MATH609-600

Programming Assignment #2

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1 Problem Specifications

The compututional examples are explored using basic iterative methods.

1.1 System with a Tridiagonal matrix

The approximate solution of the given linear system is computed for various intervals and iterative methods and then compared with the exact solution in the first part.

Method	$n = 19$	$n = 39$	$n = 79$
Jacobi	1915	7222	27078
Gauss-Seidel	977	3679	13788
SOR	426	1632	6150
SSOR	240	839	3144

Table 1: Iterations for Convergence required in Example 1, part a

Method	$n = 19$	$n = 39$	$n = 79$
Jacobi	1914	7225	27115
Gauss-Seidel	976	3679	13803
SOR	425	1631	6153
SSOR	358	1064	3546

Table 2: Iterations for Convergence required in Example 1, part b

1.2 Approximation of 2D Elliptic equation

A 5-point finite difference formula is used to model the two-dimensional elliptic equation. The approximate solution is computed by applying the given boundary conditions.
In general, SSOR converges at the fastest rate to the required tolerance level. However, due to certain requirements on the matrix to be inverted, it does not alwasys give the correct results.

Method	$n = 8$	$n = 16$	$n = 32$
Jacobi	421	1443	5149
Gauss-Seidel	217	744	2656
SOR	83	319	1171
SSOR	65	185	623

Table 3: Iterations for Convergence required in Example 2

1.3 Approximate Solution of Electrostatic Potential in a box

Once again, 5 point finite difference equation is used to compute the electric potential in a box. The boudary conditions are taken so that the three sides have voltage while the top side has 100 volts on it. The problem is solved through all the basic iterative methods.

Method	$n = 8$
Jacobi	741
Gauss-Seidel	385
SOR	161
SSOR	99

Table 4: Iterations for Convergence required in Example 3

2 Preliminaries

Basic Iterative methods for solution of linear system of eqations is implemented in MATLAB. The convergence is set for double precision data.

