Set Oriented Methods for the Numerical Treatment of (Global) Multi-Objective Optimization Problems

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Abstract: In a variety of applications in industry and finance the problem arises that several objective functions have to be optimized concurrently. For instance, for a perfect economical production plan, the ultimate desire would be to simultaneously *minimize cost* and *maximize quality*. This example already illustrates a natural feature of these problems namely that the different objectives typically contradict each other and therefore certainly do not have identical optima. Thus, the question arises how to approximate one or even more "optimal compromises" – and this leads to a *multi–objective optimization problem* (MOP).

In this talk we will present new set oriented methods for the numerical treatment of MOPs. Due to their global approach these subdivision techniques allow for the computation of the entire solution set, the so-called *Pareto set*. We will introduce several algorithms for the numerical solution of MOPs under different smoothness assumptions.

Having stated the basic algorithms for the solution of MOPs we will focus on smooth or "well-behaved" models. This will lead to a new predictor-corrector variant for the computation of Pareto points which is – like all continuation methods – of local nature but applicable even to high dimensional models with respect to both parameter space ($n \geq 10.000$) and image space (typically $2 \leq k \leq 4$). This is also valid when the MOP contains equality constraints. In fact, this method can also be used for the computation of general implicitly defined manifolds.

Finally, we will demonstrate the efficiency of our algorithms both on academic MOPs as well as on problems which naturally arise in the design of mechatronical systems.

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