Paths ahead symposium

November 12 – 14, 2009
Laboratory for Information and Decision Systems

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UCLouvain (Belgium)

Identify key future challenges that can point the audience to exciting research opportunities.

Future challenges (in 1995)

European Journal of Control

Survey on the state of system and control
Volume 1, Issue 1, 1995

Major problems and major challenges.
40 experts. Including:
K. Åström, J. Willems, P. Varaiya,...

Future challenges (in 1995)

Robust-adaptive control

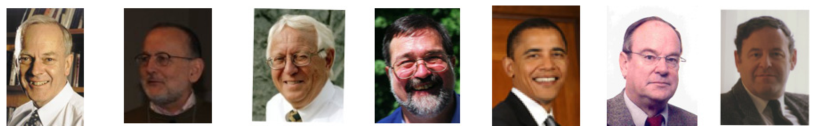
Almost everything (but things that work) in nonlinear control

Theory for continuous-discrete interaction

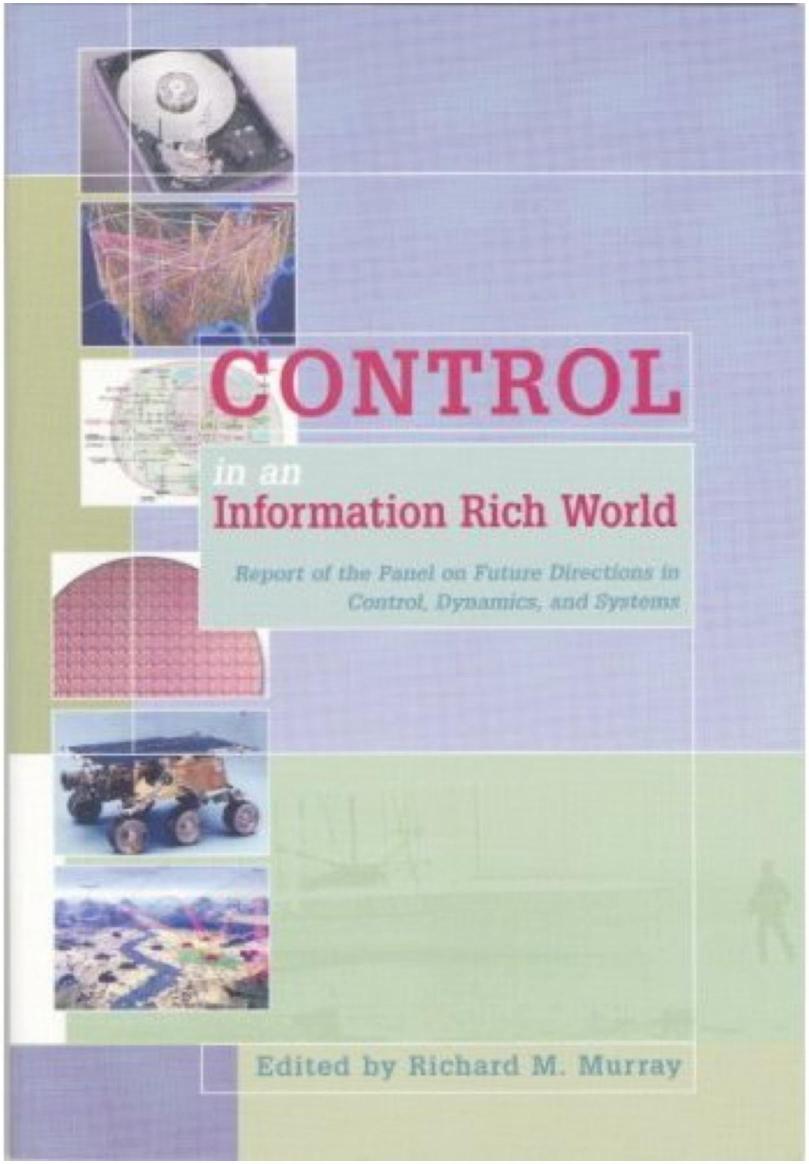
A new paradigm for modeling uncertainty

Cope with the interface between control and computer science

New blood, new applications



Future challenges (in 2000)



