A Fast Runge-Kutta Convolution Quadrature for Solution of the 3D Wave Equation in Unbounded Domains

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Abstract

We consider a Dirichlet problem for the three-dimensional wave equation in an unbounded domain with zero initial conditions. To solve the problem we use time-domain boundary element formulation and employ Runge-Kutta convolution quadrature approach for time discretization and Galerkin method for space discretization. We improve the method of the solution of the discretized system presented in [1] exploiting the fact that the convolution weights $w_n(d)$ can be approximated by zero outside a neighborhood of $d \approx n \Delta t$, and thus the series representing the discretized kernel of the wave equation can be truncated at a finite number of terms. The sparse matrices constructed for the approximation of the convolution weights are reused during different stages of the recursive matrix-vector multiplication. The algorithm presented allows reduction of the time and storage costs for both matrix construction and matrix-vector multiplication, retaining the original linear order of complexity.

This is a joint work with L. Banjai (MPI MIS, Leipzig)

References