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On Algebraic Structure of Improved Gauss-Seide Iteration

Authors : O. M. Bamigbola, A. A. Ibrahim

Abstract : Analysis of real life problems often results in linear systems of equations for which solutions are sought. The method to employ depends, to some extent, on the properties of the coefficient matrix. It is not always feasible to solve linear systems of equations by direct methods, as such the need to use an iterative method becomes imperative. Before an iterative method can be employed to solve a linear system of equations there must be a guaranty that the process of solution will converge. This guaranty, which must be determined a priori, involve the use of some criterion expressible in terms of the entries of the coefficient matrix. It is, therefore, logical that the convergence criterion should depend implicitly on the algebraic structure of such a method. However, in deference to this view is the practice of conducting convergence analysis for Gauss-Seidel iteration on a criterion formulated based on the algebraic structure of Jacobi iteration. To remedy this anomaly, the Gauss-Seidel iteration was studied for its algebraic structure and contrary to the usual assumption, it was discovered that some property of the iteration matrix of Gauss-Seidel method is only diagonally dominant in its first row while the other rows do not satisfy diagonal dominance. With the aid of this structure we herein fashion out an improved version of Gauss-Seidel iteration with the prospect of enhancing convergence and robustness of the method. A numerical section is included to demonstrate the validity of the theoretical results obtained for the improved Gauss-Seidel method.

Keywords : linear algebraic system, Gauss-Seidel iteration, algebraic structure, convergence
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