ECE Seminar

Conditionally Markov Processes: Theory and Application

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Abstract

Markov processes have been widely used in many areas of science and engineering for modeling random phenomena/systems. However, they are not adequate in cases, where the Markov property is not valid. A case in point is motion trajectory modeling with waypoints and/or destination information. Given the main components of a Markov process (i.e., an initial distribution and an evolution law), its future is determined probabilistically. So, waypoints and/or destination information cannot be incorporated. Therefore, stochastic processes more general than Markov processes are needed. Reciprocal processes, as a generalization of Markov processes, have been studied and used in some areas, including quantum mechanics, image processing, intent inference, trajectory modeling, and optimal transport. However, reciprocal processes do not offer a systematic approach for generalization of the Markov property appropriately in different problems. Conditionally Markov (CM) processes are a generalization of Markov processes based on the concept of conditioning. Having several sub-classes, CM processes provide a flexible and systematic approach for generalization of Markov processes. They are powerful from both theoretical and applied viewpoints. In this talk, some CM classes are defined, briefly studied, and their dynamic models are presented. General guidelines for applying CM processes are pointed out. An application of these processes for motion trajectory modeling in different scenarios (e.g., trajectories with waypoints and/or destination information, and trajectories of a pursuer and an evader) is demonstrated. To show the power of CM processes in theory, reciprocal processes (as a special class of CM processes) are studied from the CM viewpoint. This viewpoint, which is different from that of the literature on reciprocal processes, is very insightful and fruitful leading to new results and a better insight into reciprocal processes.

Biography

Reza Rezaie received his B.Sc. from Kerman University and his M.Sc. from Shiraz University, Iran, both in electrical engineering. Currently, he is a PhD candidate of electrical engineering at the University of New Orleans. His current research interests are stochastic processes, probabilistic graphical models, dynamical systems, statistical/machine learning, and reinforcement learning.