A well-posed DPG formulation for the wave equation in multiple dimensions

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There has been increasing interest recently in direct space-time discretizations, where time is viewed as another coordinate. Some advantages of using these approaches include their potential for performing natural space-time adaptivity, possibility to obtain convergence even under limited space-time regularity, exploitation of parallelism without causality constraints, and treatment of moving boundaries. Since the DPG method has a built-in error estimator and exhibits good pre-asymptotic mesh-independent stability properties, it is natural to consider its extension to space-time problems.

In this talk, we will present the conditions that lead to a well-posed DPG formulation based on a weak formulation using graph spaces [2]. We will focus on the proof of a non-standard density result to verify one of these conditions for the wave equation [1]. The potential of using the built-in error estimator of the DPG method for an adaptive mesh refinement strategy in two and three dimensions will be presented.

[1] J. Gopalakrishnan and P. Sepúlveda. A space-time DPG method for the wave equation in multiple dimensions, to appear in the book: Space-Time Methods. Applications to Partial Differential Equations - Radon Series on Computational and Applied Mathematics, 2019.

[2] L. Demkowicz, J Gopalakrishnan, S Nagaraj, and P. Sepúlveda. A spacetime DPG formulation for the Schrödinger equation. SIAM Journal on Numerical Analysis 55 (4), 1740-1759.