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METAHEURISTIC MULTIOBJECTIVE APPROACHES FOR THE DESIGN OF SUSTAINABLE ENERGY SYSTEMS

Approches métaheuristiques multiobjective pour la conception de systèmes énergétiques durables

The main research goals in Process Engineering (PE) consist in the design, simulation and optimization of new processes. In a general sense, these studies address to maximize the efficiency of the process while minimizing the impact to the environment and human society. Then, naturally a multiobjective optimization problem (MOP) arises. Most of related works found in literature, solve the optimization problem by means of exact techniques, thus the MOP is addressed through the transformation into single-objective problems, such as the epsilon-constraint method. Further, the main reference to the use of evolutionary algorithms (EA) is the NSGA-II.

However, to the best of our knowledge, no study reports the use of alternative and more recent metaheuristic solution approaches which are not dominance-based, such as MOEA/D, SMS-EMOA, HypE and MOPSO.
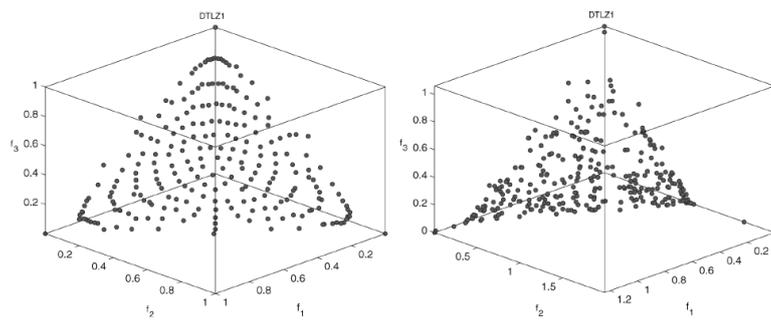
Comparison of Pareto front for DTLZ1 problem obtained with two different MOEAs. MOEA/D in the left, NSGA-II in the right.

A preliminary study of constraint handling techniques in single-objective evolutionary computation is important to do before the implementation of MOEAs, both because of the unconstrained nature of EA and the great number of constraints presented in PE optimization problems. For performance comparison purposes, some canonical functions will be studied, e.g., problems from CEC'06 and chemical engineering related problems.

Then, the implementation of two canonical MOEAs (e.g., NSGA-II and MOEA/D) for testing their behaviour on classical test suites such as ZDT, WFG, UF, DTLZ will be carried out. Then, some constraint handling techniques will be integrated to the previous algorithms, solving some classical constrained test suites such as CF, C_DTLZ.

Finally, some PE related problems will be treated, mainly two types of them: design of eco-industrial parks and the H_2 supply chain problems with at least two test instances available.