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Research profile:

General interest: strategies for fault tolerant control with set-based methods; motion planning strategies for nonlinear dynamics; programming with mixed-integer variables for complex control problems. The goal is to exploit the structure of the typical constrained control problem to find more effective algorithms and theoretical performance guarantees.

Significant results were obtained in two main directions:

1. Set-based methods, in particular invariance notions and zonotopic sets for efficient recursive formulations. The applications go from fault tolerant control with active fault detection to efficient characterization of a multi-obstacle environment.
2. Methods that use the notions of flatness to generate trajectories that guarantee obstacle and collision avoidance.

PhD coordinator from the year 2018

- No thesis currently under supervision

Scientific publications:

- The book “Mixed-Integer Representations in Control Design. Mathematical Foundations and Applications” in series “Springer Briefs in Electrical and Computer Engineering”, Springer (2016);

- The book „Set-theoretic fault detection in multi-sensor control" in series FOCUS, Hermes Penton-ISTE Ltd with Wiley (2013);
- 2 book chapters (in Springer 2013 and 2015 collections);
- 14 articles in ISI indexed journals (with a cumulated impact factor of 35.52), from which, 13 in categories Q1 or Q2;
- 40 conference proceedings (28 of them, ISI indexed) in international conferences from the area of Automatic Control (IEEE Control and Decision Conference, IEEE European Control Conference, IEEE American Control Conference, IFAC World Congress Conference, other IEEE and IFAC affiliated conferences).

Research projects:

- The PN-III "Innovation Check" project: "Implementation and development of algorithms for the dynamic motion planning of robotic systems (DEVROS)"; CI-2017-0403; July 2017 – December 2017;
- The PN-II "Young Team" project: "Set-theoretic approaches for fault tolerant control of complex systems (SETS2FTC)"; TE-2014-4-2713; October 2015 - December 2017.

Management positions / Membership in scientific organizations and committees, editorial boards

- Associated Editor at the Mathematical Problems in Engineering (2018-)
- IEEE Member, treasurer for the Romanian chapter of the Robotics section (2018-).

Proposed PhD topics:

1. *Explicit representations for robust positive/controllable invariant sets*.

   Existing methods are either conservative or require iterative approaches. The goal is that, by selecting particular families of sets (zonotopic or star-shaped), simpler algorithms as well as explicit representations for invariant approximations are obtained. Possible applications are in fault detection and isolation or stability analysis for complex systems (e.g., switched dynamics).

2. *Fault tolerant control with active fault detection and isolation for complex dynamics.*

   Existing control schemes are usually incomplete because they do not consider the problem of detection and reconfiguration in realistic conditions (the detection is not instantaneous). The purpose is to use set-based methods to explicitly characterize the effects of a closed loop fault (transient behaviour), thus ensuring performance and stability guarantees.

3. *Trajectory planning for multi-agent systems in a multi-obstacle environment.*

   The problem of trajectory planning in a complex and dynamic environment is of great interest. The goal is to synthesize trajectories through flatness with various parameterizations (e.g., NURBS) in order to guarantee performance, collision avoidance, fault accommodation. Applications of interest are in motion planning for autonomous systems (nano-drones, ground robots, etc.).