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Benchmarking stabilized and self-stabilized p-virtual element methods with variable coefficients

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Virtual Elements (VEM) [1] generalize the Finite Element Method, allowing the discretization of complex geometries through general polytopal meshes.

The discrete space, which includes polynomials to ensure accuracy, is implicitly defined, as shape functions are solutions of a local PDE that is typically not solved. The discrete problem is constructed via polynomial projections, and well-posedness is ensured by a stabilization term accounting for the non-polynomial part of the space. However, the stabilization form is generally arbitrary and may not reflect the physical properties of the problem. Consequently, stabilization-free [2] or self-stabilized [3] VEM formulations are gaining popularity.

Moreover, an improper choice of polynomial projector and stabilization may deteriorate accuracy in the presence of variable coefficients.

This study [4] investigates the p-version of VEM and compares stabilized and self-stabilized formulations on academic benchmarks and application-oriented scenarios, particularly curvilinearly stiffened variable stiffness panels, widely used in aerospace structures.

References

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Autori: CREDALI, Fabio (King Abdullah University of Science and Technology); Dr. FOLIGNO, Paola Pia (Politecnico di Milano); Prof. BOFFI, Daniele (King Abdullah University of Science and Technology, University of Pavia); Prof. VESCOVINI, Riccardo (Politecnico di Milano)

Relatore: CREDALI, Fabio (King Abdullah University of Science and Technology)

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