1116-35-1558 **Dominique Zosso*** (zosso@math.ucla.edu), **Braxton Osting**, **Mengqi Xia** and **Stanley J. Osher**. *A fast primal-dual method for the obstacle problem.*

We solve the discrete obstacle problem using a primal-dual hybrid gradients (PDHG) method. We reformulate the a convex minimization as a primal-dual problem, based on the Legendre-Fenchel transform of the surface area and the Dirichlet energy, respectively. The resulting saddle-point problems are solved by the PDHG method, which consists of three iterative steps: the dual and primal variable proximal updates, and an extra-gradient step (overrelaxation) of the primal variable. The proximal updates can be solved efficiently, and in the linear case even particularly so.

Since this method requires no matrix inversions or explicit identification of the contact set it achieves state-of-the-art precision with a speed up of 1-2 orders of magnitude. In addition to being efficient, the proposed algorithm benefits from a highly interesting physical interpretation: over iterations, there is build-up of a certain "momentum" that accelerates the updates beyond the limits of the usual CFL step-size criteria. Similarly, the scheme can be brought into a form that is highly reminiscent of a damped wave equation.

The derivation of this method is disciplined and can be adapted to a wide range of other constrained convex optimization problems and the solution of elliptic PDE. (Received September 20, 2015)