

NEW PERFORMANCE IMPROVEMENT TECHNIQUES OF CONTROL SYSTEMS USING EXPERIMENT-BASED TUNING

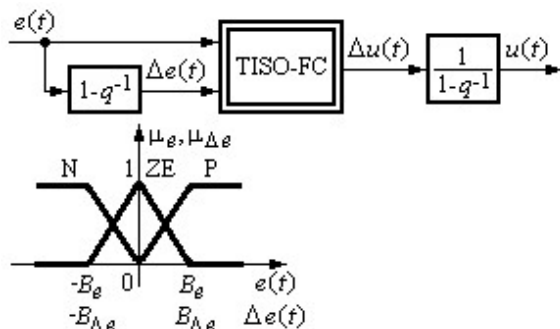
Goal of the project

Enhance the existing techniques and develop new techniques dedicated to the improvement of control system performance using experimental data.

Short description of the project

The project aims:

- Enhancement and development of data-based (data-driven) techniques and algorithms for improving control system performances using experimental data.
- Enhancement and development of nature-inspired algorithms in optimization of control system performance.
- Development of optical character recognition (OCR) applications.
- Development of new fuzzy control solutions for a wide range of industrial processes.



Project implemented by

Department of Automation and Applied Informatics.

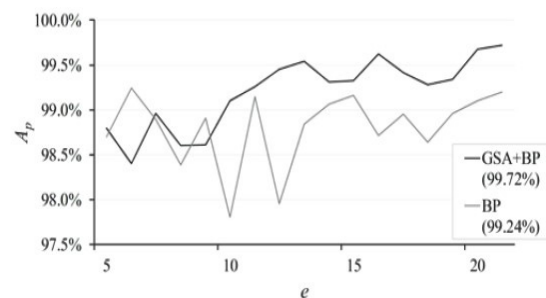
Implementation period

2011-2015

Main activities

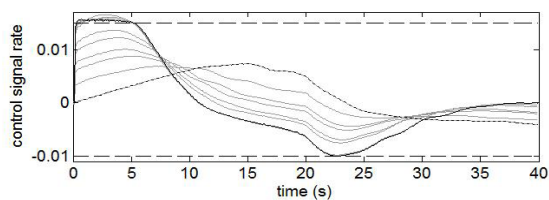
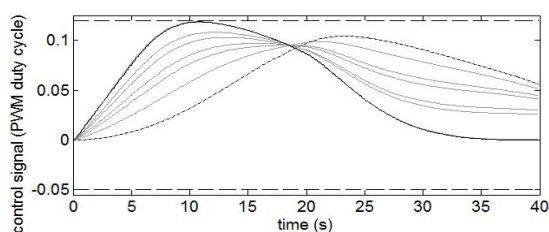
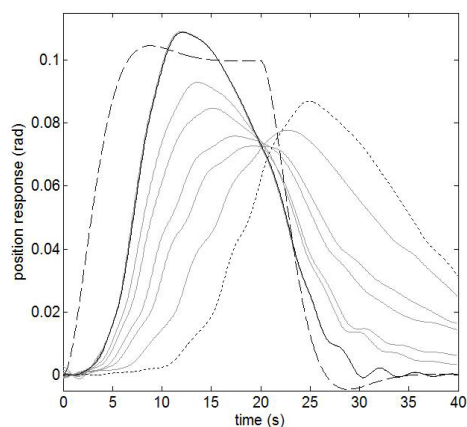
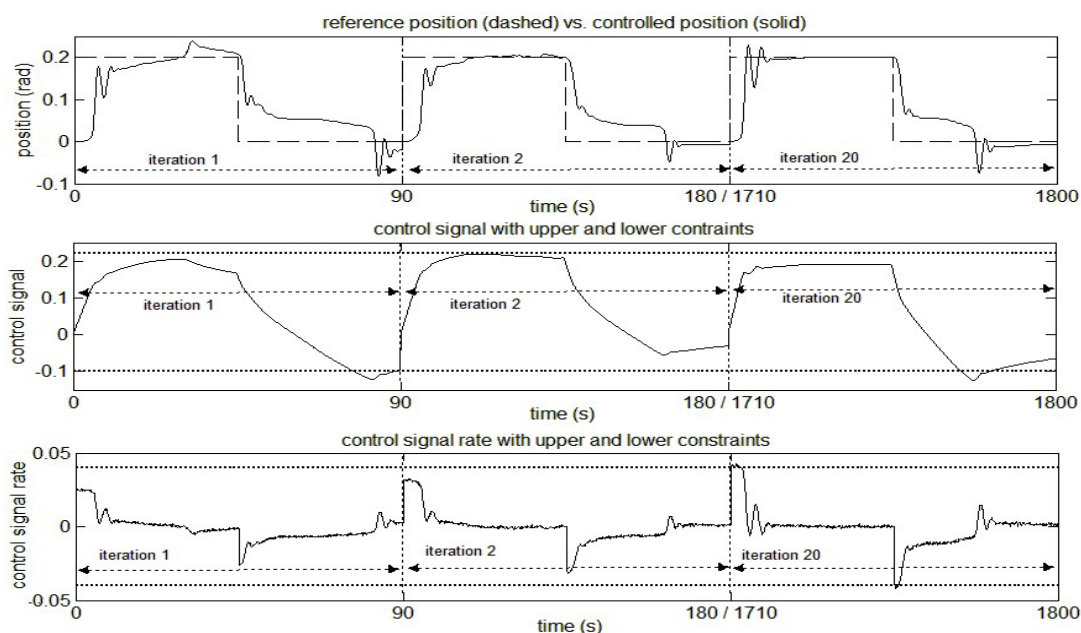
- Application of Iterative Feedback Tuning (IFT) and Simultaneous Perturbation Stochastic Approximation (SPSA) to state-feedback optimal control with Kalman filter state observers.
- Application of stable Iterative Correlation-based Tuning to servo systems.
- An experiment-based approach to Reference Trajectory Tracking optimal control problem.
- Validation of iterative techniques on laboratory equipment such as: liquid level control, motion control systems with motor actuation (speed and position control, inverted pendulum).

- Enhancement of control systems performance by fuzzy control and IFT.
- Enhancement of existing nature-inspired algorithms such as Gravitational Search Algorithm (GSA) and Charged System Search (CSS).
