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PARTICLE SWARM OPTIMIZATION WITH SELF-ADJUSTING COGNITIVE SELECTION STRATEGY

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Abstract. *Cognitive coefficient is an important parameter used to control the weight of personal historical best position, therefore many selection adjustments are proposed. However, these strategies are either deterministic or stochastic. Due to the requirement for the problem-based tuning of parameters, this paper introduces a novel self-adjusting cognitive selection strategy (SCSS). It employs an information index to judge the value for cognitive coefficient of each particle associated with the best location itself. Furthermore, a mutation strategy is introduced to avoid premature convergence, and a modified version of particle swarm optimization combined with SCSS and mutation is proposed. Simulation results show the proposed method outperforms for multi-modal benchmarks with many local optimum.*
Keywords: Particle swarm optimization, Self-adjusting cognitive selection strategy, Mutation operator, Information index

1. **Introduction.** Particle swarm optimization (PSO) [1][2] is a new self-adaptive random search methodology first introduced by Eberhart and Kennedy in 1995. The motivation is to simulate animal's social behavior such as birds flocking, fish schooling, and insects herding.

In the PSO algorithm, each individual (called particle) represents a potential solution, and flies over the problem space to seek the food (optimum point). The particles adapt their search patterns with collaborative and competitive manners. Therefore, the process of seeking optima in the problem space is analogous to the food searching process of birds in nature. In this paper, only the unconstrained minimization problems are considered:

$$\min\ f(\overrightarrow{x}) \quad \overrightarrow{x} \in [L, U]^D \subseteq \mathbb{R}^D \tag{1}$$

Suppose $\overrightarrow{x}_j = (x_j^1, x_j^2, ..., x_j^D)$ is the position of $j'th$ particle, where x_j^k represents the $k'th$ coordinate value of the position vector. In each iteration, it will fly with the following manner:

$$\overrightarrow{x}_j^k \leftarrow \overrightarrow{x}_j^k + \overrightarrow{v}_j^k \tag{2}$$

where the symbol $\overrightarrow{v}_j = (v_j^1, v_j^2, ..., v_j^D)$ represents the velocity of particle j. Inspired by the artificial *Boid* model made by Reynolds [3], Eberhat et al. [1][2][4] proposed a velocity update equation:

$$v_j^k \leftarrow wv_j^k + c_1r_1(p_j^k - x_j^k) + c_2r_2(p_g^k - x_j^k) \tag{3}$$