3 Computational Results

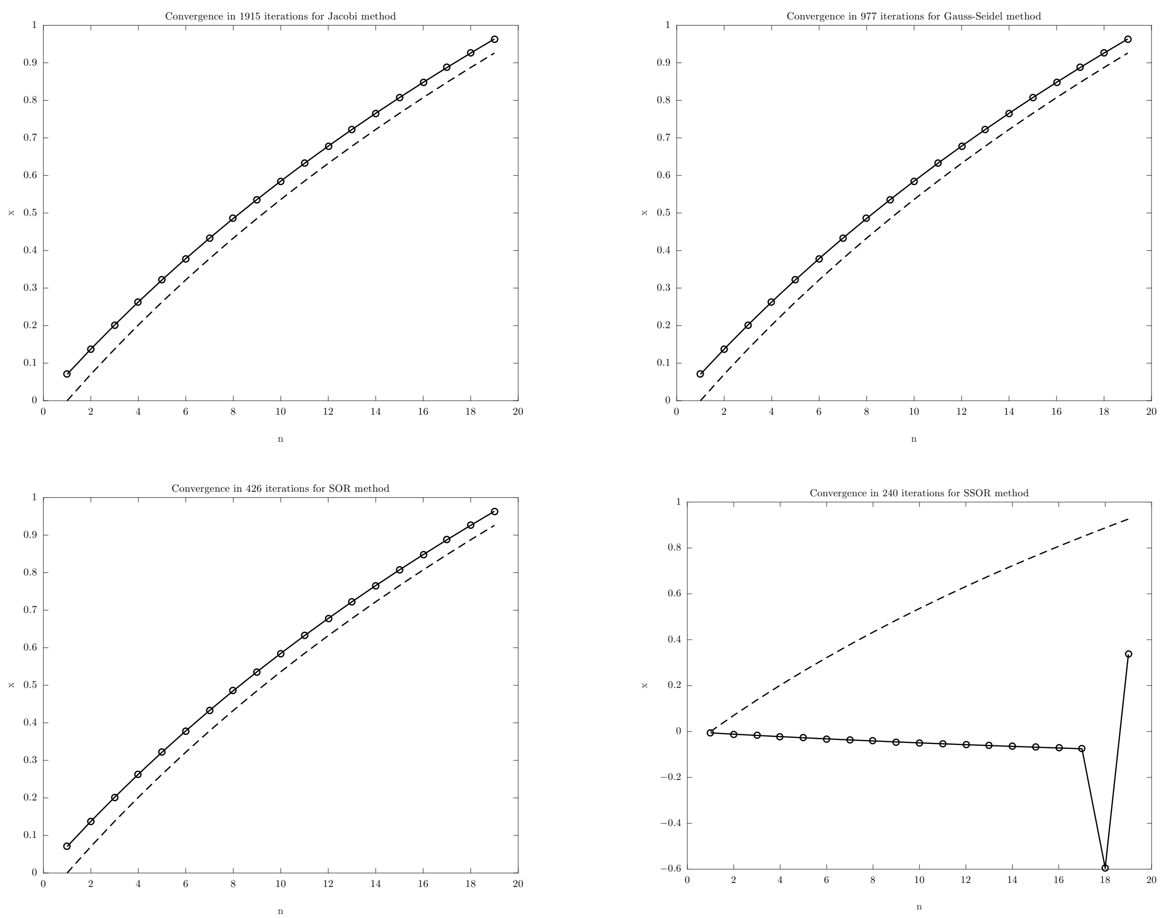

Figure 1: Comparative plots at n = 19

