

HYCON2

Highly-complex and networked control systems

HYCON2 will stimulate and establish the long-term integration in the strategic field of control of complex, large-scale, and networked dynamical systems, in particular in the domains of ground and aerospace transportation, electrical power networks, process industries, and biological and medical systems.

KEYWORDS: control, computing and communication networks, theoretical foundations, design technology

At A Glance: HYCON2

Highly-complex and networked control systems



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Industrial Advisory Board: Empresarios Agrupados; Petroleos del Norte S.A. (PETRONOR); ACOR; ETRA Investigacion y Desarrollo s.a.; GTD Sistemas de informacion; MAGILLEM; CADLM; EDF; RTE; AREVA; MOVEO;Thales Communications SpA; WEST Aquila Micron Technology Italia srl; Logic SpA; Akhela; Ford Motor Company; ECN, Energy research Center of the Netherlands

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EC Contribution: € 3 900 000

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Main Objectives

HYCON2 will address engineering technologies for highly-complex and networked control systems that is large scale, distributed and cooperating systems for monitoring and control, including wireless sensor networks. This emerging research discipline provides the theoretical foundations for modeling and analysing the behavior of embedded systems and promises a much improved design technology. In order to build successful networked control systems HYCON2 will address novel questions and issues that

- i) lie in the interface of control, computing and communication networks,
- ii) transcend the traditional problem formulations in those areas and
- iii) interact with concrete technology applications.

HYCON2 will improve robustness, safety, performance, predictability and cost of large-scale networked systems.

The key objectives of the project are:

- 1) **To foster** in both ways fundamental studies and applications,
- 2) **To develop** generic modelling and the design of control methods, under the multiple constraints inherent to embedded systems, based on a model approach (EDP, ODE, continuous, discrete, discrete events systems, hybrid systems),
- 3) **To design** dynamical reconfiguration of architectures & implementation of languages and scalable algorithms for the control of evolvable, distributed and adaptable systems,
- 4) **To master** the complexity in terms of temporal and spatial uncertainties such as parameters, delays and disturbances, limited bandwidth in communications, actuation constraints and node availability.

Technical Approach

The HYCON2 research effort will aim to integrate topics, teams, and competencies, through an ambitious and coherent research programme of research activities which are grouped into four thematic areas (TA):

- TA1: Analysis of complex systems
- TA2: Networked control systems
- TA3: System-wide coordination and control
- TA4: Self-organizing systems and control

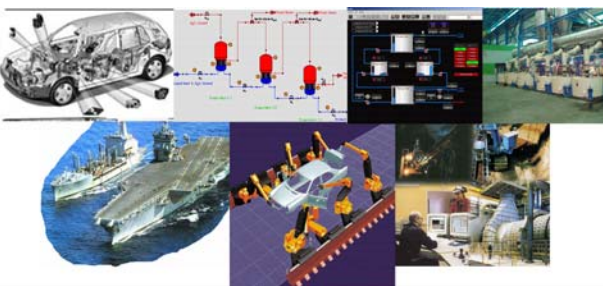
The common fundamental studies in each HYCON2 thematic area are essential for insuring significant progresses in engineering technologies. In order to prove the efficiency of HYCON2 methodologies, three application domains (AD) will be particularly emphasized. The proofs of concept studies will be developed in:

- AD1 - Transportation
- AD2 - Energy
- AD3 - Biological and Medical systems.

Benchmarking will serve as a tool for testing and evaluating the technologies developed and for stimulating and enforcing excellence by the identification and adoption of best practices. Two show-case applications have been selected:

- 1) Modeling and control of traffic flows &
- 2) Production Management in sugar factories

HYCON2 will spread and disseminate excellence through multi-disciplinary education at the graduate and undergraduate level.



Key Issues

HYCON2 will stimulate and establish the long-term integration of the European research community, leading institutions and industry in the strategic field of control of complex, large-scale, and networked dynamical systems. It will interconnect scattered groups to create critical mass and complementarity, and will provide the necessary visibility and communication with the European industries.

HYCON2 will assess and coordinate basic and applied research, from fundamental analytical properties of complex systems to control design methodologies with networking, self-organizing and system-wide coordination. HYCON2 has identified several applications domains to motivate, integrate, and evaluate research in networked control. These domains are ground and aerospace transportation, electrical power networks, process industries, and biological and medical systems. Benchmarking will serve as a tool for testing and evaluating the technologies developed in HYCON2 and for stimulating and enforcing excellence by the identification and adoption of best practices. In particular, two show-case applications corresponding to real-world problems have been selected in order to demonstrate the applicability of networked control and the need for research in control. As no substantial technological breakthrough can be achieved without preparing the proper cultural background, a further important objective of HYCON2 is to spread and disseminate excellence through multi-disciplinary education at the graduate and undergraduate level.

Impact

The HYCON2 Joint Programme of Activity is built so that tight integration between the central players of the European research community is achieved. This will make Europe both the prominent scientific and the industrial leader in the area of highly complex and networked control systems, therefore posing Europe in an extraordinary position to exploit their impact in economy and society.

	WP Title		WP Leader name
WP1	Analysis of complex systems	ETHZ	John Lygeros
WP2	Networked control	UNIVAQ	Maria Domenica Di Benedetto
WP3	System-wide coordination and control	TUDo	Sebastian Engell
WP4	Self-organizing systems and control	UNIPD / UDP	Sandro Zampieri / Antonio Bicchi
WP5	Benchmarks	UVA	Cesar de Prada
WP6	Tool integration	UNITN	Alberto Bemporad
WP7	Training	CNRS / UDP	Jamal Daafouz / Antonio Bicchi
WP8	Outreach and Industrial Advisory Board	TUe / CNRS	Paul Van den Bosch / Gilney Damm
WP9	Dissemination, networking & roadmapping	USE	Eduardo Camacho
WP10	Project coordination and management	CNRS	Françoise Lamnabhi-Lagarigue