimeler: Magnetron saçtırma, Kaplama, Homojen yüzey

MULTI PURPOSE, ENVIRONMENT ORIENTED HYBRID UNDERWATER VEHICLE DESIGN & HYDRODYNAMIC ANALYSIS

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ABSTRACT

An unmanned, initially remotely controlled, multi-purpose and functional underwater vehicle is designed and initiated. It is aimed to include BLDC propeller thrusters for maneuvering; camera for observation; temperature, pressure, sonar(for communication especially), bio and material sensors for main tasks to be completed. Designed ROV is agile and speedy to perform exploration and observation tasks for underwater environment especially for places cannot be explored by human easily such as underwater caves. It is aimed to do underwater mapping, data and bio&inorganic sample acquisition and most importantly to develop sensors, tools and swarm algorithms in order to clean underwater impurities such as heavy metals after modular and efficient vehicle design is completed. In general, such vehicles are either work class or exploration class and work class ones are very cumbersome to move and explore whereas explorer ones are not able to use tools to do some work. In this design to acomplish aims explained It wanted to combine both of those capabilities. And, during the design process researches about mechanical design, manufacturing of underwater structures, materials, thrust, flow hydrodynamics, communications and sensors are conducted; mathematical models are developed and checked with experimentation.

Keywords: ROV, Underwater vehicles, Mechanical design, Control, Robotics

ÇOK AMAÇLI, ÇEVRE KORUMA ODAKLI, HİBRİT SU ALTI ARACI TASARIMI VE HİDRODİNAMİK ANALİZİ

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ÖZET

Uzaktan kontrollü, çok amaçlı ve çoğul fonksiyonlu bir insansız su altı aracı tasarlanmış, analizleri yapılmış ve üretimi sürdürülmektedir. Fırçasız DC motorlar ve gerekli sızdırmazlık ekipmanları ile iticiler, manevra kabiliyetini sağlama üzere tasarlanmış, gözlem için kamera sistemi kurulmuş; sıcaklık, basınç ve derinlik gibi ölçümlerin alınması için sensör düzenekleri hazırlanmış ve, biyolojik örnekler alınması ve ağır metallerin toplanması ve tespit edilmesi için düzenekler üzerine çalışılmaktadır. Çalışmada, Dünya'daki örneklerin aksine, hem işçi sınıfı hem de gözlem sınıfı su altı araçlarının kabiliyetleri birleştirilmeye çalışılmış ve etkili bir gözlem ve iş kabiliyetini bir arada bulunduran bir araç tasarımı gerçeklenmeye çalışılmıştır. Böylelikle, insanların giremediği su altı bölgelerine girişler yapılabilecek, gerekli çalışmalar araçlar tarafından sürdürülebilecek ve bu çalışmalar yeterli hızda ve geniş bölgelerde kısa sürede gerçekleştirilebilecektir. Genel olarak, su altı haritalandırılması, inorganik ve organik örnekler toplama, veri toplama gibi çalışmalar hedeflenmekte ve gelecekte bunların robot sürüleri ile yapılması hedeflenmektedir. Tasarım ve üretim süreci boyunca öğrenci grubu tarafından hidrodinamik, plastik üretimi, elektronik, kontrol ve iletişim gibi konularda araştırmalar, deneyler ve gözlemler de gerçekleştirilmiştir. Bunlar yapılırken, kullanıcılara kolay bir arayüz sağlanması da hedeflenmiştir.

Anahtar Kelimeler: İnsansız su altı aracı, Hidrodinamik, Robotik, Tasarım, Kontrol

THE COMPANION

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ABSTRACT

Moving around in an airport with your luggage is sometimes a though job. It becomes annoying when one have to show boarding pass or ID. In modern world, everything around us gets smarter day by day. We decided to make our luggage smarter too so that it follows us wherever we go. Our goal was to produce a follower robot type cabin luggage but once the weight restrictions of airline companies and airport security rules are considered, we found out it is not feasible to build a robot like this. As a result, we decided to broaden our aim and produce a package carrier follower robot which will be used not only at airports but also at supermarkets and depots. To increase mobility and mimic the human movement, mecanum wheels are used in this package carrier. With the help of the mecanum wheels, The Companion will be able to follow its user in places like airports and supermarkets, and help you to carry your packages at every step. Once the first part of the The Companion is finished, special features such as built-in scale, mobile device charger and autonomous driving may be added for specific areas of useage.

Keywords: Follower robot, Package carrier, Mecanum, Airport

REFAKATÇİ (THE COMPANION)

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ÖZET

Havaalanlarında bavullarla hareket etmek zorlu bir iştir. Özellikle biletinizi veya kimliğinizi göstermeniz gerektiği anlarda bir de bavulunuzla uğraşmak can sıkıcı olur. Bu yüzden her şeyin akıllı hale geldiği bir zamanda neden bagajlarımız da akıllı hale gelmesin diye yola çıktık. Havaalanları gibi yerlerde çantalarımız bizi takip etsin diye The Companion projesini kurduk. Hedefimiz, insan yürüşüne olabildiğince uyum gösteren, kullanıcısını takip eden bir kabin boy valiz yapmaktı. Ancak projeyle ilgili araştırma yaptıkça bu hedefimizin hem hava yollarının ağırlık sınırları yüzünden, hem de güvenlik kuralları yüzünden gerçekçi olmadığını gördük. Bunun üstüne proje kapsamımızı büyüterek sadece havaalanlarında değil, marketler ve depolar gibi yerlerde de yüklerimizi taşıyabilecek bir takipçi robot yapmaya karar verdik. Takip sisteminde insan hareketine olabildiğince yakalaşabilmek için mecanum tekerlekler kullanıyoruz. Mecanum tekerlekler sayesinde aracımız yüksek hareket kabileyetine ulaşacak, günlük hayatta pek çok yerde yüklerinizi taşıyıp size yol arkadaşı olacak. Temel bir platform özelliği taşıyacak The Companion, projenin ilk aşaması tamamlandıktan sonra kullanım alanına göre tartı, mobil aletleri şarj etme, otonom sürüş gibi ek özellikler kazanacak.

