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Passive Stochastic Realizations of Stationary Vector Processes

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We state the connection between the theory of stochastic realizations and the theory of passive impedance systems. This connection leads us to a new approach to study stochastic processes, linear stochastic systems and corresponding prediction, filtering, stability problems, both in discrete and continuous time cases.

We study stationary regular vector processes with spectral densities which are the boundary values of matrix-functions with bounded Nevanlinna characteristic. Such types of stochastic processes give rise of natural and widely used class of realization models. These models lead to simple recursion estimate algorithms called filters. Specifically the processes with rational spectral densities admit minimal realizations with finite-dimensional state spaces which take on the role of such filters. Minimal and optimal restrictions of passive impedance system lead to forward and backward Kalman filters for given process.