Variational Methods for Boundary Integral Equations of the Second Kind
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The main focus of this dissertation is to investigate the notion of convergence of certain finite element numerical schemes for a second kind boundary integral equation. The first three chapters set the background that fully motivates the weak formulations to be used to generate the numerical schemes. The following chapters are then dedicated to looking at numerical solutions to the problem under study that are generated by the various weak formulations.

Several different weak formulations will be considered. Some of these will be on “solid ground” in the sense that appropriate convergence will have been shown to be guaranteed for these methods by principles of functional analysis. The remaining methods, one in particular, will be shown to involve much less work in calculations to generate the numerical approximation than the corresponding proven method, but the simpler scheme will come with the cost of being suspect in its convergence in the desired norm to the real solution of the original problem.

The tone of the dissertation then becomes to compare and contrast all of these methods and to show that under certain conditions, in particular conditions that pertain to the boundary integral equation under study, the simpler methods are sometimes sufficient to give the desired convergence of the numerical solutions in the desired norm. This would suggest that certain classes of problems can be solved more easily than might be expected at first glance, especially in terms of writing and running the computer code that generates the numerical approximations to an actual solution of one of these problems.