Anahtar Kelimeler: Takipçi Robot, Yük Taşıma, Mecanum, Havaalanı

CARDBOARD BICYCLE

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ABSTRACT

In this research project, an eco-friendly, low cost green bicycle made out of 80% by volume recycled materials which have enough commercial life span was built. Cardboard and knitted hemp together with epoxy resin were used as the main material combinations throughout the bicycle body. In the main body of the bicycle, tubular cardboards while in the wheels corrugated cardboards adhered to each other by wood glue are used and eventually they were embedded in the epoxy resin. Sack cloths made out of hemp was selected as joining components for tubular cardboards. Finally, the stress distribution of the main body was analyzed by commercially available software according to the material properties obtained from mechanical tests.

Keywords: Cardboard bicycle, composite material, eco-friendly, natural

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ÖZET

Bu çalışmada, hacimsel olarak %80 geri dönüştürülmüş malzemeler kullanılarak ucuz maliyetli ve yeterli bir ticari ömre sahip, hafif ve ekolojik bir bisiklet yapılması amaçlanmıştır. Bu amaçla, karton ve örülmüş kendir lifleri epoksi ile birlikte kullanılmıştır. Bisikletin ana gövdesi masura ve epoksi, tekerlekler ise tutkal ile bir araya getirilmiş oluklu mukavva ve epoksiden oluşmuştur. Kenevir liflerinden örülmüş çuval bezleri, masuraları birleştirmek için kullanılmıştır. Son olarak, mekanik testlerden elde edilen veriler, uygun bir yazılıma aktarılarak, ana gövde üzerindeki kuvvet dağılımının analizi yapılmıştır.

Anahtar Kelimeler: Karton bisiklet, kompozit malzeme, çevre dostu, doğal

DESIGN MANUFACTURING AND TESTING OF AN APPARATUS FOR LASER MICROLITHOGRAPHY

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ABSTRACT

Microlithography is a laser optical coating method, which is used to manufacture several integrated circuits, microelectronic devices, micro-fluidic channels or chips. Micro-laser lithography system is a new way that allows manufacturers to create and guide a new platform of systems. New developments in lithography technology contribute on integrated circuits (IC) and micro electro mechanics systems (MEMS). In this study, an experimental microlithography system that has a laser, which allows lithography without the masking requirement, has been developed. This work is tested by means of methods and the most efficient analysis platform. Mechanical control could be done by the LABVIEW code and in the movement of the motors the position is controlled through the code. Without masking technology, our system allows people to get better and concrete results.

Keywords: Laser, Microlitgraphy

LAZER MIKROLITOGRAFI AMAÇLI BİR CİHAZIN TASARIMI İMALATI VE TEST EDİLMESİ

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ÖZET

Mikrolitografi, lazer kullanılarak yapılan optik bir kaplama metodudur. Bu yöntem birçok entegre devrenin, mikroelektronik cihazların, mikro-akışkan kanallarının ya da çiplerin yapılmasında etkin olarak kullanılmaktadır. Litografi teknolojisindeki yeni gelişmeler entegre devrelerin ve mikro elektro mekanik sistemlerin de gelişmesinde rol oynamaktadır. Bu çalışmada lazer kullanan deneysel bir mikrolitografi cihazı geliştirilmiştir. Bu sistem maskeleme uygulamadan kullanıma uygundur. Bu çalışmada geliştirilen sistem gelişmiş analiz yöntem ve platformları ile test edilmiştir. Mekanik kontrol bir LABVIEW kodu ile gerçekleştirilmektedir ve motorların pozisyonu bu kod ile kontrol edilmektedir. Geliştirilen sistem maskeleme uygulaması olmadığından dolayı daha iyi ve olumlu sonuçlar vermektedir.

Keywords: Lazer, Mikrolitgrafi

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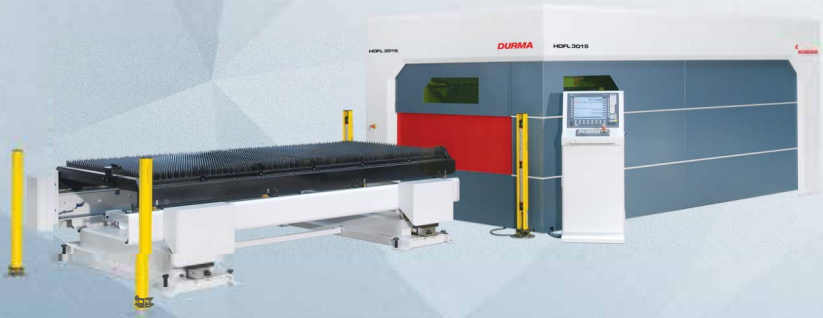

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