Approximating a class of nonlinear fourth-order ordinary differential problems

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Differential matrix models are an important component of many interesting applications in science and engineering. This work elaborates a procedure to approximate the solutions of special nonlinear fourth-order matrix differential problems of the type

\[ Y^{(4)}(x) = f(x, Y(x)), \quad x \in [a, b], \]

by suitable matrix splines \cite{1}. Traditionally, the scalar fourth-order ordinary differential equations are transformed to a first-order system of ordinary differential equations so that standard numerical methods may be applied. However, this technique comes with an increase of computational cost due to the higher dimensionality of the problem. For this reason, in the scalar case, direct integration methods have attracted significant attention for solving fourth-order or higher-order problems. These direct methods give impressive advantages in accuracy and speed over the conventional approach, see \cite{2, 3, 4} and references therein, which we now generalize to matrix systems. In conclusion, we provide two examples of the proposed matrix method and demonstrate its efficiency.

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