

On the reference mapping for quadrilateral and hexahedral elements on multilevel adaptive grids

Friedhelm Schieweck¹ Gunar Matthies²

We study the properties of a general non-affine family of quadrilateral and hexahedral meshes with possibly hanging nodes which are typically generated by an adaptive finite element method starting from a regular coarse mesh. It turns out that for such meshes the reference mapping, which maps a fixed reference element to an arbitrary element of the mesh, behaves nearly like an affine mapping up to a perturbation of the magnitude of the mesh-size. This result may be useful for the finite element analysis since it allows to generalize by means of a perturbation argument some existing results that are proved in the literature only for the special case of an affine equivalent quadrilateral and hexahedral finite element mesh. However, from the practical point of view, the assumption of an affine equivalent mesh is too restrictive for quadrilateral and hexahedral mesh cells since it would admit only parallelograms or parallelepipeds. As an application we show how the local inf-sup condition for the (Q_r, P_{r-1}) element can be proved via transformation from a known inf-sup condition on the unit cube.

¹Otto-von-Guericke Universität Magdeburg, Institut für Analysis und Numerik, Postfach 4120, 39016 Magdeburg, Germany,

Friedhelm.Schieweck@mathematik.uni-magdeburg.de

²Ruhr-Universität Bochum, Fakultät für Mathematik, Raum NA 2/69, D-44780 Bochum, Gunar.Matthies@ruhr-uni-bochum.de