Advanced control for energy efficiency in hybrid vehicles

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Team – thank you all!

Formal	Informal
Lucian Buşoniu	Víctor Estrada-Manzo
	Jimmy Lauber
	Thierry-Marie Guerra
	Előd Páll
	Maxime Tintillier
	Paula Raica
	and many others…

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Outline

- **Objectives**
- **Activities**
- **Milestones**
- **Challenges**
- **Results**
- **Next steps**

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Objectives

- **Testing and validation of theories that may constitute research themes financed by national or international organizations**

- **Preparing a proposal to apply in national or international calls**

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Objectives – Context

- **Strong collaboration with LAMIH, University of Valenciennes, France**

- **Expertise:**
    - **Optimization of IC engines**
    - **Analysis and design using Takagi-Sugeno fuzzy models**
    - **Analysis and design for nonlinear dynamic systems**

Objectives – Goal

Controller design for energy efficiency in hybrid vehicles

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Activities – Modeling

- **Electric engine: hybrid structure**
- **Discrete and continuous dynamics**
- **Cyclic representation**

- **Need: more efficient control**

Activities – Control

- **Hybrid energy management**
- **Engine control**

- **Hybrid structure**
- **Periodic control and estimation**

Activities – Control for periodic systems

- **Stability conditions**
- **Controller and observer design**
- **Stabilizing switching laws**
- **Robust control, disturbance attenuation**

Activities

- **Descriptor models**
  - **Stabilization**
  - **Observer design**

- **Optimization**
  - **In the presence of uncertainties**
  - **For switching systems**

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Milestones

- **Theoretical controller design**

- **Testing and validation on a testbench**

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Challenges

- **Periodic controller and observer design**

- **Nonquadratic Lyapunov functions**

- **LMI conditions**

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Results – Proposals

- **Computational intelligence for sustainable energy systems. COST Actions, ICT. Consortium: Romania, France, Spain, Germany, The Netherlands, UK, Portugal**

- **Low-cost solutions for improving vehicle energy management. Capacities, Romania-France cooperation, Brancuşi-Hubert Curien Integrated Actions**

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Results – Testing and validations

Results – Publications

- **3 accepted/published journal papers**

- **10 international conference papers**

Results – Conferences

- **Visits**
  - **IFAC World Congress, August 2014, Cape Town, South Africa**
  - **Conference on Decision and Control, December 2014, Los Angeles, California**

- **Organization**
  - **Special session at the IFAC World Congress, August 2014, Cape Town, South Africa**
  - **2014 IEEE Symposium on Adaptive Dynamic Programming and Reinforcement Learning, Orlando, Florida, December 2014**

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Results – Research visits

- **Víctor Estrada-Manzo, 1 March - 1 June 2014**
- **Maxime Tintillier, 1 March - 1 September 2014**
- **Thierry-Marie Guerra, 18 May - 23 May 2014**

- **Lucian Buşoniu, 9 June - 8 July 2014**
- **Zsófia Lendek, 12 June - 2 July 2014**
- **Előd Páll, 1 September – 30 September 2014**

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Next steps

- **Theoretical developments**
  - **Switching systems**
  - **Descriptor models**

- **Testing and validation on a hybrid vehicle**

- **Horizon 2020 proposal**

Thank you for your attention!
Questions?