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COMPUTING $\exp(-\tau A)b$ WITH LAGUERRE POLYNOMIALS*

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Abstract. This paper discusses a method based on Laguerre polynomials combined with a Filtered Conjugate Residual (FCR) framework to compute the product of the exponential of a matrix by a vector. The method implicitly uses an expansion of the exponential function in a series of orthogonal Laguerre polynomials, much like existing methods based on Chebyshev polynomials do. Owing to the fact that orthogonal polynomials satisfy a three-term recurrence, what these series expansion methods offer over other approaches such as Krylov subspace methods lies in the elimination of inner products and the economy in storage since there is no need to compute and keep a set of basis vectors. Compared with Chebyshev polynomials that are orthogonal within a restricted interval and need estimates of the outermost eigenvalues, Laguerre polynomials offer the added feature that they are orthogonal on the half real line, alleviating therefore the need to estimate eigenvalues.

Key words. Conjugate residual, filtered conjugate residual, polynomial filtering, exponential propagation, orthogonal polynomials

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