Scientific Computing Project Report

**Iterative Numerical Solutions for the Two-Dimensional Poisson Equation:**

**Gauss – Seidel and Successive Over Relaxation Methods**

**(Project: AP02-2)**

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**Abstract**

**Mathematical Problem Statement**

A MATLAB code was written to generate a numerical solution for the following problem:

Where the domain is a rectangle with bounds

,

,

And the following boundary conditions

, ,

,

**Discretization of 2nd Order 2D Poisson Eqn.**

Gauss – Seidel:

Approximate 2nd order terms using the Taylor Series 2nd Order Centered Difference Formula, where,

And substitute

Assuming , expression simplifies to

And yields to a 4-point discretized solution

*“Gauss-Seidel Discretized Solution”*

Successive Over-Relaxation:

The method of *Successive Over-Relaxation* can be viewed a modification of the *Gauss-Seidel* method, where *i = iteration*

*“Successive Over-Relaxation Discretized Solution”*

Where is a *relaxation factor* and *uGS* represents the discretized *Gauss-Seidel* solution. It is interesting to note that an SOR solution with simplifies to the regular *Gauss-Seidel* method.

**Numerical Method and Algorithm**

It is convenient to note the algorithm for *Gauss-Seidel* and *SOR* are very similar, with just a couple small accommodations.