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A discontinuous Galerkin approach to the elasto-acoustic problem on polytopic grids

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Coupled elasto-acoustic evolution problems arise, for example, in geophysics, namely in the modeling and simulation of seismic events near coastal environments, but also in the modeling of sensing/actuation devices immersed in an acoustic fluid, or in medical ultrasonics. In practical applications, the underlying geometry one has to deal with is remarkably complicated and irregular. For this reason, considering a conforming triangulation would be computationally very expensive. We are thus led to consider a space discretization capable to reproduce the geometrical constraints under consideration to a reasonable extent of accuracy, without being at the same time too much demanding. Such discretization is then performed using general polygonal/polyhedral (polytopic) elements, with no restriction on the number of faces each element can possess, and possibly allowingfor face degeneration in mesh refinement.

In this work we develop and analyse a discontinuous Galerkin (dG) method on polytopic grids for a coupled evolution problem involving propagation of viscoelastic and acoustic waves. We state and prove a well-posedness result for the strong formulation of the problem, present a stability result for the semi-discrete formulation, and finally prove an a priori energy error estimate for the resulting formulation. The convergence results are validated by numerical experiments.