Enhancing Autonomous Guided Vehicles with Red-Black TOR Iterative Method

ABSTRACT

To address an autonomous guided vehicle problem, this article presents extended variants of the established block over-relaxation method known as the Block Modified Two-Parameter Over-relaxation (B-MTOR) method. The main challenge in handling autonomous-driven vehicles is to offer an efficient and reliable path-planning algorithm equipped with collision-free feature. This work intends to solve the path navigation with obstacle avoidance problem explicitly by using a numerical approach, where the mobile robot must project a route to outperform the efficiency of its travel from any initial position to the target location in the designated area. The solution builds on the potential field technique that uses Laplace's equation to restrict the formation of potential functions across operating mobile robot regions. The existing block over-relaxation method and its variants evaluate the computation by obtaining four Laplacian potentials per computation in groups. These groups can also be viewed as groups of two points and single points if they're close to the boundary. The proposed B-MTOR technique employs red-black ordering with four different weighted parameters. By carefully choosing the optimal parameter values, the suggested B-MTOR improved the computational execution of the algorithm. In red-black ordering, the computational molecules of red and black nodes are symmetrical. When the computation of red nodes is performed, the updated values of their four neighbouring black nodes are applied, and conversely. The performance of the newly proposed B-MTOR method is compared against the existing methods in terms of computational complexity and execution time. The simulation findings reveal that the red-black variants are superior to their corresponding regular variants, with the B-MTOR approach giving the best performance. The experiment also shows that, by applying a finite difference method, the mobile robot is capable of producing a collision-free path from any start to a given target point. In addition, the findings also verified that numerical techniques could provide an accelerated solution and have generated a smoother path than earlier work on the same issue.