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Self-Adaptive MultiMethod Search for Global Optimization of Hydrologic Model Parameters

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Many different algorithms have been developed in the last few decades for solving complex real-world search and optimization problems. The main focus in this research has been on the development of a single universal genetic operator for population evolution that is always efficient for a diverse set of optimization problems. In this paper, we argue that significant advances to the field of evolutionary computation can be made if we embrace a concept of self-adaptive multi-method optimization in which multiple different search algorithms are run concurrently, and learn from each other through information exchange using a common population of points. We present an evolutionary algorithm, entitled AMALGAM-SO, that implements this concept of self adaptive multimethod search. This method simultaneously merges the strengths of the Covariance Matrix Adaptation (CMA) evolution strategy, Genetic Algorithm (GA) and Particle Swarm Optimizer (PSO) for population evolution and implements a self-adaptive learning strategy to automatically tune the number of offspring these three individual algorithms are allowed to contribute during each generation. Classical benchmark problems in 10, 30 and 50 dimensions and hydrologic model calibration studies show that AMALGAM-SO obtains similar efficiencies as existing algorithms on relatively simple unimodal problems, but is superior for more complex higher dimensional multimodal optimization problems. The new search method scales well with increasing number of dimensions, converges in the close proximity of the global minimum for functions with noise induced multimodality, and is designed to take full

advantage of the power of distributed computer networks.