Defence Science Journal, Vol. 61, No. 4, July 2011, pp. 287-288, DOI: 10.14429/dsj.61.1122

Guest Editorial

SPECIAL ISSUE ON AEROSPACE AVIONICS AND ALLIED TECHNOLOGIES

Avionics is a very crucial and important technology, not only for civil/military aircraft but also for missiles, spacecraft, micro air vehicles (MAVs) and unmanned aerial vehicles (UAVs). Even for ground-based vehicles and underwater vehicles (UWVs), avionics is a very important segment of their successful operation and mission accomplishment.

The advances in many related and supporting technologies, especially digital electronics, embedded systems, embedded algorithms/software, mobile technology, sensors and instrumentation, computer (network)-communication, and real-time operations and simulation, have given a great impetus to the field of avionics. Here, for the sake of encompassing many other applications as mentioned above, the term is used in an expanded sense: Aerospace Avionics (AA), although it is popularly known as Aviation Electronics (or Avionics). However, use of this technology is not limited to aircraft, and hence, we can incorporate all the three types–ground, land, and underwater vehicles–under the term avionics.

In particular, the R & D and technological issues in the context of Aerospace Avionics would be : Aircraft-, spacecraft-, and rockets- digital electronics, embedded systems and software, real-time (onboard) computational algorithms, aircraft electrical/electronic systems, radiowave communications/wave guides, antennas, transmitters, radomes, voice communications, aircraft/underwater instrumentation, sensors/navigation sensors, audio and switching systems, multi-function displays, electronic control systems, flight/cockpit management systems, ground/underwater electronics, mathematical modelling certain avionics sub-systems, hardware/software architectures, use of artificial Intelligence (AI-neural networks, fuzzy logic, and genetic algorithms) wherever feasible in the design/development, environmental and new testing facilities, testing procedures, and testing software for avionics. The dynamic systems (platforms) normally considered would be: aircraft, spacecraft, missiles, autonomous systems, mobile/fixed systems, mini-/micro air vehicles (MAVs), and underwater- and ground-based systems, and surveillance systems.

In this special issue, on the whole, there has been a fair representation of various aspects and current issues related to the Aerospace Avionics and Allied Technologies spread over a number of review/research papers.

In the first paper, the authors Ananda, and co-authors review the avionics for general aviation light transport aircraft and provide an insight into the avionics systems, integration and related technologies. In fact, the avionics of current-day aviation systems is influenced by the advancement of several related technologies. The avionics industry has moved rapidly towards the integrated architecture called Integrated Modular Avionics, and hence, the paper presents typical light transport aircraft avionics architecture, integration and testing methods, test facilities and supporting instruments along with advanced technology for application development. The paper also includes a discussion on new technology, merits and de-merits along with relevant global awareness of the systems being adopted.

Lingaraju and co-authors in the paper titled, 'Real-time Interactive Steerable Scientific Visualisation of Free Surface Flow in the Context of Synthetic Vision' review the existing techniques in the context of fluid modelling and simulation. They have also developed generic framework that would enable an easy integration of various modules with the aim of extending the work to real-time simulation and visualisation. They demonstrated the concept of real-time interactive scientific visualisation with a surface flow application. The authors state and expect that the presented–generic framework, device, interface, and simulation engine (used in this work) will have a significant impact in the area of free surface flow specifically, and in real-time applications such as synthetic vision in avionics, in particular.

In the review-cum-research paper titled, 'Predicting Software Faults in Large Space Systems using Machine Learning Techniques', Twala shows how maximum likelihood techniques (or classifiers) can be used to predict software faults in space systems including many aerospace systems. The author shows, using benchmarking results of four NASA datasets, that the Naive Bayes classifier is more robust to software fault prediction. Based on the study, the author has concluded that the most ensembles with a decision tree classifier as one of its component, achieve higher accuracy rates.

