

BORSA N. 14

DAUSY

D.M. 351/2022

Ambito: Pubblica Amministrazione
Tematica: "Fault Diagnosis and Security in Smart Cities"

Research theme title:

Fault Diagnosis and Security in Smart Cities

Contacts:

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Curriculum of DAUSY:

C3 AS for monitoring and security

Hosting University/Research Centre:

University of Cagliari

Department:

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https://unica.it/unica/it/dip_ingelettrica.page

Prospective Supervisors:

Prof. Alessandro Giua

Description:

A smart city is a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business. From the perspective of automation and control, three key aspects are particularly relevant in this context. a) Smart cities are examples of large-scale distributed plants whose overall behaviour derives from the interaction of multiple agents and where monitoring and control can only be enforced in a decentralized fashion. b) Different heterogeneous services co-exist and interact with each other: this requires adopting very general models, capable of describing hybrid systems, characterized by both time-driven and event-driven dynamics. c) To ensure the secure behaviour of the overall systems while satisfying privacy concerns even in the presence of malicious attacks, it is necessary to implement and manage a high-level infrastructure capable of monitoring the overall behaviour of the system.

The objective of this thesis is that of addressing the issue of security and privacy in smart cities with a unifying approach that is not service-dependent but could be applied in different applicative domains. The reference paradigm that will be adopted for the modelling and analysis is that of cyber-physical systems, which integrate sensing, computation, control and networking into physical objects and infrastructure, connecting them to the Internet and to each other.

The approach that will be adopted is that of extending to the more general setting of cyber-physical systems recent approaches, that have been developed by the discrete-event systems community to addresses problems of fault diagnosis, privacy analysis and enforcement, and resilience to cyber-attacks. The proposed methodologies will be developed in view of enabling their technology transfer toward a platform that could be used by local administrations to offer these new services to users.

Specific Information:

The candidate PhD student should have a master's or equivalent degree in the area of Information Engineering, with a good background in Control Systems.

References:

- [1]. O. Bubelíny, M. Kubina, M. Varmus, "Railway Stations as Part of Mobility in the Smart City Concept," *Transportation Research Procedia*, Vol. 53, pp. 274-281, 2021.
- [2]. C.G. Cassandras, "Smart Cities as Cyber-Physical Social Systems," *Engineering*, Vol. 2, No. 2, pp. 156-158, 2016.
- [3]. European Commission, "Smart cities: using technological solutions to improve the management and efficiency of the urban environment," https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en
- [4]. Y.H. Hu, Z.Y. Ma, Z.W. Li, A. Giua, "Diagnosability enforcement in labeled Petri nets using supervisory control", *Automatica*, Vol. 131, 2021.
- [5]. S. Rani, A. Kataria, M. Chauhan, P. Rattan, R. Kumar, A.K. Sivaraman, "Security and Privacy Challenges in the Deployment of Cyber-Physical Systems in Smart City Applications: State-of-Art Work," *Materials Today: Proceedings*, 2022.
- [6]. R. Su, "Supervisor synthesis to thwart cyberattacks with bounded sensor reading alterations," *Automatica*, Vol. 94, pp. 35-44, 2018.
- [7]. Y. Tong, Y.C. Wang, A. Giua, "A Polynomial Approach to Verifying the Existence of A Threatening Sensor Attacker," *IEEE Control Systems Letters*. March 2022.

- [8]. J. Zaytoon, S. Lafortune, "Overview of fault diagnosis methods for Discrete Event Systems," Annual Reviews in Control, Vol. 37, No. 2, pp. 308-320, 2013.
- [9]. Q. Zhang, C. Seatzu, Z.W Li, A. Giua, "Joint State Estimation Under Attack of Discrete Event Systems," IEEE Access, Vol. 9, pp. 168068 - 168079, 2021.

Type of scholarship:

DM 351/2022 – Project on Public Administration

Study and research period outside the Hosting Institution:

- Period of study and research at a Public Administration: 6 months. ARST – Trasporti Regionali della Sardegna s.p.a. (sole shareholder: Autonomous Region of Sardinia), via Posada 8/10, 09122 Cagliari.
<http://www.arst.sardegna.it>
- Period of study and research abroad: 6 months. Prof. Christos G. Cassandras, Division of Systems Engineering, Boston University, Boston. Massachusetts, USA.
<https://www.bu.edu/eng/departments/se>

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