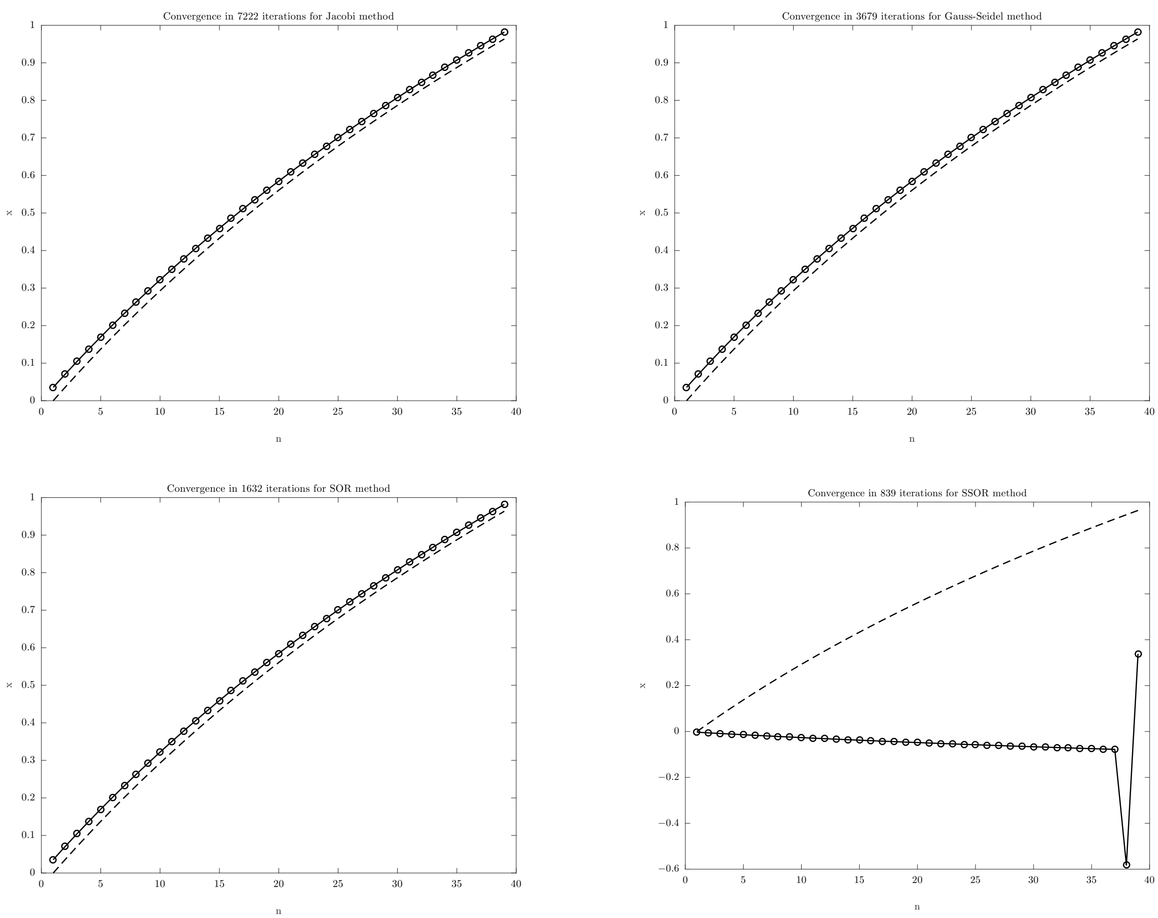

Figure 2: Comparative plots at n = 39

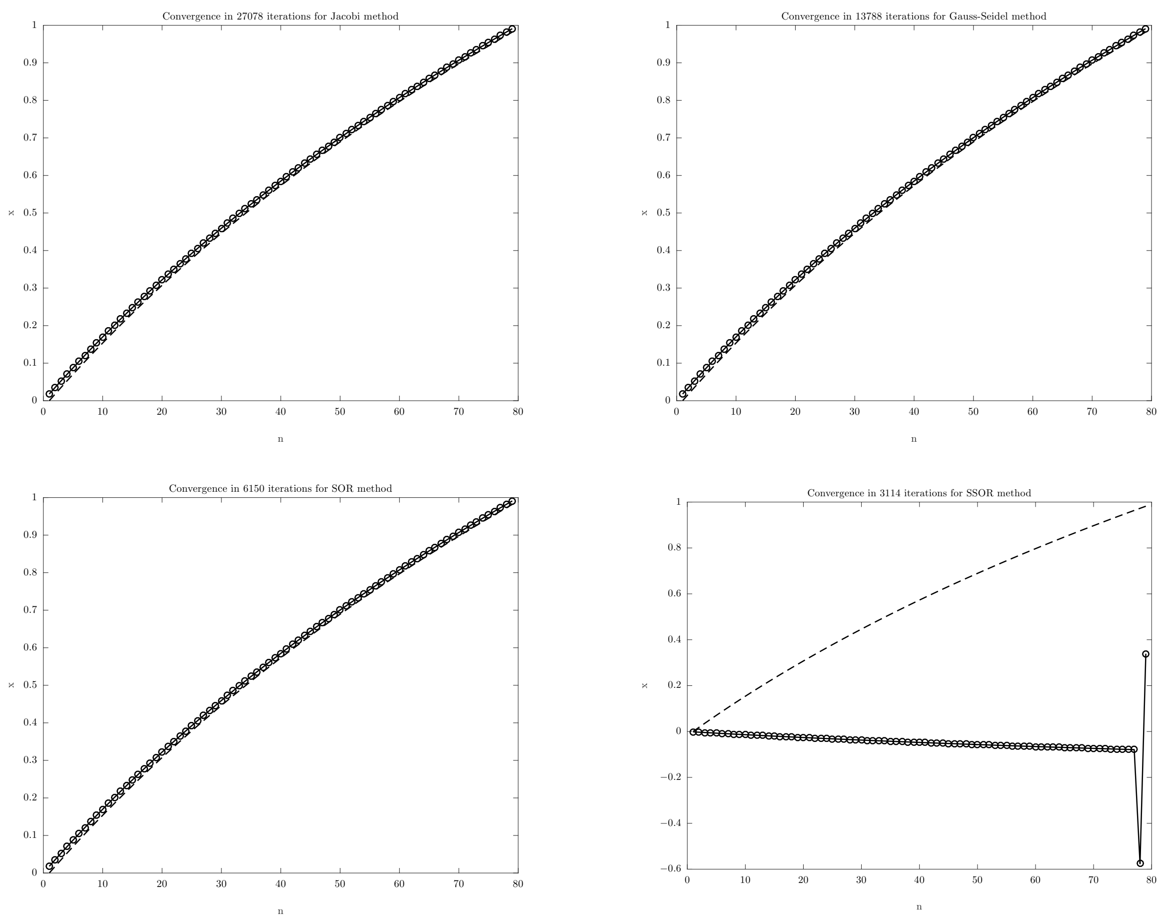

