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BUBBLE STABILIZATION OF DISCONTINUOUS GALERKIN METHODS

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ABSTRACT

Most commonly used DG methods need the addition of suitable stabilizing terms in order to provide good convergence properties. The typical stabilizing procedure consists in the introduction of *penalty terms* that penalize the jumps across neighboring elements. Here we analyze the stabilizing effect of the introduction of suitable bubble functions in DG formulations for linear second order elliptic problems. Apparently, the addition of bubble functions does not mean much in DG-formulations, as all the basis functions already have support in a single element (hence, in a sense, they are *all*, already, bubbles). We could therefore consider that for DG methods adding bubbles is just the same as augmenting the finite element space, in an arbitrary way. For instance, in two dimensions, shifting from linear discontinuous elements to quadratic discontinuous elements could be seen as adding three bubbles per element (corresponding to x^2, y^2, and xy).

The aim of this talk is to provide conditions that allow to obtain stability by augmenting the finite element space with the *minimum* number of bubbles. In particular we analyze the nonsymmetric formulation of Baumann-Oden on rather general decompositions, and we show that the piecewise linear discontinuous approximation, without jump stabilization, can be used if suitable bubbles are added to the local spaces. More precisely, on a decomposition into polygons of n edges, $n-2$ bubbles per element are needed. We explicitly provide the bubble needed for triangular meshes, and the two bubbles needed on quadrilateral meshes, and show numerical results.

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