

# **Solving hyperbolic partial differential equations using multi-domain bivariate spectral collocation method**

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## **Abstract**

In this article, the multi-domain bivariate spectral collocation method is applied, for the first time, in solving hyperbolic partial differential equations (PDEs) that are defined over large time domains. The proposed method is based on decomposing the time domain into smaller non-overlapping subintervals. This study is aimed at showing that the reduction in the size of the computational domain at each subinterval guarantees that accurate results are obtained within shorter computational time. In the solution process, the approximate solutions of the PDEs are approximated by bivariate Lagrange interpolation polynomials. The PDEs are discretized on both time and space variables using spectral collocation. The resulting linear systems are then solved independently at each subinterval with the continuity equation being employed to obtain initial conditions in subsequent subintervals. Finally, the approximate solutions of the PDEs are obtained by matching the solutions on different subintervals along common boundaries. New error bound theorems and proofs for bivariate polynomial interpolation using Gauss-Lobatto nodes are given. The effectiveness and accuracy of the proposed method are demonstrated by presenting error analysis and the computational time for the solution of well-known hyperbolic PDEs. The method can be adopted and extended to solve problems in real life that are modelled by hyperbolic PDEs.