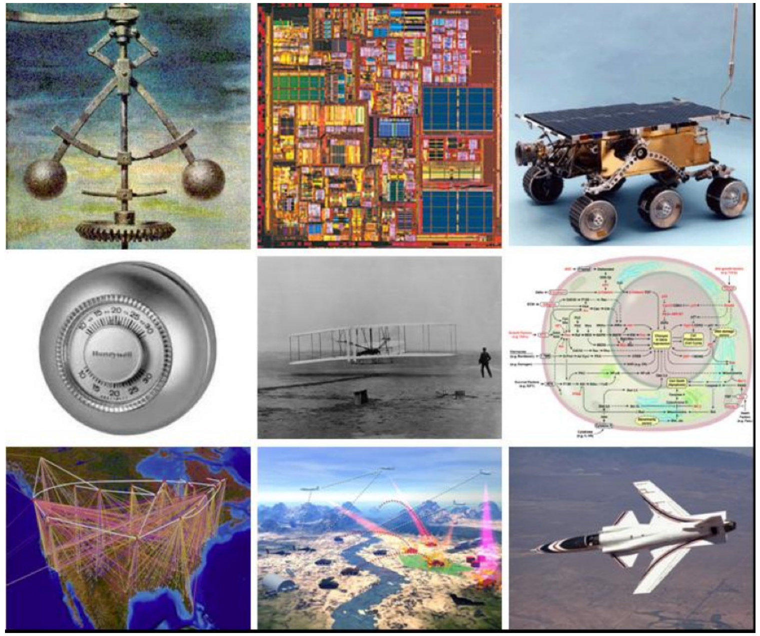
Panel on Future Directions in Control, Dynamics, and Systems

R. Murray, chair
K. Åström
S. Boyd
R. Brockett
M. Dahleh
J. How
P. Kumar
G. Stein
P. Varaiya

SIAM 2003

Future challenges (in 2000)

- Control of systems with both symbolic and continuous dynamics
- Control in distributed, asynchronous, networked environments



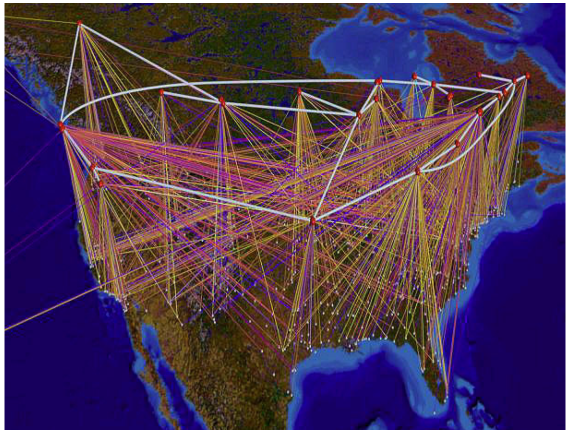
- High level of coordination and autonomy
- Automatic synthesis of control algorithms, with integrated verification and validation
- Building reliable systems from unreliable parts

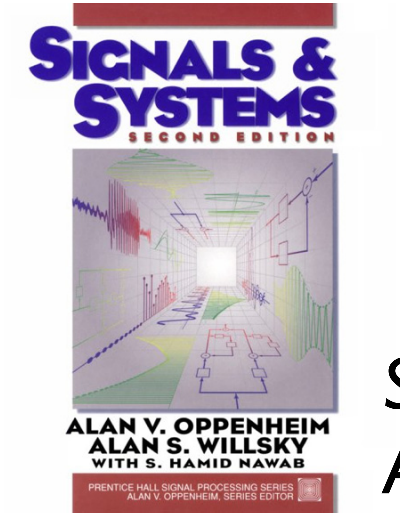
Recommendations (in 2000)

- Increase research aimed at the integration of control, computer science, communication, and networking
- Increase research in control at higher levels of decision making (learning, adaptation, artificial intelligence)
- Explore high-risk, long range applications to new domains
- Maintain support for theory and interaction with mathematics
- Invest in new approaches to education and outreach for the dissemination of control concepts to non-traditional audiences

1. Invisible

- Public attention and support
- Attract funding
- Attract students
- Education: make control visible to students





