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SYMP_17: MECHATRONICS DESIGN: APPLICATIONS AND CASE STUDIES

Coordinators(*): Luís F. Silva (U.Minho, Portugal), Eurico Seabra (U.Minho, Portugal), Hélder Carvalho (U.Minho, Portugal) and Gilberto Santos (College of Design Polytechnic Institute Cávado Ave, Portugal)

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Coordinators(*): Teresa Morgado (FCT/UNL, Portugal), Carla Machado (FCT/UNL, Portugal), Pamies Teixeira (FCT/UNL, Portugal) and Telmo Santos (FCT/UNL, Portugal)

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DESIGN AND DEVELOPMENT OF MECHATRONIC SYSTEMS AT UMINHO: A REVIEW OF SOME CASE STUDIES

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ABSTRACT

Mechatronics is an interdisciplinary area of engineering that combines mechanical engineering, electrical engineering and information technology. The development methodology for mechatronic systems supports the creation of innovative solutions, improving the reliability and ability of products and reducing their costs. This study reviews some projects (as case studies) that were undertaken by the authors in the area of mechatronics applied to the mechanical, textile, biotechnology and biomedical fields.

Keywords: mechatronics design, industrial solutions, case studies.

INTRODUCTION

The VDI 2206 (2004) proposes a practical guideline for the systematic development of mechatronic systems. The innovation potential of the technologies and the functional and spatial integration of the technologies represent a major benefit potential of mechatronics. The following case studies were undertaken by the authors under the scope of national Portuguese financed R&D projects, which enabled the design and development of innovative devices and equipments, within a mechatronics framework, capable to meet the initial needs and requirements.

DESIGN OF DIFFERENT MECHATRONIC SOLUTIONS

New alternative mechanisms for controlling the feeding systems of industrial sewing machines - The sewing process has been studied at the University of Minho since the early 1990's, involving research staff from the departments of Textile, Mechanical and Electronics Engineering. Several "sewability" testers designed and developed specifically for this purpose were used, where the performance of needles, presser feet, feed dogs, fabrics and sewing threads could be assessed during high speed sewing. These analyses led to a better scientific understanding of the sewing process and enabled the design of new monitoring, actuation and control systems. One of these devices was implemented to the presser foot bar of an overlock sewing machine to improve the performance of the fabric feeding system (Carvalho, 2012).

Evaluation of the mechanical system to produce file cutting edges in an industrial machine - This project involved a well-known company in the area of files production and it enabled the study of the whole mechanical system and the redesign of the cam-follower mechanism (that produces the alternative motion of the cutting tool to generate the file cutting edges) using an adequate measurement system and specific actuation devices to ease the setup of the

production machine and to provide a good operating performance (Seabra, 2012).

Friction testing devices - The first one of these devices is the FRICTORQ®, a laboratory equipment developed to measure the friction coefficient in fabrics and other non rigid materials, also enabling a quantitative assessment of touch/handle. This device is protected by the Portuguese Patent Nº. 102790 and it has a working principle based on a rotary action, measuring, therefore, the reactive torque generated by the drag between two bodies in relative motions (Vasconcelos, 2013). The second one is a linear testing device, which can measure surface roughness of the tested samples using a laser triangulation sensor.

System and method for on-line monitoring of beer primary fermentation based on UV-VISSWNIR spectroscopy - This project gathered R&D staff from the largest beverages company in Portugal and the departments of Biological and Mechanical Engineering from the University of Minho. It is based on UV-VIS-SWNIR spectroscopy and it includes a fiber-optic probe and a universal probe adaptor specially designed for industrial fermenters; a mini-spectrometer; a software specially developed for multivariate calculation of fermentation parameters, and a graphical interface (Rodrigues, 2013).

Medical devices for wrist rehabilitation - An ongoing project directed to the design and development of specific devices to carry out the rehabilitation of the wrist. A new type of Powerball® device has already been developed, which includes sensors, a data acquisition board and a human-machine interface to control the rehabilitation process. Presently, a new active and passive device is being designed, which can be coupled to a stabilization system to ease the passive rehabilitation of the wrist at an initial stage of rehabilitation (Seabra, 2013).

FINAL REMARKS

This abstract briefly reviewed the solutions achieved by the cross-domain cooperation for the development of mechatronic solutions. For the sake of completeness, the involved phases, the developments undertaken, the tests and the final obtained outcomes for each one of these projects will be detailed in the full paper and presentation.

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