

## THEORETICAL ASPECTS OF EVOLUTIONARY MULTIOBJECTIVE OPTIMIZATION — CURRENT STATUS AND FUTURE TRENDS

### Workshop at GECCO 2010

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Thursday, July 8, 2010 | 14:00 - 18:00 | Salon B

### Program

14:00 - 14:10	welcome
14:10 - 14:40	<p><b>Adriana Lara</b>, Oliver Schütze, Carlos A. Coello Coello <b>New Challenges for Memetic Algorithms on Continuous Multi-objective Problems</b></p> <p>This work presents the main aspects to tackle when designing memetic algorithms using gradient-based local searchers. We address the main drawbacks and advantages of this coupling, when focusing on the efficiency of the local search stage. We conclude with some guidelines and draw further research paths in these topics.</p>
14:40 - 15:10	<p><b>Ilya Loshchilov</b>, Marc Schoenauer, Michèle Sebag <b>A Pareto-Compliant Surrogate Approach for Multiobjective Optimization</b></p> <p>This paper discusses the idea of using a single Pareto-compliant surrogate model for multiobjective optimization. While most surrogate approaches to multi-objective optimization build a surrogate model for each objective, the recently proposed mono surrogate approach by the authors aims at building a global surrogate model defined on the decision space and tightly characterizing the current Pareto set and the dominated region, in order to speed up the evolution progress toward the true Pareto set. This surrogate model is specified by combining a One-class Support Vector Machine (SVMs) to characterize the dominated points, and a Regression SVM to clamp the Pareto front on a single value. The aims of this paper are to identify issues of the proposed approach demanding further study and to raise the question of how to efficiently incorporate quality indicators, such as the hypervolume into the surrogate model.</p>
15:10 - 15:40	<p><b>Thomas Voß</b>, Tobias Friedrich, Karl Bringmann, Christian Igel <b>Scaling Up Indicator-based MOEAs by Approximating the Least Hypervolume Contributor: A Preliminary Study</b></p> <p>Recently, a Monte-Carlo algorithm for approximately determining the least hypervolume contributor of a given Pareto-front approximation has been presented in (Bringmann/Friedrich 2009). We hypothesize that using this approximation instead of the exact</p>

	<p>contributing hypervolume will make the EMOAs relying on the contributing hypervolume applicable to problems with many objectives and that the resulting algorithms will push the boundaries of today's EMOAs for many-objective optimization. In this study, we employ the approximation within the steady-state MO-CMA-ES (termed <math>(\mu + 1)</math>-MO-CMA-ES and using the recent improvements presented in (Voß et al. 2010)) and the SMS-EMOA to empirically investigate whether the Monte-Carlo approximation is indeed useful in practice.</p>
15:40 - 16:50	discussion
15:50 - 16:10	coffee break
16:10 - 16:40	<p>Oliver Schütze, Xavier Equivel, <b>Adriana Lara</b>, Carlos A. Coello Coello</p> <p><b>Some Comments on GD and IGD and Relations to the Hausdorff Distance</b></p> <p>When measuring distances between different objects such as different sets the use of metrics has been well established in literature. We investigate here two widely used indicators for the evaluation of Multi-objective Evolutionary Algorithms, the Generational Distance (GD) and the Inverted Generational Distance (IGD), with respect to the properties of a metric. Since the outcome is quite poor, we propose further on a new indicator which is made up of GD and IGD. The novel indicator can be viewed as an 'averaged version' of the Hausdorff distance and forms a quasi-metric under certain assumptions.</p>
16:40 - 17:10	<p><b>Manuel López-Ibáñez</b>, Thomas Stützle, Luís Paquete</p> <p><b>Graphical Tools for the Analysis of Bi-objective Optimization Algorithms</b></p> <p>An approach to the quality assessment of multi-objective SLS algorithms derives from the concept of attainment function. The attainment function extends the scalar concepts of mean and variance to random sets. The attainment function theory may completely characterize the statistical distribution of solutions in the objective space in terms of location, spread and mutual dependence. Moreover, statistical testing and inference are possible. However, the use of attainment functions is still rather limited in practice. We present here two practical applications of the first-order attainment function for analysing the output of SLS algorithms for biobjective optimization problems. Programs implementing the techniques presented here are also available. Later, we discuss what would be necessary to extend this work for more than two objectives and for other types of analysis.</p>
17:10 - 17:40	<p>Michael Emmerich, <b>André Deutz</b>, Johannes Krusselbrink, Rui Li</p> <p><b>Getting Lost or Getting Trapped: On the Effect of Moves to Incomparable Points in Multiobjective Hillclimbing</b></p> <p>Divergent behavior may occur in elitist multiobjective EAs which allow moves to incomparable solutions. We study under which conditions this is exhibited. For simple model landscapes stochastic dynamics are studied and quantified by means of Markov chains. The studies suggest that increasing the population size tempers divergent behavior. In addition, we study whether common elitist algorithms such as NSGA-II and SMS-EMOA have divergent behavior.</p>
17:40 - 18:00	discussion + closing