A generalized multiobjective particle swarm optimization solver for spreadsheet models: application to water quality

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Abstract. Decision making in water resources planning and management frequently involves multiple objectives. As greater attention is being given to environmental and social aspects the need for effective multiobjective optimization approaches is increasing.

This paper presents an application of an evolutionary optimization algorithm for multiobjective analysis of selective withdrawal from thermally stratified reservoirs. A multiobjective particle swarm optimization (MOPSO) algorithm is used to find nondominated (Pareto) solutions when minimizing deviations from outflow water quality targets of: (i) temperature; (ii) dissolved oxygen; (iii) conductivity; and (iv) potential of hydrogen (pH). The decision variables are the flows through each port in the selective withdrawal structure.

Particle swarm optimization (PSO) is one of the newest techniques within the family of evolutionary optimization algorithms. The algorithm is based on an analogy with the choreography of flight of a flock of birds. Due to its fast convergence, PSO has been advocated to be especially suitable for multiobjective optimization.

The MOPSO algorithm, implemented as an add-in for Excel, is able to find nondominated solutions for any combination of the four abovementioned objectives. An interactive graphical method was also developed to display nondominated solutions in such way that the best compromise solutions can be identified, for different relative importance given to each objective. The method allows the decision maker to explore the Pareto set and visualize not only the best compromise solution but also sets of solutions that provide similar compromises.

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