

CONTROL ALGORITHMS AND OPTIMAL TUNING OF FUZZY MODELS FOR AUTOMOTIVE, MECHATRONICS APPLICATIONS AND MOBILE ROBOTS

Goal of the project

Development of control structures and algorithms and optimal tuning of fuzzy models for a wide range of industrial processes, mechatronics, mobile robots and automotive applications.

Short description of the project

The project aims:

- Advanced control structures for automotive and mechatronics applications.
- Improvement and development of new Takagi-Sugeno (T-S) fuzzy models and control solutions for a wide range of industrial processes.
- Optimal tuning of fuzzy models for automotive and mechatronics applications.
- Improvement and development of control algorithms for mobile robots.

Project implemented by

“Gheorghe Asachi” Technical University of Iasi (TUIASI) – Coordinator;
Politehnica University of Timisoara, Department of Automation and Applied Informatics – Project Partner P1;
S.C. ROMUS Trading & Development SRL – Project Partner P2.

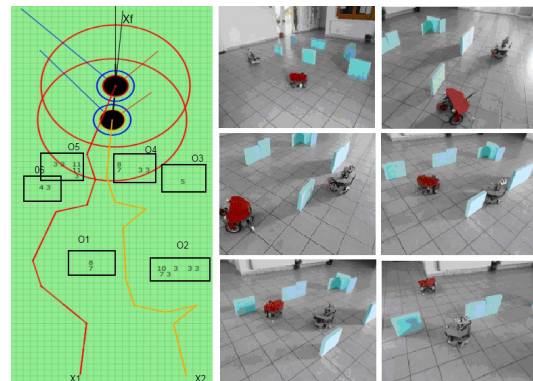
Implementation period

2012–2016

Main activities

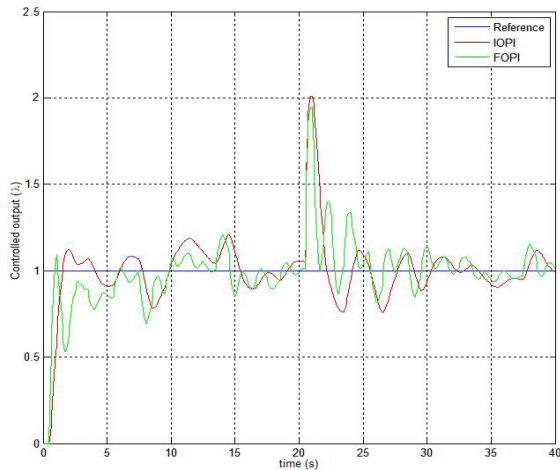
- Design of low-cost T-S state feedback fuzzy controllers for the position control of a class of nonlinear servo systems.
- Sensitivity analysis with respect to the process parametric variations in the low-cost controller designs for vehicle power train systems with spark-ignition engine and continuously variable transmission.
- Modelling, simulation, analysis and design of linear, fuzzy and variable structure control solutions for direct current electric drive systems with continuously variable reference input, variable moment of inertia and variable load disturbance input, applicable to rolling mills and to strip winding systems.
- Development and experimental validation of simple T-S fuzzy models for several processes in automotive and mechatronics: anti-lock braking systems, nonlinear DC drive servo systems, magnetic levitation systems, electromagnetic actuated clutch systems, inverted pendulums.
- Fuzzy logic control algorithms that stabilize chaotic dynamical systems.

- Frequency domain design of fractional order proportional-integral controllers for lambda control in the framework of automotive engine control systems.
- Development of two-degree-of-freedom linear and fuzzy controllers, of hybrid T-S fuzzy controllers, of hybrid PI neuro-fuzzy controllers and of adaptive sliding mode fuzzy controllers for speed and position control of brushless DC drives with variable parameters – continuously variable reference input (speed), variable moment of inertia and variable load disturbance.
- Optimal tuning of parameters of T-S fuzzy models using nature-inspired algorithms (simulated annealing, particle swarm optimization and gravitational search algorithms) and evolving fuzzy modelling.
- Continuous development of the nRobotic platform in the framework of path planning and collision avoidance for mobile robots in missions.
- Development and testing of path planning algorithms for mobile robots using nature-inspired optimization algorithms.



Results

- 20 papers published in ISI journals with impact factors.
- 3 papers published in journals indexed by international databases.
- 7 book chapters published in Springer-Verlag volumes.
- 20 papers published in conference proceedings indexed by international databases (IEEE Xplore, INSPEC, DBLP, Scopus).
- more than 50 independent citations in 2014.



Applicability and transferability of the results

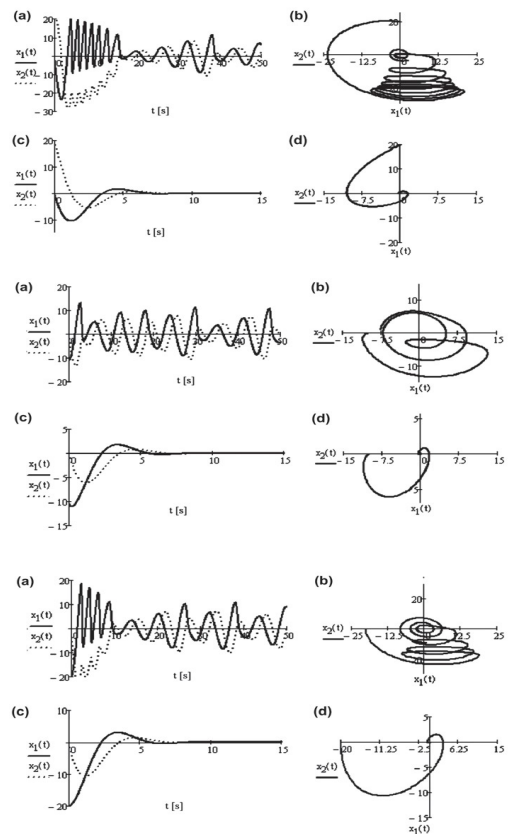
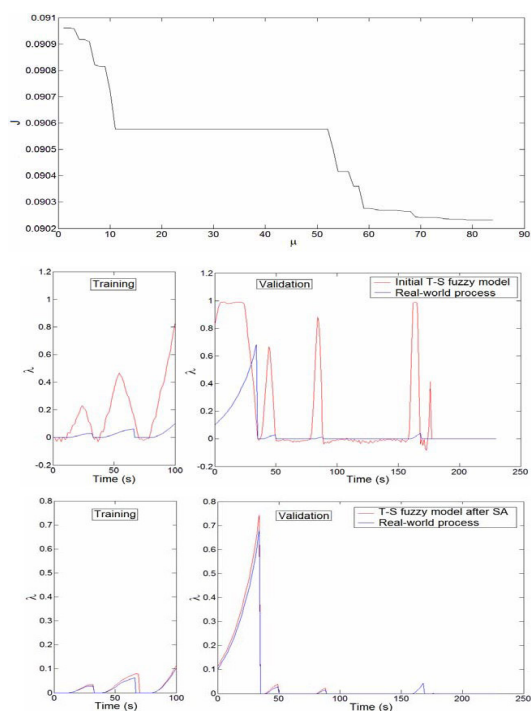
Nature-inspired optimization algorithms in modelling and control design, low-cost solutions for control problems in mechatronics, electrical drives, automotive and robotics, tools for the modelling, optimization and design of fuzzy control systems, real-time programming and operating systems for control and robotics.

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Research Centre

CCISA - Research Centre for Automatic Systems Engineering



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