Figure 3: Comparative plots at n = 79

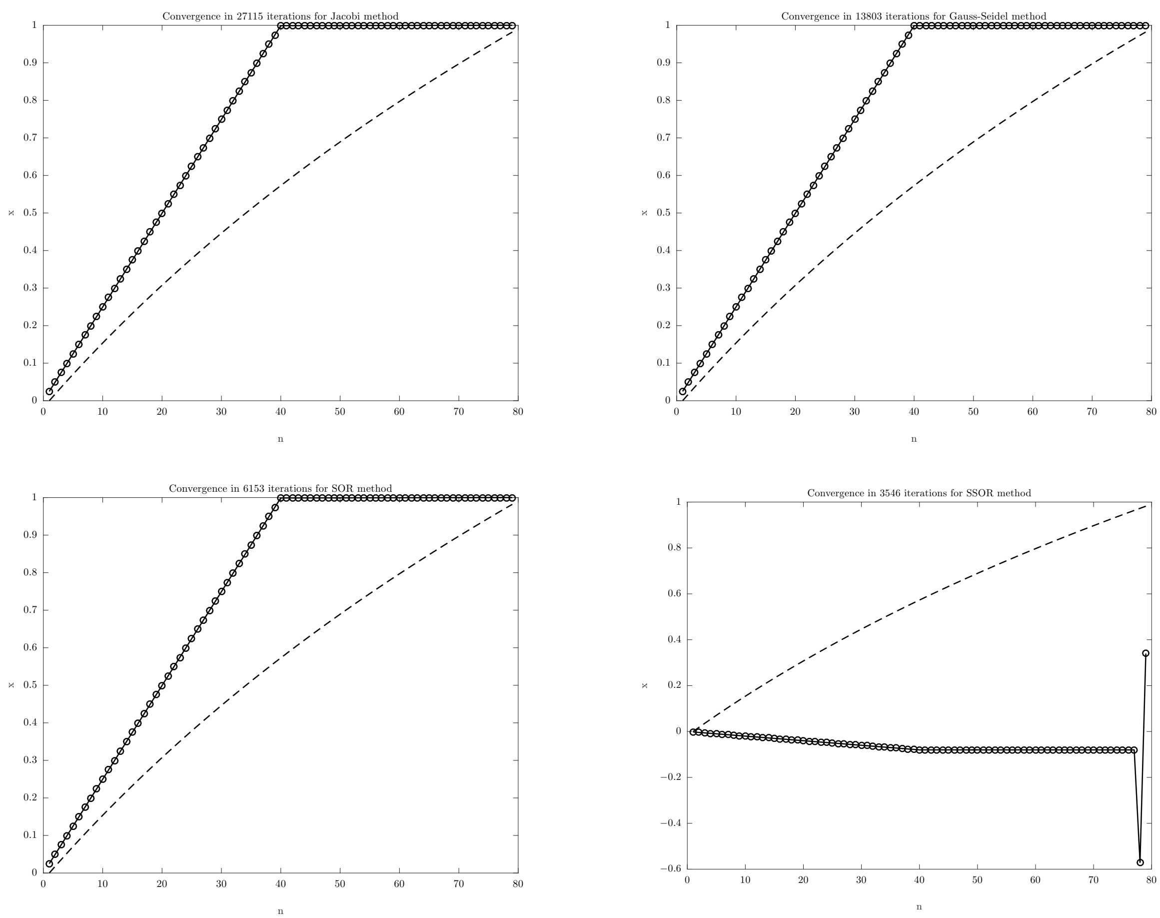

Figure 4: Comparative plots at n = 79

