

Nell'ambito delle attività culturali del Corso di dottorato in Ingegneria Aerospaziale, vi invito cordialmente al seminario

NextGen Unmanned Aviation: Challenges and Opportunities

Dr. Kimon P. Valavanis, John Evans Professor

Director, Research and Innovation, and, DU Unmanned Systems Research Institute

D. F. Ritchie School of Engineering and Computer Science

University of Denver, Denver, CO 80208

kimon.valavanis@du.edu

ABSTRACT. The seminar presents a summary of on-going research activities in robotics and automation and unmanned systems in DU²SRI. Emphasis is given to UGV and UAV design, modeling, sensor-based navigation/control, formation control, integrated control and diagnostics, flight control systems that are agnostic to the specific vehicle, as well as custom-designed and custom-built UGV-landing platform-UAV ensembles that function in unison as autonomous systems (operating in dynamic and uncertain environments) – UAVs may takeoff from, land on and recharge on the landing platform. Then, the focus shifts to addressing specifics of ongoing challenging problems, all related to *NextGen* unmanned robotic systems: i.) *Control of families of nonlinear systems with unstructured uncertainties*. For systems with unstructured uncertainties and time-varying characteristics, navigation/controller design is based on a family of admissible models with unknown uncertainty bounds. As such, a robust nonlinear controller is presented that consists of a dynamic inversion inner-loop and a μ -synthesis outer-loop controller that is suitable for such systems. A design application is demonstrated using fixed-wing aircraft. ii.) *Multi-rotor systems flying in restricted areas or confined spaces*. When designing/using multi-rotor UAVs for infrastructure monitoring, inspection and support, it is crucial to understand and overcome limitations related to ground, ceiling and wall effects. The widely-used Cheeseman-Bennett model for conventional helicopters may not be sufficient in such cases. Thus, through exhaustive experimental studies, a modified parametric relation is introduced to account for confined space effects, demonstrated and implemented on quadrotors. iii.) *Autonomous UGV-UAV ensembles*. Two completely functional ensembles are presented that consist of a custom built autonomous UGV serving also as landing platform for helicopters and multi-rotors. Vision-based landing is demonstrated. Platform leveling within 1° of the horizon is shown while the base platform navigates through rough and uneven terrains. The seminar concludes with a brief report on joint PoliTo (DIMEAS)–DU ongoing research projects.

BIO. Kimon P. Valavanis is John Evans Professor and Director, Research and Innovation, Ritchie School of Engineering and Computer Science, University of Denver, and Director of the Unmanned Systems Research Institute. After serving as Editor-in-Chief of the IEEE Robotics and Automation Magazine for 10 years, since 2006 he is Editor-in-Chief of the Journal of Intelligent and Robotic Systems. He is also Founder of the ICUAS Association that organizes the annual International Conference on Unmanned Aircraft Systems (ICUAS). His research spans unmanned systems with focus on design, and integrated control and diagnostics, as well as integration of unmanned aviation into the national airspace system. He has graduated 35 PhD students and more than 100 M.Sc. students, and has received close to \$50 M in research funds from Federal/State agencies, industry and the private sector. He has published more than 400 book chapters, technical journal/transaction, referred conference papers, invited papers and technical reports, including authoring / editing 19 books. Valavanis serves as co-chair/chair of the Aerial Robotics and Unmanned Aerial Vehicles Technical Committee since 2008. He is Fellow of the American Association for the Advancement of Science, Fellow of the U.K Institute of Measurement and Control, Senior Member of IEEE and Fulbright Scholar.

Il Seminario si terrà presso la **Sala Riunioni (terzo piano DIMEAS)** a partire dalle ore **14:30** di **giovedì 7 Febbraio 2019**. Tutti gli interessati sono cordialmente invitati a intervenire.

Per informazioni, contattare Giorgio Guglieri giorgio.guglieri@polito.it

Il Coordinatore
(Marco Gherlone)