**Solving the Helmholtz Equation Utilizing**

**Gauss-Seidel & Over-Relaxation in MATLAB**

**MECE 5397 – Scientific Computing**

**Project A - Helmholtz Equation**

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Friday May 5th, 2017

# Abstract

# Mathematical Statement of Project

This reports will cover the different test conducted, utilizing numerical methods to solve the Helmholtz Equation. In the subject of mathematics, the Helmholtz equation is the partial differential equation that represents the time-independent wave equation. Below is Helmholtz Equation, where is the Laplacian, k is the wavenumber, and A is the amplitude.

The problem assigned asked to solve the Helmholtz equation on a rectangular surface with the following boundary conditions: 3 nonhomogeneous Dirichlet, 1 homogenous Neumann, and a function of F(x,y).

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2. 2
3. )-

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# Discretized Version of the Equations

Discretization is the transformation of continuous differential equation transforming them into discrete difference equation, which are fit for numerical computing. The partial derivatives given in the problem, are approximated by linear combinations of functions values at the grid point. Then, the second order center difference approximation is applied to both the x and y second derivatives at all points in the mesh.



Now, the equation can be replaced into the original wave equation to approximate the x and y second derivatives of us at the mesh (i,j). Center difference approximation shown below:

After rearranging the equation above, one can find the discretized Helmholtz Equation, solved for ui,j:

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# Numerical Method – Pseudo Code

# Technical Specification of the Computer Used

# Results