Πανεπιστήμιο Κύπρου
University of Cyprus

School of Engineering
Department of Electrical and Computer Engineering

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Department of Electrical and Computer Engineering

Title: « Stochastic Realization of Finite-Valued and of Countably-Valued Stochastic Processes»

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Friday, 27th January 2017, 17:00 – 18:00
Room XOD02 – B208, New Campus – University of Cyprus

Abstract:
The aim of the lecture is to present to the audience a tutorial lecture on stochastic realization of finite-valued and of countably-valued stochastic processes. The lecture was presented at a workshop in December 2016.
The motivation of the lecture is the use in control and in filtering of stochastic control systems with finite-valued and with countably-valued output processes. Such systems are known as finite stochastic systems, hidden Markov models, and counting process systems. Research areas in which such systems are used include: information theory, communication theory, signal processing, queueing theory, control engineering, etc.
In addition, such systems are used as approximations of continuous-space stochastic systems. Such an approximation has the advantage that algorithms for filtering and for control of finite stochastic systems are available.
The concept of a finite stochastic system with a finite-valued output process will be defined both for discrete-time and for continuous-time systems. The associated concept of a countable-valued stochastic system is defined in which the set of gamma probability distributions appears. It will be shown that all these stochastic systems have both a forward and a backward representation.
The weak and the strong stochastic realization problems for finite-valued and for countably-valued processes will be formulated and embedded in a larger class of problems. The weak problem asks for the existence of a stochastic realization as a finite system, for the minimality of a realization, and for the classification of all minimal stochastic realizations. The existence problem has been solved for finite-valued processes during the 1960's. It is formulated in terms of the probability distributions of the output process which have to belong to a polyhedral cone with a finite number of vertices.
The minimality of stochastic realizations is not solved satisfactorily yet and the existing approaches will be discussed. For this the concepts of stochastic observability and of stochastic co-observability are formulated.
For the classification sub problem, the decomposition of positive matrices into a direct sum of irreducible positive matrices will be used followed by an investigation of the class of irreducible positive matrices.

Biography:
Jan H. van Schuppen studied at the Department of Applied Physics of the Delft University of Technology and graduated with an engineering diploma in 1970. He was awarded a Ph.D. diploma by the Department of Electrical Engineering and Computer Science of the University of California at Berkeley, California, USA in 1973. He is currently employed as Full Professor at the Department of Mathematics of the Delft University of Technology, Delft, The Netherlands. His research area is control and system theory, and more widely applied mathematics. Research areas outside mathematics in which he has experience in include: motorway traffic, communication systems, compartmental modeling, and biochemical reaction systems. His current research focus is on: control of distributed systems and networks, control of hybrid systems, control of discrete-event systems, realization and system identification, and modeling and control of biochemical reaction systems.