Umalca
Unión Matemática de América Latina y el Caribe

Escola Latino Americana de Matemática 2018

27 de agosto a 06 de setembro de 2018 • CMCC-UFABC, Santo André, SP, Brasil

Time reversed Markov jump linear quadratic problem and applications

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Abstract

Real world problems often suffer the intervenience of certain phenomena which can be modeled by stochastic processes. This is the case of dynamic systems subject to disturbances and faults, occurring for instance in weather models, stock exchange and internet based control. Linear systems with jump parameters are examples of a stochastic model with great potential in applications including as a sub- class the iconic Markov jump linear systems (in short, MJLS), as can seen in [1, 2, 6]. Recently, in [3] was introduced another sub-class of jump linear systems whose parameters jump according to a time reversed Markov chain, denominated time reverse Markov jump linear systems (in short, TRMJLS). In this paper, was obtained control formulas for optimizing standard quadratic costs, named time reversed Markov jump linear quadratic problem (TRM-JLQ problem). Also, the control problem of TRMJLS is in a rather natural duality with filtering of MJLS. TRMJLS are similar to standard MJLS, because they are useful in applications subject to abrupt changes of behaviour, they are linear, their second moment can be characterized by linear operators. They are dissimilar in other aspects, for instance the optimal gains of a TRMJLS depend on the distribution of the Markov chain. In fact, the only situation where TRMJLS and MJLS are essentially identical is when the Markov chain is revertible. One application of TRMJLS consists of drilling sedimentary rocks whose layers can be modelled by a Markov chain from bottom to top as a consequence of their formation process; the first drilled layer is the last formed one. Another application arises in the field of networked controllers, [4, 5] whose gains are typically pre-computed in a backward induction, sent one by one via a communication network to be stored in the controller's memory, and subsequently used in forward time during the on-line phase; note that the controller's memory works as an LIFO (last in first out) queue.

References

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