Curriculum Vitae

Prof. John Lygeros

Professor of Control and Computation
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Degrees/Higher Education

1996	PhD, Electrical Engineering University of California, Berkeley, U.S.A.
1991	MSc, Systems Control Imperial College, London, U.K.
1990	B. Eng. Electrical Engineering Imperial College, London, U.K.

Professional Career

2010 - present	Professor of Control and Computation, Department of Information Technology and Electrical Engineering, D-ITET, ETH Zurich
2009-present	Head, Automatic Control Laboratory, Department of Information Technology and Electrical Engineering, D-ITET, ETH Zurich
2006–2009	Associate Professor of Control and Computation, Department of Information Technology and Electrical Engineering, D-ITET, ETH Zurich
2003–2006	Assistant Professor, Department of Electrical and Computer Engineering, University of Patras, Greece
2000–2003	Lecturer, Department of Engineering, University of Cambridge, U.K.
1998–1999	Research Engineer (part-time), SRI International, Menlo Park, CA, U.S.A.
1997–1999	Postodoctoral Research Associate, University of California, Berkeley, U.S.A.
1996–1997	Postdoctoral Research Associate, Laboratory for Computer Science, MIT, U.S.A.

Professional Activities

- Associate Editor, IEEE Transactions on Automatic Control
- Guest Editor, International Journal of Adaptive Control and Signal Processing and the European Journal of Control
- Member of the IEEE Control Systems Society Conference Editorial Board, 1997–99
- Member of the program committees and organizing committees of numerous conferences and workshops

Membership in Societies

Fellow of the IEEE. Member of IET and the Technical Chamber of Greece

Publications

- 55 Refereed Journal Publications
- 156 Refereed Conference Publications
- 4 Edited volumes
- 43 Chapters in edited volumes

Research Interests

- Foundations of continuous time hybrid and stochastic hybrid systems
- Reachability and optimal control concepts in nonlinear and stochastic control
- Foundations of stochastic model predictive control
- Randomized methods for reachability computations in nonlinear, hybrid and stochastic hybrid systems
- Applications to air traffic management
- Applications to modeling analysis and control of biological systems
- Applications to power systems, including security considerations
- Applications to the control of camera networks

Current funded research projects

- Principal Investigator, Hierarchical Control for Renewable Wind Energy Generation, Staatssekretariat fur Bildung und Forschung (SBF)
- Coordinator and Principal Investigator, Modeling, verification and control of complex systems: From foundations to power network applications (MoVeS), European Commission, FP7- ICT-257005
- Principal Investigator, Highly-complex and networked control systems (HYCON II), European Commission, FP7-ICT-257462
- Principal Investigator, Intelligent Monitoring, Control, and Security of Critical Infrastructure systems (IntelliCIS), European Science Foundation COST Action, IC-0806
- Principal Investigator, Stochastic Model Predictive Control, Swiss National Science Foundation, 200021-122072
- Principal Investigator, Vital Infrastructure, Networks, Information and Control Systems Man- agement (VIKING), European Commission, FP7-ICT-SEC-225643,
- Principal Investigator, Feedback design for wireless networked systems (FeedNetBack), European Commission, FP7-ICT-223866
- Principal Investigator, Towards and understanding of nutrient signaling and metabolic operation (YeastX), SystemsX

Teaching

- Signals and Systems Theory II
- Linear Systems Theory
- Advanced Topics on Control

Personnel

Scientific coworkers	5
Non-scient. coworkers	2
Diploma/BA/MS projects	12
Doctoral students	11

For more information visit http://control.ee.ethz.ch/~jlygeros/

Prof. John Lygeros - Research Highlights

Control and Computation

Keywords

- Automatic Control, Hybrid and stochastic hybrid systems
- Reachability and safety verification
- Air traffic management, systems biology, networked control systems

Future priority areas

- Foundations of stochastic reachability in continuous time
- Randomized methods for reachability and optimal control
- Stochastic model predictive control
- Applications to systems biology
- Applications to power systems
- Applications to networked camera surveillance

Focus

The research activities of the group of Prof. John Lygeros concentrate on modeling analysis and control of complex, uncertain systems. Research ranges from studies into the theoretical foundations of complex, uncertain systems, to computational methods and applications, to air traffic management systems, systems biology, and networked control systems, including surveillance by camera networks and the security and control of power systems.

