

TEMPO Mid-term Review

Project title : Robustness of MPC Explicit solutions

ESR6: Rajesh Koduri

Supervision by

Professor Pedro Rodriguez-Ayerbe
Professor Sorin Olaru

Automatic Control Department, CentraleSupélec

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CentraleSupélec

Bio

Native Chennai, India

Education

- **Technical University of Dortmund, Germany**
Master of Science in Automation and Robotics
- **Anna University, India**
Bachelors of Engineering in Electronics and Instrumentation

Objective

The **general objective** of our research can be summarized in the following points:

- 1 Tackle uncertainties imposed on the system dynamics
- 2 To adjust the nominal MPC tuning parameters in order to obtain a certain degree of robustness
- 3 Calculate the robustness margin explicitly for different piecewise affine control laws
- 4 Extend current or find new methodologies for accomplishing our primary objective
- 5 Build tools to apply the theoretical results in real-time applications

1 Problem Specification

- Parametric uncertainties
- Unstructured uncertainties

2 Methodologies

- Construct control laws with contractive sets and (λ, N) -contractive sets
- Analysis of robustness margin
- Classification of different control laws

P1 - Summary (1 of 2)

Title: **Explicit robustness margin for contractive piecewise affine control laws**

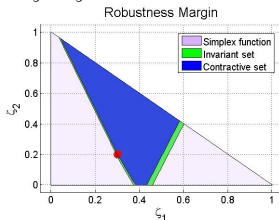
Authors: K. Rajesh, P. Rodriguez-Ayerbe¹ and S. Oлару

Submitted to: European Control Conference 2016

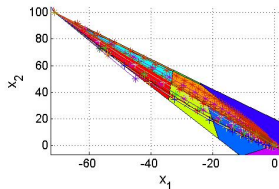
- The objective is to calculate the robustness margin guaranteeing the contractivity of the control law.
- The robustness margin is represented as a subset of parameters included in the set describing the polytopic uncertainty
- This set of parameters is then compared to the set assuring the invariance of the considered closed-loop PWA dynamics

P1 - Summary (2 of 2)

- Robustness margin for contractive and invariant set in the space of parameters ζ_1, ζ_2



- Trajectories for different nominal systems for the same initial state



P2 - Summary

Title: **Explicit robustness margin for (λ, N) -contractive piecewise affine control laws**

Authors: K. Rajesh, P. Rodriguez-Ayerbe¹ and S. Olaru

Submitted to: Control Decision Conference 2016 (planned)

- The objective is to consider contractive trajectories after several N steps
- Compute the robustness margin for the (λ, N) -contractive explicit control laws

Secondment

Title: **Interval Parametric programming for piecewise affine systems**
Supervisor: Michal Kvasnica
University: Slovak University of Technology Bratislava

- The objective is to tackle uncertainty in the mathematical model
- Here, the coefficients and variables of the system model can be represented as intervals in the Interval programming problems
- Extend the existing methodology or find new ways to transform the interval programming problem into parametric programming problem

Other activities

- Summer School
 - Numerical Optimal Control and Embedded Optimization Summer School (Freiburg University)
 - TEMPO spring school on Theory and Numerics for Nonlinear Model Predictive Control (Freiburg University)
- Workshops
 - Embedded Systems Training (Oxford University)
 - Presentation skills workshop (Oxford University)
- Professional course
 - Techniques for scientific writing and associated softwares (CentraleSupélec)

Impact on Career

- 1 Specialist and generalist knowledge within the given field
- 2 Computing and information searching skills
- 3 Communication, presentation and interpersonal skills
- 4 The ability to read and synthesize a range of documentation
- 5 Self-motivation and discipline

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Any questions?