SOLUTION OF DELAY SYSTEMS VIA COMBINED ORTHOGONAL FUNCTIONS AND POLYNOMIAL SERIES

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ABSTRACT

Depending on the structure, the orthogonal functions may be widely classified into three families. The first includes sets of piecewise basis functions (e.g., block-pulse, Haar, Walsh, etc). The second class consists of sets of orthogonal polynomials (e.g., Chebyshev, Laguerre, Legendre, etc). The third class is the set of sine-cosine functions in the Fourier series. While orthogonal polynomials and sine-cosine functions together form a class of continuous basis functions, piecewise basis functions have discontinuities or jumps.

Delays occur frequently in biological, chemical, electronic, communication, and power systems. Time-delay systems are therefore very important classes of systems whose control and optimization have been of interest to many investigators. In the present work we introduce a direct computational method to solve delay systems. The method consists of reducing the delay problems to a set of algebraic equations by first expanding the candidate function as a hybrid function with unknowns coefficients. These hybrid functions, which consist of block-pulse functions and polynomial series are given. The operational matrices of integration and delay are introduced. These matrices are then used to evaluate the coefficients of the hybrid function for the solution of delay systems. Numerical examples are included to demonstrate the applicability and the accuracy of the proposed method.