Theoretical foundations: Reachability

The theoretical work revolves mainly around reachability problems for dynamical systems. Roughly speaking, the question of interest is whether it is possible to keep a given system in a desirable set of states. Reachability can directly be related to problems of safety; for example it is the type of question one needs to address to ensure collision avoidance among aircraft in an air traffic management system. Reachability problems can take many diverse forms, depending on the types of dynamics considered, the presence or not of control and disturbance inputs, etc. We are looking at these issues for a range of dynamical systems, including deterministic continuous time control systems, continuous time hybrid systems with control and/or disturbance inputs, and discrete time stochastic hybrid systems with control inputs. In all cases we draw on mathematical machinery from the areas of dynamic programming, game theory and non-smooth analysis. An example of a numerical reachability computation using our methods is shown in Fig. 1.

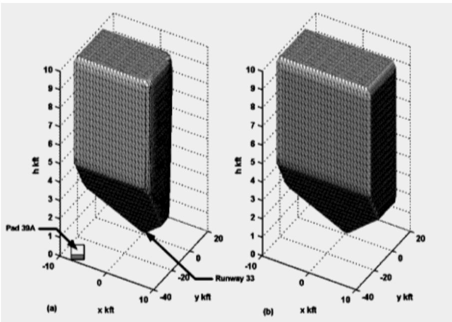

Figure 1: Results of a reachability computation that arises in the landing of the NASA HL-20 Personnel Launch Vehicle

Application Highlight: Air traffic management

The aim of our research in this area is to develop decision support tools to help the air traffic controllers deal with increased levels of traffic, while maintaining or improving the current level of safety. Doing this requires models for predicting the future positions of the aircraft and algorithms for determining whether safety problems are likely to arise in the near future and, if so, what to do about them. The group has been using randomized algorithms to estimate probabilities of collision and establish optimal decisions to resolve potential safety problems. An overview of the building blocks of the model developed to predict the future aircraft positions is shown in Fig. 2.

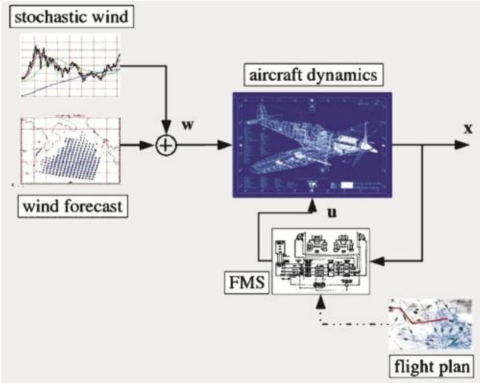

Figure 2: Building blocks of the stochastic hybrid model developed to capture aircraft flight from the point of view of air traffic controllers

Application Highlight: Systems biology

Modeling and understanding biological systems has been a topic of research for several decades. At the molecular level this effort has been given new impetus over the last decade by the advent of high throughput experimental methods (such as micro-arrays and confocal microscopy) that have allowed a new glimpse into the structure of genetic and protein networks, metabolic and signaling pathways, etc. The aim of our research in this area is to exploit these new sources of data to develop models for specific biological processes at the molecular level. The hope is that the predictions of the resulting models (in silico experiments) can lead to new insights into the workings of living organisms.

Application Highlight: Surveillance by networked cameras

In recent years there has been a growing interest in the use of surveillance cameras to prevent accidents and crime, promote security and safety, and monitor critical systems and traffic scenes. Surveillance systems can be found everywhere: in transport systems from taxis to trams, from small corner stores to large banks, from lonely footpaths to crowded streets and sport arenas. With the advent of closed circuit television (CCTV) the task of monitoring no longer requires a significant physical presence: the collective images from a large number of cameras may be monitored by “controllers” working in front of several monitors. Because human monitoring of surveillance video is a very labor-intensive task, however, there is growing interest in developing intelligent and automated surveillance systems. Our research aims to develop control algorithms to enable the automation of surveillance tasks for networks of cameras. The resulting algorithms are tested on hardware test-beds (shown below) comprising pan-tilt-zoom cameras, mobile robots and RC helicopters.

Figure 3: Building blocks of the hardware camera surveillance test-bed

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