





BORSA N. 24 DAUSY

D.M. 351/2022

Ambito: PNRR Tematica: "Model-based design for increasing reliability and safety of autonomous systems"

Research theme title:

Model-based design for increasing reliability and safety of autonomous systems

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Curriculum of DAUSY:

C1 AS for Automation

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Description:

Autonomous systems represent a key enabling technology for the digital transition. For a system to reach autonomy, it must be indeed capable of collecting and properly processing a large quantity of information, and possibly employ it to ensure its proper functioning as well as the safety of the people next to it. It is thus of utmost importance that unexpected internal problems, such as faults, can be discovered and quickly addressed before degenerating into a total system failure, which may cause both economical and human losses. For instance, an autonomous aerial vehicle experiencing a fault should be at least able to land in order to avoid a crash, or a faulty industrial robot should be at least able to stop before causing harm to a human operator. This may be achievable thanks to the information on the internal states of the system and on the environment in which it operates. Moreover, whenever such information is augmented by a model, fault diagnosis and fault-tolerant control techniques represent an effective way to increase the reliability and safety of the system. Starting from relevant models available in the literature, the PhD candidate will be required to investigate the state of the art on linear and nonlinear techniques for fault detection and diagnosis, as well as fault-tolerant control techniques, using both active and passive approaches. These techniques will be then validated in one or more application scenarios, which may include unmanned vehicles, mobile robots, industrial manipulators and intelligent machines in general.

Specific Information:

Applicants must hold a Master's Degree, preferably in Engineering, with a good background in relevant areas of interest (i.e., modelling, estimation, and control). Proficiency in both spoken and written English is required. Solid mathematical, coding and teamwork skills are encouraged.

References:

[1]. A. Monteriù, A. Freddi, S. Longhi (editors), "Fault Diagnosis and Fault-tolerant Control of Robotic and Autonomous Systems", IET (UK), July 2020.

[2]. R. Felicetti, A. Baldini, A. Freddi, S. Longhi, A. Monteriù, "Actuator Fault Tolerant Control of Variable Pitch Quadrotor Vehicles," in IFAC-PapersOnLine - 21st IFAC World Congress, vol. 53, no. 2, pp. 4095 – 4102, Berlin, Germany, Jul. 2020.

[3]. Baldini, R. Felicetti, A. Freddi, S. Longhi, and A. Monteriù, "Actuator Fault-Tolerant Control Architecture for Multirotor Vehicles in Presence of Disturbances," Journal of Intelligent & Robotic Systems, Springer Nature (Switzerland), vol. 99, pp. 859–874, Feb. 2020.

[4]. A. Baldini, L. Ciabattoni, R. Felicetti, F. Ferracuti, A. Freddi, and A. Monteriù, "Dynamic surface fault tolerant control for underwater remotely operated vehicles," ISA Transactions, Elsevier (Netherlands), vol. 78, pp. 10–20, Jul. 2018 (first online 1 March 2018).

[5]. S. Li, J. Yang, W. Chen, and X. Chen, Disturbance Observer-Based Control: Methods and Applications, ser. Disturbance Observer-based Control: Methods and Applications. CRC Press, Taylor & Francis Group, 2017.

[6]. Gao, Zhiwei, Carlo Cecati, and Steven X. Ding. "A survey of fault diagnosis and fault-tolerant techniques—Part I: Fault diagnosis with model-based and signal-based approaches." IEEE transactions on industrial electronics 62.6 (2015): 3757-3767.

[7]. A. Lanzon, A. Freddi, and S. Longhi, "Flight Control of a Quadrotor Vehicle Subsequent to a Rotor Failure," Journal of Guidance, Control and Dynamics, AIAA (United States of America), vol. 37, no. 2, pp. 580–591, Mar. 2014 (first online 12 February 2014).







Type of scholarship:

DM 351/2022 – Project on PNRR (Italy's Recovery and Resilience Plan)

Study and research period outside the Hosting Institution:

- Duration: 6 to 18 months;
- Foreign Hosting Institution:

Department of Mechanical Engineering - Eindhoven University of Technology https://www.tue.nl/en/