

Development of DPG Methods for Nonlinear Elasticity

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The talk will be a 'continuation' of the presentation on a general framework for Discontinuous Petrov-Galerkin (DPG) methods for nonlinear problems, I gave at TH Hamburg two years ago. This time, we will focus directly on a class of nonlinear elasticity problems represented by the classical Cook's membrane problem. We will discuss several technical subjects:

- (i) Choice of a variational formulation [1].
- (ii) Comparison of Newton-Raphson with Steepest Descent Method [2].
- (iii) Construction of a robust formulation for nearly incompressible elasticity [3].

Time permitting, I may mention some related results on combining Machine Learning technology with hp DPG FE methods for determining parameter-to-solution map (joint work with W. Dahmen).

- [1] J. Zhang and L. Demkowicz, "Nonlinear Elasticity with the Discontinuous Petrov-Galerkin Method. I. Various Variational Formulations".
Computer and Mathematics with Applications: 200, pp. 276-289, 2025.
- [2] J. Zhang and L. Demkowicz, "Nonlinear Elasticity with the Discontinuous Petrov-Galerkin Method. The Steepest Descent Method",
Comp. Meth. Appl. Mech. Engr: 454: 118875, 2026.
- [3] J. Zhang and L. Demkowicz, "Construction of a robust formulation for nearly incompressible nonlinear elasticity", submitted to Computer and Mathematics with Applications.