Hydrology and Earth System Sciences Discussions

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Comment

Interactive comment on "Comment on "How effective and efficient are multiobjective evolutionary algorithms at hydrologic model calibration?" by Y. Tang et al., Hydrol. Earth Syst. Sci., 10, 289–307, 2006" *by* J. A. Vrugt

J. A. Vrugt

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We would like to thank this reviewer for his / her comments. Our responses are found after the individual comments

Reviewer 2: Anonymous

The main comment made by Dr. Vrugt to the paper by Tang et al. (2006) is related to the initial sampling strategy employed in the comparison of the optimisation algorithms. He refers to some of his own work (Vrugt et al., 2003) where it has been demonstrated that the efficiency of the Multi-objective Shuffled Complex Evolution Metropolis

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(MOSCEM-UA) algorithm can be significantly improved by using an alternative sampling strategy. I find that this is an important issue in relation to the evaluation of optimization procedures. However, in relation to the work by Tang et al. (2006) I don't think this will have any major impacts on the general conclusions from their study (although this is, of course, speculative). An alternative sampling strategy as suggested by Vrugt et al. (2003) would be interesting to analyse, but in this case should be used in all three algorithms to make a consistent and fair comparison. And since the alternative sampling strategy by Vrugt et al. (2003) basically reduces the size of the hypercube where the initial population is drawn, one would expect that this would have the same impact on the performance of all three algorithms.

Response: I agree that this approach could be used in all the algorithms. However, to accurately reflect the content of our original work, we believe that this alternative sampling approach should have been used to properly describe and implement the work presented in Vrugt et al. (2003)

Still, one can discuss if the comparison is 100% objective and fair. Optimisation algorithms include different parameters that can be tuned to optimise their performance. Experience in the use of a particular algorithm thus has an advantage when doing comparative studies and hence could bias the outcome of such analyses. In the reply to the comment by Dr. Vrugt, Dr. Reed and co-authors emphasize that both the SPEA2 and MOSCEM-UA algorithms were tested for different algorithmic parameter settings in order to maximise their performances, Thus, in this regard I find that Tang et al. (2006) have adequately addressed the problem of comparing an algorithm that they have developed with other algorithms that they are (probably) less familiar with.

Response: I agree. Existing theory and experiments have demonstrated that it is impossible to develop a single evolutionary algorithm that will always be superior to any other algorithm over some set of complex optimization problems. In a recent paper we therefore argue that significant advances to the field of evolutionary computation can be made if we embrace a concept of self-adaptive multimethod optimization in which

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the goal is to develop a combination of search methods that have all the desirable properties to efficiently handle a wide variety of response surfaces. We present a new optimization algorithm, called AMALGAM, that implements this new concept of multi-method search, and runs a diverse set of optimization algorithms simultaneously for population evolution and adaptively favors individual algorithms that exhibit the highest reproductive success during the search. By adaptively changing preference to individual search algorithms during the course of the optimization, AMALGAM has the ability to quickly adapt to the specific difficulties and peculiarities of the optimization problem at hand. Synthetic multiobjective benchmark studies covering a diverse set of problem features have demonstrated that AMALGAM significantly improves the efficiency of evolutionary search, approaching a factor of 10 improvement over current available methods. Details can be found in Vrugt and Robinson (2007).

Still, another issue could be commented on. In their reply, Dr. Reed and co-authors emphasise the strength of the epsilon-NSGAII algorithm in the use of dynamic epsilon-dominance (ED) archiving. This is a pre-conditioning of the search, which is different to starting the search from a randomly generated large population that is included in the other two algorithms. Indeed, this form of pre-conditioning has similar features as the sampling strategy proposed by Vrugt et al. (2003). It would be interesting to compare the effect of the different pre-conditioning approaches on the performance of the optimisation algorithms. I'll leave this exercise to be considered by Dr. Vrugt and Dr. Reed.

Response: Good comment, and worthy of further investigation in future work.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 179, 2007.

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