

ABSTRACT

The Particle Swarm Optimization (PSO) algorithm shows sensitivity to the determination of inertia weight parameters, which can affect the balance between global exploration and local exploitation in the search for solutions. Inertia weight is essentially a constant value, so it needs to be modified to be dynamic. Therefore, this study proposes a new inertial weight function, namely the Arcus Tangent Inertia Weight function, hereinafter referred to as Improved Particle Swarm Optimization (IPSO). Testing was carried out on 15 benchmark functions with dimensional variations. The IPSO method succeeded in lowering the standard deviation value from 0.1936 to 0.0739, the average from 0.09 to 0.02, the number of iterations from 931 to 277 and the computing time from 1.03 to 0.16 seconds in one of the scenarios. This indicates that IPSO produces a high-quality solution with low deviation, faster convergence, and excellent computational efficiency compared to EPSO, IWCF-PSO, and LDW-PSO methods. Then the IPSO method is applied to the K-Means algorithm to determine the initial centroid. Basically, the K-Means algorithm obtains the initial centroid randomly, resulting in a solution that is less than optimal and vulnerable to local optimization solutions. The results of the IPSO-K-Means method successfully optimized the clustering performance, which was shown by an increase in the Silhouette Score from 0.7204 to 0.7669, a decrease in the Davies-Bouldin Index from 0.6501 to 0.5507, and a computational time from 0.2756 to 0.0139 seconds in one of the scenarios. Overall, the IPSO-K-Means method successfully excelled in 119 out of 135 clustering scenarios compared to Regular K-Means. The results of this study confirm the effectiveness of the IPSO method in handling the complexity of optimization and clustering, especially for high-dimensional data.

Keywords: Clustering; Global Optimization; Initial Centroid; K-Means; Particle Swarm Optimization.