

An Ensemble Learning Method for Applying Particle Swarm Optimization Algorithms to Systems Engineering Problems

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Abstract : As a subset of metaheuristics, nature-inspired optimization algorithms such as particle swarm optimization (PSO) have shown promise both in solving intractable problems and in their extensibility to novel problem formulations due to their general approach requiring few assumptions. Unfortunately, single instantiations of algorithms require detailed tuning of parameters and cannot be proven to be best suited to a particular illustrative problem on account of the “no free lunch” (NFL) theorem. Using these algorithms in real-world problems requires exquisite knowledge of the many techniques and is not conducive to reconciling the various approaches to given classes of problems. This research aims to present a unified view of PSO-based approaches from the perspective of relevant systems engineering problems, with the express purpose of then eliciting the best solution for any problem formulation in an ensemble learning bucket of models approach. The central hypothesis of the research is that extending the PSO algorithms found in the literature to real-world optimization problems requires a general ensemble-based method for all problem formulations but a specific implementation and solution for any instance. The main results are a problem-based literature survey and a general method to find more globally optimal solutions for any systems engineering optimization problem.

Keywords : particle swarm optimization, nature-inspired optimization, metaheuristics, systems engineering, ensemble learning

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