DK Seminar

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University of Vienna,
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Perception of discontinuous Galerkin finite element methods as discrete approximation schemes

We propose a new kind of analysis for discontinuous Galerkin finite element methods (DGFEM) [1] which employs the framework of discrete approximation schemes (DAS) [2].
Nowadays DGFEM are widely spread and extensively used for various applications. Some reasons for this popularity are easy coupling of different discretization methods, block diagonal mass matrices for explicit time-stepping, favourable properties for transport dominated problems and an alternative to second order regular elements. However, the classical analysis of DGEM requires severe smoothness assumptions on the solution which may not be satisfied in practice. Only very few approaches have been reported under minimal regularity assumptions.
The theory of DAS, which goes back to Stummel, formulates a most general form of approximation scheme and derives sufficient conditions to yield convergence. The avaible results yield a rich toolbox to analyse approximations to e.g. non-linear operator equations and holomorphic operator eigenvalue problems.
In this talk we give a brief introduction into the two concepts of DGFEM and DAS. We explain how to embed DGFEM into the framework of DAS which naturally requires only minimal regularity assumptions. Subsequently

we employ the former to derive convergence results for several scalar model problems. If time permits, we expose how the presented concept paves the way to analyze CDGFEM approximations to an electromagnetic fourth order non-symmetric quadratic interior transmission eigenvalue problem.

[1] Di Pietro, Ern (2012): Mathematical aspects of discontinuous Galerkin methods, Springer

[2] Genadi Vainikko (1976): Funktionalanalysis der Diskretisierungsmethoden, Teubner Verlag