1125-65-1947 **Joseph A Eichholz*** (eichholz@rose-hulman.edu), 5500 Wabash Ave, Terre Haute, IN 47803.

A new multi-grid method for the obstacle problem. Preliminary report.

The obstacle problem is a standard example of a variational inequality of the first kind. Variational inequalities naturally arise in a wide range of applications, for example, elastoplasticity, contact mechanics, heat control problems, and options pricing problems in finance. Due to the inequality in the formulation of the obstacle problem, the standard quadratic finite element method only achieves $\mathcal{O}(N^{-3/4+\epsilon})$ convergence, where N is the number of degrees of freedom and $\epsilon > 0$ arbitrary. We introduce a new multi-grid algorithm for solving the obstacle problem in which we solve the obstacle problem, capture the free boundary, refine the mesh, and solve the problem on a new mesh. We extend previous work to demonstrate that the method has has nearly optimal convergence order $\mathcal{O}(N^{-1+\epsilon-p})$, where p is the degree of the basis. Numerical evidence is provided indicating superior performance to standard finite element methods. (Received September 19, 2016)