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From h to p Efficiently: Implementing finite and spectral/ hp element methods to achieve optimal performance for low and high order discretisations.

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Abstract

The spectral/ hp element method can be considered as bridging the gap between the – traditionally low order – finite element method on one side and spectral methods on the other side. Consequently, a major challenge which arises in implementing the spectral/ hp element methods is to design algorithms that perform efficiently for both low- and high-order spectral/ hp discretisations, as well as discretisations in the intermediate regime. In this paper, we explain how the judicious use of different implementation strategies can be employed to achieve high efficiency across a wide range of polynomial orders. Furthermore, based upon this efficient implementation, we analyse which spectral/ hp discretisation (which specific combination of mesh size h and polynomial order P) minimises the computational cost to solve an elliptic problem up to a predefined level of accuracy. We investigate this question for a set of both smooth and non-smooth problems.