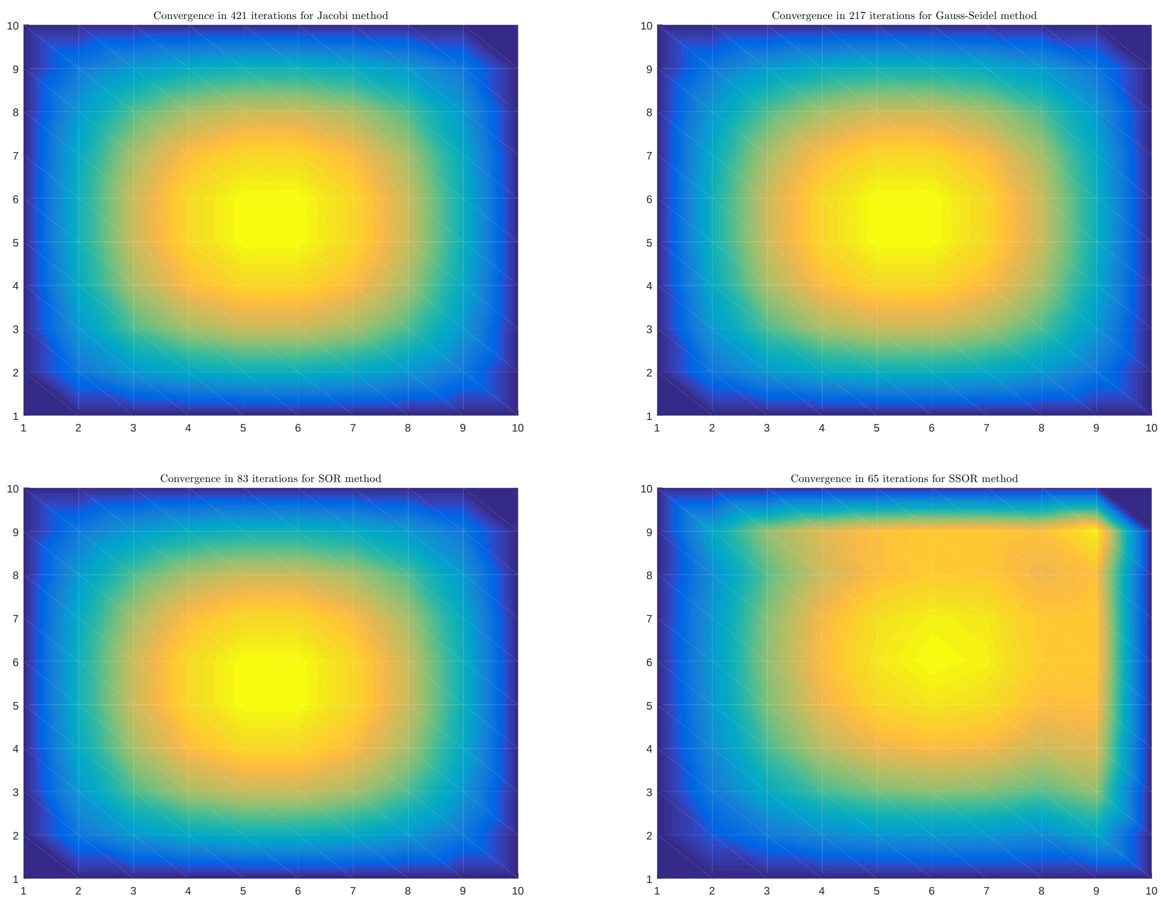

Figure 5: Surface Plots of Five-point Finite Difference Equation solution at n = 8

