Mathematics > Probability

Pointwise stabilization of discrete-time matrix-valued stationary Markov chains

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Let $(\Omega,\mathscr{F},\mathbb{P})$ be a probability space and $\bS=\{\mathrm{S}_1,...,\mathrm{S}_K\}$ a discrete-topological space that consists of K real d-by-d matrices, where K and d both ≥2. In this paper, we study the pointwise stabilizability of a discrete-time, time-homogeneous, stationary $(\bp,\bP)$-Markovian jump linear system $\Xi=(\xi_n)_{n=1}^{+\infty}$ where $\xi_n\colon\Omega\rightarrow\bS$. Precisely, Ξ is called "pointwise convergent", if to any initial state $x_0\in\mathbb{R}^{1\times d}$, there corresponds a measurable set $\Omega_{x_0}\subset\Omega$ with $\mathbb{P}(\Omega_{x_0})>0$ such that \bean x_0{\prod}_{\ell=1}^n\xi_\ell(\omega)\to\mathbf{0}_{1\times d}\quad\textrm{as} n\to+\infty,\qquad\forall\omega\in\Omega_{x_0}; \eean and Ξ is said to be "pointwise exponentially convergent", if to any initial state $x_0\in\mathbb{R}^{1\times d}$, there corresponds a measurable set $\Omega_{x_0}^\prime\subset\Omega$ with $\mathbb{P}(\Omega_{x_0}^\prime)>0$ such that \bean x_0{\prod}_{\ell=1}^n\xi_\ell(\omega)\xrightarrow[]{\textrm{exponentially fast}}\mathbf{0}_{1\times d}\quad \textrm{as} n\to+\infty,\qquad\forall\omega\in\Omega_{x_0}^\prime. \eean Using dichotomy, we show that if Ξ is product bounded, i.e., $\exists\beta>0$ such that \bean \|{\prod}_{\ell=1}^n\xi_\ell(\omega)\|_2\le\beta\quad\forall n\ge1\textrm{and}\mathbb{P}\textrm{-a.e.}\omega\in\Omega; \eean then Ξ is pointwise convergent if and only if it is pointwise exponentially convergent.

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