A space-time dual-pairing summation-by-parts framework for wave equations

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Abstract

The dual-pairing summation-by-parts (DP-SBP) framework has recently gained considerable attention due to its accuracy and robustness in solving wave propagation problems. In this talk, we present an extension of the DP-SBP framework to integrate in time using the second order wave equation as a model problem. This approach enables us to achieve temporal high order accuracy while naturally introducing dissipation in time. We combine our proposed framework with spatial DP-SBP operators and weakly impose the initial and boundary conditions using the simultaneous-approximation-term (SAT) technique. Fully discrete energy estimates are derived, ensuring the stability of the resulting numerical approximation. Furthermore, the proposed framework allows us to construct semi-discrete and fully discrete adjoint consistent numerical approximations, which can be applied to solve inverse wave propagation problems. We provide numerical experiments to verify the theoretical analysis and demonstrate convergence of numerical errors.