Signals and Systems
A. Oppenheim, A. Willsky

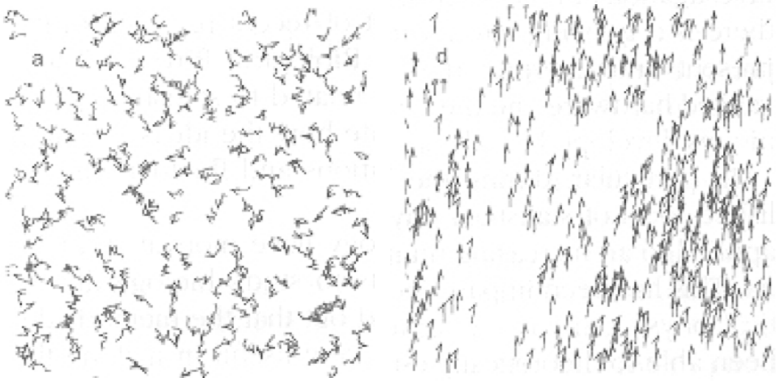
2. Theory-Application

- Need to be relevant for applications.

Prestigious control journals publish too many papers with internal questions that will never be of even indirect relevance to the outside world [Mark Davis]

- Unifying concepts and keep coherence.

- Diverse community.



Coordination in multi-agent systems

Tamás Vicsek, 1999

3. Service

Control is not like physics.
It is more like statistics: it is a service industry.

- Relevant for our clients
- Find new clients

Climate to energy to food supply to homeland security to medicine and biology [Munther Dahleh]

- Examples
  - Biological systems and bio-medical data analysis.
  - Coordination of unmanned autonomous systems.
  - Energy information systems
  - Intelligence, surveillance, and reconnaissance (ISR) systems.
  - Large-scale data assimilation for the geosciences
  - Network scheduling and routing
  - Sensor networks
  - Social network analysis and characterization
  - Ultra-wideband and other emerging communications technologies

Massachusetts Institute of Technology

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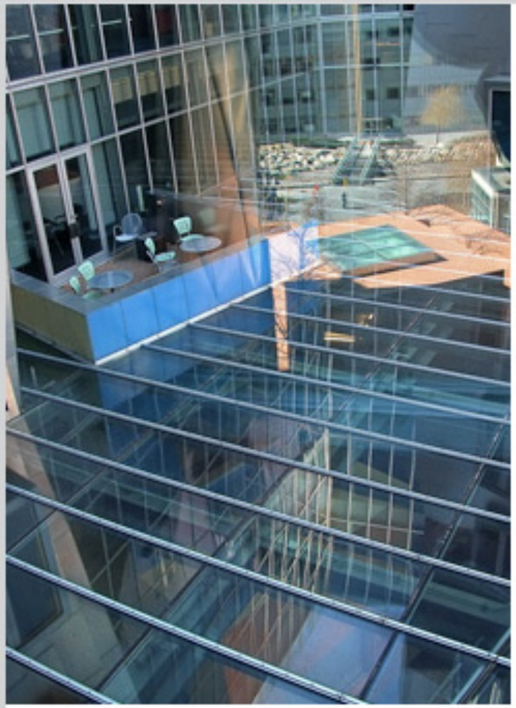

Research

LIDS research, while grounded in certain established disciplines, is predominantly of a multidisciplinary nature. It also spans the full range from fundamental research and the development of new methodologies, to applications of major significance.

Core engineering disciplines
Much of the research in LIDS revolves around the core disciplines of:

- Systems and control
- Communications, transmission of information, and networks
- Inference and statistical data processing

More often than not, research activities involve a combination of these disciplines. On the one hand, LIDS research builds on the knowledge base of these disciplines; but more importantly, LIDS plays a key role in identifying novel directions and advancing the state of the art in each of them.

Underlying methodologies
LIDS research relies on the analytical foundations provided by various mathematical disciplines, such as **probability and statistics**, **dynamic systems**, and **optimization and decision theory**. It also strives to advance these foundations along new directions, relevant to emerging engineering problems.

Application domains
Research in LIDS addresses and is driven by broad challenges, emerging applications, critical needs, and intellectual opportunities for technological advances. Active areas include:

- Biological systems and bio-medical data analysis.
- Coordination of unmanned autonomous systems.
- Energy information systems
- Intelligence, surveillance, and reconnaissance (ISR) systems.
- Large-scale data assimilation for the geosciences
- Network scheduling and routing
- Sensor networks
- Social network analysis and characterization
- Ultra-wideband and other emerging communications technologies