A KSOR solution based on the established Redlich-Kister Finite Difference for solving one dimensional diffusion problems

ABSTRACT

This paper introduces a novel approach based on the two newly established second-order Redlich-Kister Finite Difference (RKFD) discretisation scheme for solving one-dimensional (1D) diffusion problems. In the course of investigating the applicability of this methodology, the second-order RKFD discretisation is implemented by incorporating all derivative terms pertinent to the proposed problem, thereby rearranging it yields the second-order RKFD approximation equation. After that, the derived approximation facilitates the construction of a system of equation characterised by large-scale and sparse coefficient matrix. Considering the distinctive characteristics of this matrix, we employ two numerical methods, namely the Gauss-Seidel (GS) and Kaudd Successive Over Relaxation (KSOR) iterative methods, to iteratively solve this system of equations. To validate the applicability of the proposed method, two examples of one-dimensional diffusion are examined to confirm the efficiency of the established Redlich-Kister Finite Difference and the performance of the KSOR iterative method in comparison to the GS iterative method. The comparison between these iterative methods focuses on the number of iterations, execution time, and maximum norm. The findings of this investigation reveal that the KSOR method necessitates fewer iterations and achieves faster execution times in contrast to the GS method.