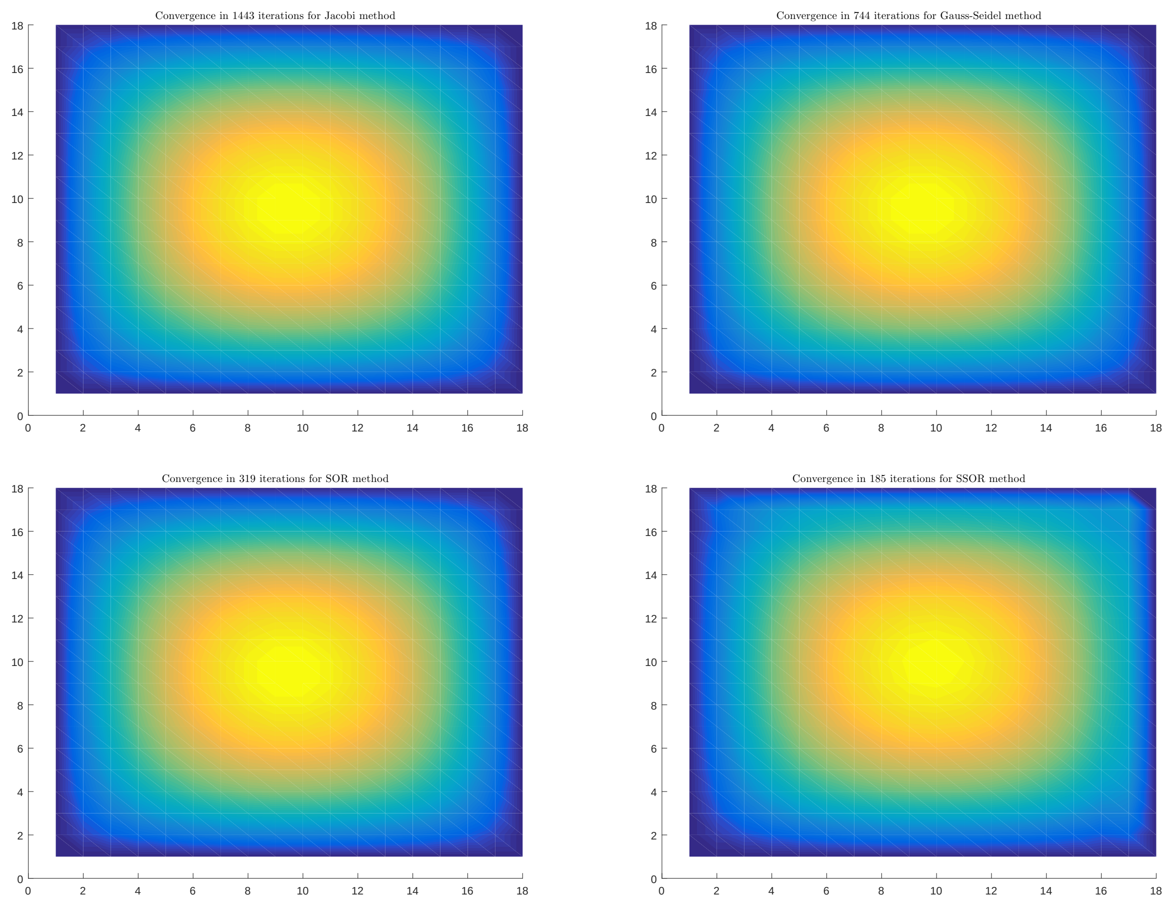

Figure 6: Surface Plots of Five-point Finite Difference Equation solution at n = 16

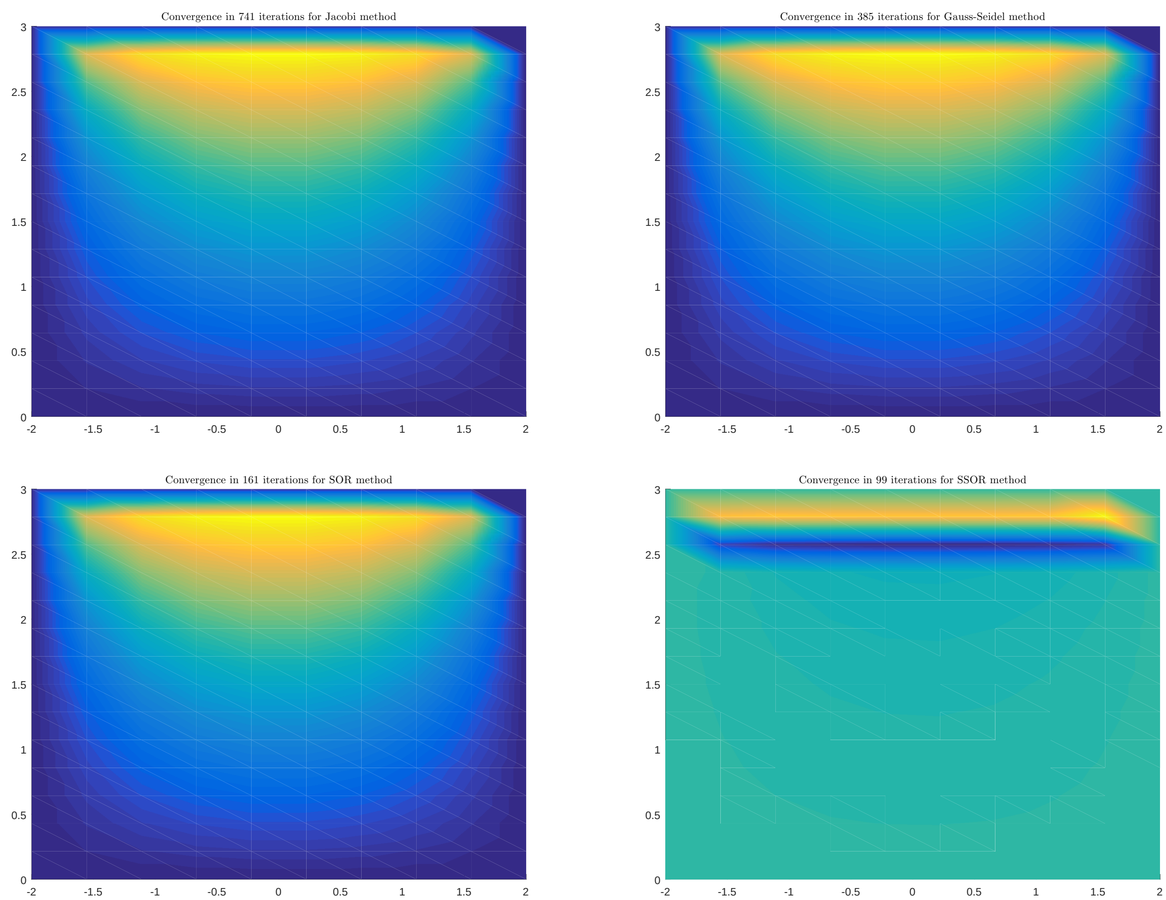

Figure 7: Surface Plots of Five-point Finite Difference Equation solution at nx = 10 and ny = 15