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Accurate solution of the Poisson equation with discontinuities[1]
JEAN-CHRISTOPHE NAVE, McGill University, ALEXANDRE MARQUES, RODOLFO ROSALES, Massachusetts Inst of Tech-MIT — Solving the Poisson equation in the presence of discontinuities is of great importance in many applications of science and engineering. In many cases, the discontinuities are caused by interfaces between different media, such as in multiphase flows. These interfaces are themselves solutions to differential equations, and can assume complex configurations. For this reason, it is convenient to embed the interface into a regular triangulation or Cartesian grid and solve the Poisson equation in this regular domain. We present an extension of the Correction Function Method (CFM), which was developed to solve the Poisson equation in the context of embedded interfaces. The distinctive feature of the CFM is that it uses partial differential equations to construct smooth extensions of the solution in the vicinity of interfaces. A consequence of this approach is that it can achieve high order of accuracy while maintaining compact discretizations. The extension we present removes the restrictions of the original CFM, and yields a method that can solve the Poisson equation when discontinuities are present in the solution, the coefficients of the equation (material properties), and the source term. We show results computed to fourth order of accuracy in two and three dimensions.

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