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A deformed spectral quadrilateral multi-domain penalty model for the incompressible Navier-Stokes equations[1] SUMEDH JOSHI, Center for Applied Mathematics, Cornell University, PETER DIAMESSIS, Department of Civil and Environmental Engineering, Cornell University — A penalty method is a variant of a spectral element method that weakly enforces continuity between adjacent elements and weakly enforces continuity at physical boundaries. Furthermore, at the boundaries, the PDE is also partially satisfied. The spirit of such a formulation is that in theory, a PDE operates arbitrarily close to any measure-zero boundary. Here, a previous spectral multi-domain penalty model for the incompressible Navier-Stokes equations is extended to include deformed boundaries for shoaling-type problems encountered in environmental fluid mechanics. Some difficulties addressed include satisfying compatibility conditions in a (pseudo-)pressure Poisson equation that arises. A previous strategy to satisfy compatibility by use of a null singular vector is presented and strategies to enforce compatibility for the deformed problem are discussed. Results are shown for standard incompressible flow benchmarks. The primary goal of this work is to model nonlinear internal wave propagation along a shallow, sloping bathymetry, as may be characteristic of a continental shelf region.

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