

Finite Element Method and its Analysis for a Nonlinear Helmholtz Equation with High Wave Numbers

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The well-posedness of a nonlinear Helmholtz equation with an impedance boundary condition is established for high frequencies in two and three dimensions. Stability estimates are derived with explicit dependence on the wave number. Linear finite elements are considered for the discretization of the nonlinear Helmholtz equation, and the well-posedness of the finite element systems is analyzed. Stability and preasymptotic error estimates of the finite element solutions are achieved with explicit dependence on the wave number. Numerical examples are also presented to demonstrate the effectiveness and accuracies of the proposed finite element method for solving the nonlinear Helmholtz equation.