Mr Narendar in the paper titled, 'Mathematical Modelling of Rotating Single-walled Carbon Nanotubes used in Nanoscale Rotational Actuators' presents the ideas of modelling using the non-local/non-classical continuum mechanics. The spectrum and dispersion curves were obtained as a function of rotating speed as well as non-local scaling parameter. The author shows that the dispersive flexural wave tends to behave non-dispersively at very high rotation speeds and presents the numerical-simulation results for a rotating single-walled carbon nanotube as a waveguide.

In the paper titled, 'Algorithm for Suppression of Wideband Probing in Adaptive Array with Multiple Desired Signals' by Singh and Jha, the weight estimation for the multiple desired signal environments has been carried out using a modified variant of the improved LMS (least means square) algorithm. The modified method suppresses the narrowband/wideband probing towards the antenna array. The simulation results were used by the authors to demonstrate the efficacy of

this novel algorithm in active cancellation of narrowband/ wideband probing sources and yet the simultaneous maintaining of multiple signals in intended directions. The authors opined that the performance of the proposed algorithm was better than those of standard and recursive LMS algorithms.

In the paper titled, 'Underwater Navigation using Pseudolite', Tiwary and co-authors have proposed a technology for ground and space applications for the augmentation of GPS using pseudolite or pseudo satellite to obtain underwater navigation. They have also proposed the hardware configuration for pseudolite trans-receiver for making the self-calibrated array. They stated that the pseudolite array would give position fixing similar to that given by GPS for underwater applications.

Gupta, and co-authors in the paper, 'Design/Development of Mini/Micro Air Vehicles through Modelling and Simulation: Case of an Autonomous Quadrotor' present a systematic approach and have constructed a fairly detailed model. They carried out numerical simulation studies with a view to retuning the baseline design, building a controller, as well as testing the flying qualities of the vehicle for which a ground-based flight simulator can be used. Thus, a smooth transition to rig and flight testing can be enabled in a cost-time effective manner to meet all the design requirements for MAVs.

In the paper titled, 'Sliding-mode Controller with Multisensor Data Fusion for Piezo-actuated Structure', the authors' goal is to bring out the benefits of multisensor data fusion in the considered application. The vibrating modes of the smart cantilever beam were measured by two sensors and the states were estimated using information filter. These states were then fused and applied as input to the controller. The controller has been designed using the linear dynamic model of a piezo-actuated beam. The mathematical model is identified using Recursive Least Square method. A digital control system that consists of virtual instrumentation software (LabVIEW and USB data acquisition module NI 6008) was used for simulation and real-time control. The authors have reported the improved closed-loop performance when the controller used fused data, compared to when only a single sensor was used. The authors state that the beam structure used in this work is a pilot model of the structures used in aerospace applications. The experimental results presented here show the benefits of data fusion in controlling the vibration modes, and the necessary electronics required for this implementation can be easily facilitated by HW/ SW used for this work. Thus, the results are considered useful for an aerospace avionics application.

In the paper, 'High Performance Interconnection Technology in Avionics', Raghunath and co-authors have discussed various aspects of laminates and the current developments facilitating the designers in selecting appropriate laminate systems for avionics sub-systems. In this direction, enormous efforts have been focused in the avionics industry on the development of the system-on-chip (SOC).

George and Gupta in their paper titled, 'Viscous Shock Layer Method to Predict Communication Blackout during Re-entry Phase' predict the electron density, and thereby, the plasma frequency for various configurations. They have successfully implemented the method for analytic and non-analytic geometry configurations. They have shown that the electron densities computed for the RAM-C configuration agree well with the flight-test results. They also predicted the onset of blackout during the re-entry phase using the proposed method and show that the proposed method performs well at higher altitudes, where non-equilibrium conditions prevail.

The Guest Editors are grateful to all the expert reviewers for their time and efforts and for providing valuable comments for improving the papers. They are also grateful to all the authors for their valuable contributions covering various facets of this very important technology.

The Guest Editors are also grateful to the Director, who is also the Editor-in-Chief and the Editorial Team of *Defence Science Journal* for their untiring efforts in bringing out this special issue.

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