

# Preface

The 2017 CEAS (Council of European Aerospace Societies) Specialist Conference on Guidance, Navigation and Control (CEAS EuroGNC) was organized together by Warsaw University of Technology (WUT), the largest technical university in Poland and the Rzeszów University of Technology (RzUT), an important centre in aviation. The EuroGNC Conference was held on 25–27 April 2017. It was chaired by Robert Głębocki, from the Faculty of Power and Aeronautical Engineering (WUT), Faculty which has a long history in aerospace engineering and providing important contribution to the aviation development in Poland. The EuroGNC Conference was co-chaired by the Bogusław Dołęga, On behalf of the RzUT, from faculty of Mechanical Engineering and Aeronautics (RzUT), faculty which achieved the status of an Advanced Technology Centre within the AERONET Aviation Valley. The International Program Committee, that gathered over 40 finest scientists and researchers from all over the world, put an effort and commitment leading the preparation of the Conference to the success.

The CEAS EuroGNC 2017 Conference aims to promote scientific and technical excellence in the fields of Guidance, Navigation and Control (GNC) in aerospace and other fields of technology. The Conference joins together the industry with the academia research. It creates an opportunity for better understanding the incoming challenges in the development of novel GNC methods, applications and technologies. Submitted papers were carefully reviewed, and the best 40 were selected to be published in this monograph. The book covers four main topics: Guidance and Control, Control Theory Application, Navigation, UAV Control and Dynamic. The papers included focus on the most advanced and actual topics in guidance, navigation and control research areas.

In aviation, the mission diversity constantly changes that consequently extorts new problems in terms of control and dynamics. As an alternative to satellites, the High Altitude Long Endurance (HALE) aircraft needs to cope with set of specific problems. A new flight path control laws for a multi-body aircraft was implemented to perform a one-year mission. A new design method and structure for the inner-loop was applied; the  $H_\infty$  loop shaping in the frequency domain was successfully used.

Development of optimization and control laws design methods resulted in a new workflow for the clearance of flight control laws with continuous control or disturbance inputs using Optimal Control Theory and Post-optimal Sensitivity Analysis.

The sensors integration and the data fusion is still a challenge in navigation. The optimal performance of the conventional Kalman filters is deteriorated if there is uncertainty in the process and measurement noise covariance. To reduce this effect, a Fuzzy Adaptive Iterated Extended Kalman Filter (FAIEKF) and Fuzzy Adaptive Unscented Kalman Filter (FAUKF) were developed to overcome this issue. The UAV domain is growing extremely fast, and many challenges that already solved in aviation become still a challenge due to the complexity and variety of the platforms. The increasing availability and affordability of the UAVs platforms allowed to perform a new set of various missions that demand new control laws, techniques and have to cope with different navigation problems. One of the emerging challenges is to manage number of UAVs performing common mission in an efficient and safe manner. The modified sequential greedy algorithm was proposed to enhance the efficiency of task allocation for cooperative parcel delivery problem of multiple unmanned aerial vehicles (UAVs). The other significant UAV aspect is safety which has an important role in aviation in general. Generally, UAVs have not reached sufficient level of integrity to be implemented in the civil airspace. The reconfigurable method for UAV platform was developed to obtain performances of a damaged aircraft as close as possible to an undamaged one using advanced algorithms.

The CAES EuroGNC 2017 Conference would not be a success if not a strong support of many people. On behalf of National Organizing Committee, we would like to thank to all contributors to the conference, especially to the Warsaw University of Technology, Faculty of Power and Aeronautical Engineering, the Institute of Aeronautics and Applied Mechanics, International Committee, American Institute of Aeronautics and Astronautics (AIAA), and to the all reviewers of technical papers.

We hope that this book will help the reader to understand the most advanced and emerging challenges in Guidance, Navigation and Control domain.

Warsaw, Poland  
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Robert Głębocki  
Bogusław Dołęga

Advances in Aerospace Guidance, Navigation and  
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