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Summary: This paper analyzes a method for solving the third- and fifth-order differential equations with constant coefficients using a Jacobi dual-Petrov-Galerkin method, which is more reasonable than the standard Galerkin one. The spatial approximation is based on Jacobi polynomials $P_{\alpha,\beta}^n$ with $\alpha, \beta \in (-1, \infty)$ and $n$ is the polynomial degree. By choosing appropriate base functions, the resulting system is sparse and the method can be implemented efficiently. A Jacobi-Jacobi dual-Petrov-Galerkin method for the differential equations with variable coefficients is developed. This method is based on the Petrov-Galerkin variational form of one Jacobi polynomial class, but the variable coefficients and the right-hand terms are treated by using the Gauss-Lobatto quadrature form of another Jacobi class. Numerical results illustrate the theory and constitute a convincing argument for the feasibility of the proposed numerical methods.

MSC:
65L60 Finite element, Rayleigh-Ritz, Galerkin and collocation methods for ordinary differential equations
33C45 Orthogonal polynomials and functions of hypergeometric type (Jacobi, Laguerre, Hermite, Askey scheme, etc.)

Keywords:
Petrov-Galerkin method; Jacobi collocation method; Jacobi polynomials; Jacobi-Gauss-Lobatto quadrature; fast Fourier transform; Jacobi-Jacobi Galerkin method

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