TEMPO mid-term review meeting

ESR: Niels van Duijkeren

Promotors: Jan Swevers, Goele Pipeleers

December 1, 2015
Background

Training activities

Research

Career Impact
Background

Training activities

Research

Career Impact
Background

BSc mechanical engineering

TU Delft

MSc systems & control

TU Delft

Extracurricular

Forze H2
Hydrogen Electric Racing

Erasmus

ETH Zürich

MSc thesis

VOLVO
MSc thesis

Driver assistance function for lane changing and merging;
- employing predictive control strategy: NMPC
Forze Delft

Student team developing *hydrogen electric* race cars:

- ~ 60 active students (~ 7 full-time)
Forze Delft

Student team developing *hydrogen electric* race cars:

- ~ 60 active students (~ 7 full-time)
Current position
Career plan

Training to improve career opportunities, through ITN and PhD:
- establish company related to automotive/robotics control
- academic research in control of mechatronic systems
- research & development position
Background

Training activities

Research

Career Impact
Doctoral training activities

Thematic courses

- TEMPO spring school on theory and numerics for nonlinear model predictive control
  *ALU Freiburg, February 2015, J. Rawlings & M. Diehl*
  3 ECTS

- TEMPO summer school on numerical optimal control
  *EPFL & ALU Freiburg, July 2015, M. Diehl & C. Jones*
  3 ECTS

- Convex optimization
  *KU Leuven, February 2016, G. Pipeleers*
  3 ECTS

Skills courses

- Teaching assistance training
  *KU Leuven, t.b.d.*
  2 ECTS

- Academic English: writing
  *KU Leuven, t.b.d.*
  2 ECTS
Doctoral training activities

Workshops

- Automotive embedded control workshop
  *Renault, February 2015*

- Presentation skills workshop
  *Oxford, September 2015*

- Embedded systems training (NI)
  *Oxford, September 2015*

- Professional development and complementary skills workshop
  *Imperial College, April 2016*

- Entrepreneurship workshop
  *Ampyx Power, April 2016*

- Professional development and complementary skills courses at ABB University
  *ABB Switzerland, 2017*
Background

Training activities

Research

Career Impact
Research topic

Real-time NMPC for robotic path following applications:
- allow deviation from path, defined in workspace
- trade-off time-optimality, accuracy, energy consumption

Applications: welding, gluing, laser cutting, assembly
Research objectives

Model predictive path following control, challenges:
- real-time performance
- stability and robustness

Objectives:
- optimal control formulation
- establish theoretic stability results
- establish performance bounds
- experimental validation
- free software implementation

Build upon research results by e.g., (Faulwasser et al, 2009)
Intermediate results

- offline time-optimal motion planning for a robotic arm subject to inertial force and torque constraints
- path-parametric system reformulation of robot dynamics
  - employed in velocity-tracking MPFC*
  - employed in time-optimal MPFC*
- ongoing MPFC* implementation on experimental setup
  - using ACADO Toolkit

* model predictive path following control
Published work

International Conferences and Symposia


Meeting Abstracts and Posters


Submitted work

International Conferences and Symposia


Planned Publications

International Conferences, Symposia and Meetings


Submit paper to an internationally reviewed academic journal by March/April 2016.
Secondment

Secondment to ALU Freiburg
Prof. Moritz Diehl
April-June 2016

Robot modeling for optimal control:
- benchmark robot modeling strategies
  - minimum: configuration space
  - non-minimum: natural coordinates
- structure exploiting solution strategy
Outreach activities

- in house days KU Leuven
- presentations at network meetings (DYSCO, OPTEC, ...)
Background

Training activities

Research

Career Impact
Impact of TEMPO

Desired career opportunities:
- establish company in automotive/robotics control
- academic research endeavors in control of mechatronics
- research & development position in existing company

Marie-Curie ITN: excellent preparation for future career:
- acquire research skills
- build large relevant network
- training through technical courses
- training for broad set of non-technical skills
Thank you!