Non-Conforming Grids for Flexible Discretization with Applications to Computational Acoustics

Manfred Kaltenbacher[1]

We investigate flexible discretization techniques for the approximate solution of wave propagation problems. In order to keep as much flexibility as possible, we use independently generated grids which are well suited for approximating the solution of decoupled local sub-problems in each subdomain. Therefore, we have to deal with the situation of non-conforming grids appearing at the common interface of two subdomains. Special care has to be taken in order to define and implement the appropriate discrete coupling operators. We apply the Finite Element (FE) method and use three approaches to handle non-conforming grids: (1) Mortar coupling (2) Nitsche type mortaring and (3) Hybrid Nitsche type mortaring. In the first approach we guarantee the strong coupling of the numerical flux (normal derivative of the acoustic pressure) by introducing a Lagrange multiplier and coupling of the acoustic pressure in a weak sense. The Nitsche's type coupling does not need the additional Lagrange multiplier and handles the coupling by symmetrizing the bilinear form and adding a special jump term. Thereby, the method can be also interpreted as an IP-DG (Internal Penalty - Discontinuous Galerkin) at the interface. Finally, the hybrid Nitsche type mortaring introduces an additional hybrid variable to allow for an efficient decoupling of subdomains. Furthermore, the degrees of freedom of the hybrid variable are defined globally with respect to the geometry and represented by means of basis splines. The interface geometry is given by NURBS (Non-uniform Rational Basis Splines) allowing for an exact description of curved interfaces, an aspect incorporated from Isogeometric Analysis.

We will compare the proposed methods, discuss their advantages and disadvantages and will apply them to practical examples in computational acoustics.

[1] Institute of Mechanics and Mechatronics, TU Wien, Austria,
manfred.kaltenbacher@tu-wien.ac.at