BIO-INSPIRED MINIATURIZED AERIAL VEHICLES

Juan Antonio Escareno,
Associate Professor, Institut Polytechnique de Sciences Avancées, Ivry-sur-Seine France
Thibaut Raharijaona,
Associate Professor, ISM Marseille, Marseille France
Dr. Jonatan-Uziel Alvarez,
Laboratoire des Systèmes Aériens Autonomes Institut Polytechnique des Sciences Avancées, France
Micky Rakotondrabe,
Associate Professor with HDR, Univ. Bourgogne Franche-Comté in Besançon France

TUESDAY JUNE 19, 2018
HOTEL HILTON GUADALAJARA
CONFERENCE ROOM "AMÉRICA"
14:15-18:15

Abstract

It is well accepted that micro aerial vehicles (MAVs) are one of the most popular and challenging topics in the recent years within interest of the aerial robotics scientific community. Interest and motivation in such MAVs are multiple: exploration of small places (small tubes, ...) where only miniaturized UAV can access; discreet, noise-free and environment harmless exploration; discreet espionage; weather high-resolution monitoring (distributed aerial micro aerial probes for temperature, pollution, ...); disaster assessment (victims find-&-rescue), logistics (warehouse inventory), just to mention a few. A logical design criterion is to inspire on biological aerial homologous to acquire information about the mechanics, the navigation profile, the vision, and swarm flight. Aspects like these have encouraged the development of a new generation of aerial vehicles inspired on nature. In the actual case, we especially focus on miniature aerial robots. While bioinspired MAVs concepts have great promise, it also comes with significant challenges. Foremost amongst these is designing controllers that will work over the complete flight envelope of the vehicle: from high-rate control for non-conventional actuators control to robust navigation and perception while considering a complex aerodynamics.

The development of MAVs requires a complete re-design and a use of very different technology relative to that of mini and that of classically sized UAVs since rotative actuators cannot anymore be used due to their non-reducible dimensions. In MAVs, smart materials such as piezoelectric materials are used as basis of the actuators. These smart materials-based actuators being non-rotative, very different techniques than in UAVs are employed to create the lifting force and to create the vertical and longitudinal movements. These techniques are generally bio-inspired: for instance, design of flapping-wing mechanism with piezoelectric actuators. Beyond the complexity of the design, the modeling and the control of the MAVs also raise challenges because the smart materials-based actuators are highly nonlinear and generally with high Q-factor. Finally, the link between the smart materials-based actuators (joint space) and the navigation layers (operational space) at these small scale presents a lot of uncertainties because of the high sensitivity of the MAVs to the environment as they are small. Consequently, the development of adapted sensors, embedded or exteroceptive, is of great interest in order to make possible feedback control.

The objective of this workshop is to present previous results and current research on bio-inspired micro aerial vehicles (bioMAVs) in term of design, modeling, control and perception. The workshop is programmed such that the various elements in such bioMAVs are covered: the smart materials-based actuators at the joint levels, the mechanisms and the bioMAVs architecture, the sensor and perception systems, and the control at various levels (joint space, operational space). Additionally, to the speakers, the workshop is intended to bring together researchers from different, but complementary disciplines, motivated to address such topicregarding strategic research collaborations. Expected audience includes these researchers, and also includes students and engineers in companies working in the topics of micro aerial vehicles.