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Paper

On approximation of stable linear dynamical systems using Laguerre and Kautz functions â˜†

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Abstract

Approximation of stable linear dynamical systems by means of so-called Laguerre and Kautz functions, which are the Laplace transforms of a class of orthonormal exponentials, is studied. Since the impulse response of a stable finite dimensional linear dynamical system can be represented by a sum of exponentials (times polynomials), it seems reasonable to use basis functions of the same type. Assuming that the transfer function of a system is bounded and analytic outside a given disc, it is shown that Laguerre basis functions are optimal in a mini-max sense. This result is extended to the â€œtwo-parameterâ€ Kautz functions which can have complex poles, while the poles of Laguerre functions are restricted to the real axis. By conformai mapping techniques the â€œtwo-parameterâ€ Kautz approximation problem is recast as two Laguerre

Thus, the well-developed theory of Laguerre functions can be applied to analyze Kautz approximations. Unilateral shifts are used to further develop the connection between Laguerre functions and Kautz functions. Results on Ã¾$_2$ and Ã¾â^ž approximation using Kautz models are given. Furthermore, the weighted L_2 Kautz approximation problem is shown to be equivalent to solving a block Toeplitz matrix equation.

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Keywords

Linear systems; model approximation; orthonormal basis functions; Laguerre functions; model reduction

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