MULTI-POPULATION EVOLUTIONARY ALGORITHMS ON MULTI-OBJECTIVE OPTIMIZATION OF GROUNDWATER REMEDIATION

Orientador: Prof. Dr. Eduardo Savio Passos Rodrigues Martins
Dissertação (Mestrado) - Universidade Federal do Ceará, UFC. Data de Defesa: 2009.

ABSTRACT

Through the last three decades the evolutionary algorithms had success on application in many areas. Among the main its advantages, accordingly various researchers, are the application facility, the efficiency and the confidence. In the groundwater remediation problem, generally, we are looking for minimize cost, minimize contaminant presence, maximize the pumping efficiency among others objectives. These objectives naturally are in conflict and the search for optimal solutions, or nearest of optimal solutions, are needed. With this fact in mind, the evolutionary optimization methods come being applied and refined in these search domain for solutions. A brief description of these methods is presented, talking about its advantages and limitations. Five mathematical functions are used to measure the performance of algorithms and allow a comparison between these algorithms. To optimize a pump-and-treat system in the hypothetical site remediation, multi-population evolutionary algorithms are used, considering the multi-objective dimension problem. The multi-population approach come being applied as mitigating for main drawback evolutionary optimization: the excessive computational time. The groundwater flow modeler MODFLOW (modular finite-difference flow model) is used with the contaminant transport simulator MT3DMS (modular three-dimensional multispecies transport model). One from the three used algorithms, MINPGA (multi-island Niched Pareto Genetic Algorithm) is a NPGA multi-population version using injection island approach; a second algorithm, MHBMO (Multi-Hive Honey Bee Mating Optimization) is a HBMO multi-population version; and a PSO (Particle Swarm Optimization) multi-population version, called MCPSO (Multi-Swarm Cooperative Particle Swarm Optimization) closes trio. Mathematical functions test validates presented algorithms. Remediation problem by pumping-and-treat had as objectives the remediation cost and the contaminant final plume minimization. The algorithms get good result, with tenuous advantage to MINPGA.