- PI and fuzzy controller tuning to ensure a reduced sensitivity with respect to the parametric variations of processes.
- Enhancement of the training algorithm of Convolutional Neural Networks using a mixed approach of Back-Propagation and Gravitational Search Algorithm.
- Development of telesurgical applications and control of telerobots in space medicine,
- Control of nonlinear discrete-time MIMO systems.
- Application of IFT for controller tuning to nonlinear processes in constrained environments using neural networks.
- Application of model-free Iterative Learning Control to the control of repetitive processes in constrained environments.



Results (overall 2011-2014)

- 26 papers (ISI) published in journals with impact factors, cumulated impact factor according to 2013 Journal Citation Reports (JCR) released by Thomson Reuters in 2014 = 51.240, cumulated relative influence score = 32.889.
- 1 journal paper indexed by international database (Zentralblatt Math).
- 7 book chapters published in Springer-Verlag volumes.
- 17 papers published in conference proceedings indexed by Thomson Reuters Web of Science.
- 18 papers published in conference proceedings indexed by international databases (IEEE Xplore, INSPEC, DBLP, Scopus).



Research centre

Research Centre for Automatic Systems Engineering (CCISA)

Applicability and transferability of the results

Control systems with a reduced parametric sensitivity, tools for the computer-aided design of controllers, computer-aided techniques in iterative data-based control, nature-inspired optimization algorithms in control design and image processing, tools for the systematic development of fuzzy control systems.

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