

A Cumulative Evidential Stopping Criterion for Multiobjective Optimization Evolutionary Algorithms

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1. THE MGBM STOPPING CRITERION

In this work we present a novel and efficient algorithm-independent stopping criterion suitable for Multiobjective Optimization Evolutionary Algorithms (MOEAs). Our criterion, called MGBM, is particularly useful in complex and/or high-dimensional problems where the traditional procedure of stopping after a predefined amount of iterations can not be used.

The MGBM criterion, after each iteration of the optimization algorithm, gathers evidence of the improvement of the solutions obtained so far. A global evidence accumulation process based on a Kalman filter with a simple (linear) dynamic model decides when the optimization should be stopped.

Evidence is collected using a novel relative improvement metric constructed on top of the Pareto dominance relations. This metric contrasts how many non-dominated individuals of iteration t dominate the non-dominated individuals of the previous one ($t - 1$) and vice versa.

Due to the simple dynamic model used in the Kalman filter only free parameter of the criterion is the variance of the measurement noise, R . This R can be interpreted as how much the criterion will prime single measurements against the accumulated mass.

2. A TEST WITH THE DTLZ3 PROBLEM

The results when solving the DTLZ3 problem using NSGA-II and SPEA2 can be observed in Figures 1. The plots show the distance after each iteration from the obtained set of non-dominated solutions to the Pareto-optimal set and when criterion fired using different values of R . In both cases

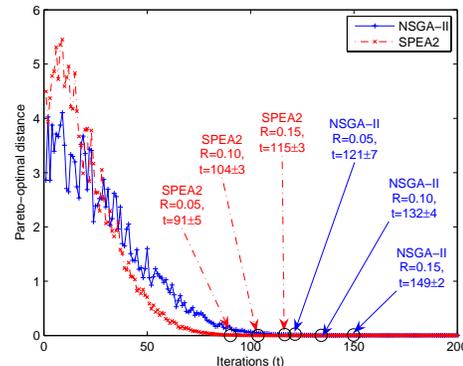


Figure 1: The iterations when MGBM fired, for different R s, solving the DTLZ3 with NSGA-II and SPEA2 in an assured success setup.

the stop criterion fired when the algorithms had become stable and close to the optimum. Depending on the value of R the criterion had a quicker or more inertial response. In our experiments other test problems and experimental situations were analyzed yielding always positive results.

3. FINAL REMARKS

Since this is an initial approach some questions remain yet to be properly handled. For example, a better understanding of the impact of the R parameter is required and a proper study on the complexity of the evidence accumulation algorithm must be performed.

One salient issue is the interpretation of the final state of the algorithm in order to establish the reason of the process halt. Evidences obtained during the production of this work that indicate that, by analyzing amount of dominated and non-dominated individuals in the population, some conclusions can be extracted.

Although the criterion discussed here is meant for MOEAs, it can be easily extended to other softcomputing or numerical methods by substituting the local improvement metric with a suitable one.

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