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A CHEBYSHEV COLLOCATION METHOD FOR SOLVING ORDINARY LINEAR DIFFERENTIAL EQUATIONS WITH VARIABLE COEFFICIENTS

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Abstract

Differential equations are frequently used to describe continuous-time dynamical system. Not all differential equations can be solved analytically, so several techniques have been developed to find approximate solutions. However, these methods are restricted to certain types of differential equations. Non-homogenous ordinary linear differential equations with variable coefficients are the very general class of ordinary linear differential equations. The intention of this work is to present an integral collocation method by using shifted Chebyshev polynomials of first kind to find an approximate solution of a linear differential equation with variable coefficients. The method starts with writing the highest derivative of the unknown function in a given differential equation as truncated shifted Chebyshev series in analytical form. Then, lower order derivatives and the unknown function are obtained by means of successive integrations and substituted in the given differential equation. Thereby, the equation reduces to an algebraic equation with unknown coefficients. Chebyshev nodes, given initial and or boundary condition values are used as shrewd collocation points to determine the Chebyshev unknown coefficients and integral constants. Three numerical examples with different initial and or boundary conditions are discussed to show the efficacy of the proposed method. An advantage of the method over conventional numerical method is that the solution is in polynomial form. Thus, solution obtained by this method can be used to interpolate other functional value in the domain. Also, it illustrated through the numerical examples presented that when the degree of the approximating polynomial increases, the approximate solution converges to exact solution.

Keywords: a*nalytical form, Chebyshev polynomials, Chebyshev nodes, collocation, interpolate, non-homogenous, ordinary linear differential equations*