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Improved robustness and efficiency of the SCE-UA model-calibrating algorithm

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In our previous study [1], the systematic initial population lead to improvement in the "exploration" capability of the shuffled complex evolution (SCE-UA) model calibrating algorithm [2], which lead to a significant reduction in the number of failures, evaluated on a suite of test functions. In the present study, we aim at improving its "exploitation" capability (i.e., reducing the number of function evaluations to reach the optimum) by enhancing one of the key concepts used within the SCE-UA, the simplex search method of Nelder and Mead. The SCE-UA combines two powerful strategies of "multiple complex shuffling" and "simplex search method based evolution". The multiple complexes and their periodic shuffling provide extensive exploration of the search space and the simplex search method provides effective exploitation. The simplex search method uses only the value of the objective function of the points in the simplex to direct the search towards promising regions in the search space.

In the version of simplex search method employed in the original SCE-UA, the new points are generated by reflecting (or contracting) the worst point (point with highest function value, in case of function minimization) in a simplex. We propose to move the newly generated reflected (or contracted) point towards the best point in the simplex, with the aim of directing the simplex towards the optimum using a lesser number of function evaluations. Thus, not only the worst point, but also the best point in a simplex is used, making better use of the already available information, leading to better "exploitation". This enhanced SCE-UA is tested on a suite of test functions, and the results show a general reduction in the number of function evaluations to reach the global optimum, by about 20-30% when compared to the original SCE-UA algorithm.

Keywords: Model calibration; shuffled complex evolution; optimization.

References

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