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ADVANCED PARTICLE SWARM OPTIMIZATION FOR COMPUTING PLURAL ACCEPTABLE SOLUTIONS

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Abstract. *In many engineering applications (engineering design problems), since the environment and/or situation of applications may change, it is important to detect plural acceptable solutions (plural decent means). As a technique of detecting not a single global optimum solution but plural acceptable solutions, this paper presents a new method based on the Particle Swarm Optimization (PSO) method that belongs to the category of swarm intelligence methods, named the Particle Swarm Optimization method for computing Plural Acceptable Solutions (PSO-PAS). In this paper, the performance of the proposed method (PSO-PAS) is investigated using benchmark problems on the minimization of multimodal functions with many local and global minima and its effectiveness is verified.*

Keywords: Swarm intelligence, Detecting plural acceptable solutions, Specialization of role, Particle swarm optimization

1. **Introduction.** The minimization of multimodal functions with many local and global minima is a problem that frequently arises in diverse scientific fields and numerous engineering design problems. This problem is NP-hard in the sense of its computational complexity even in simple cases. As techniques of computing a global minimum of the objective function, many *meta-heuristics*, which are search algorithms for optimization based on heuristic knowledge, have been proposed. Some well-known representative *meta-heuristics* are Simulated Annealing and Tabu Search, which are the traditional optimization algorithms, Genetic Algorithm (GA) [1] and Immune Algorithm (IA) [2], which are classified as evolutionary computation techniques, and Ant Colony Optimization (ACO) [3] and Particle Swarm Optimization (PSO) [4-15], which belong to the category of swarm intelligence methods.

The features of *meta-heuristics* are outlined from the viewpoint of handled variables. GA and IA, classified as evolutionary computation techniques, are generally techniques for combination optimization problems. In GA and IA, the variables of continuous type are frequently translated into those of discrete (genetic) type. If there is a dependency between variables, therefore, a promising solution may be destroyed during the solution search process (genetic operation) and the solution search performance may deteriorate. To the contrary, PSO can directly handle the variables of continuous type. Even when there is a dependency between variables, therefore, an efficient and effective solution search can be realized. From the viewpoint of solutions obtained during the search process, PSO and GA generally present a single quasi-optimum solution, whereas IA can present several quasi-optimum solutions.