consistency on constraints, even though the Lions-Mercier property is not fulfilled.

■ HB-10

Thursday, 10:00-11:40 - Room 10

Multiobjective Optimization

Stream: Multicriteria Decision-Making and Multiobjective Optimization (contributed)
Contributed session
Chair: Nikolai Krivulin

1 - Explicit Multi-objective Model Predictive Control for Nonlinear Systems Under Uncertainty

Carlos Ignacio Hernández Castellanos, Sina Ober-Blöbaum, Sebastian Peitz

In this work, we consider nonlinear multi-objective optimal control problems with uncertainty on the initial conditions, and in particular their incorporation into a feedback loop via model predictive control (MPC). For such problems, not much has been reported in terms of uncertainties. We focus on the set-based robustness which allows the decision maker to analyze a given solution from the worst-case perspective. In this kind of problems, each solution in decision space maps to a set that represents the trade-offs of the worst possible scenarios.

To address this problem class, we design an offline/online framework to compute an approximation of efficient control strategies. To reduce the numerical cost of the offline phase –which grows exponentially with the parameter dimension– we exploit symmetries in the control problems. Furthermore, to ensure optimality of the solutions, we include an additional online optimization step, which is considerably cheaper than the original multi-objective optimization problem.

We test our framework on a car maneuvering problem where safety and speed are the objectives. The multi-objective framework allows for online adaptations of the desired objective. Our results show that the method can design driving strategies that deal better with uncertainties in the initial conditions, which translates into potentially safer and faster driving strategies.

2 - A modified NSGA-II for the multiobjective problem of support unit location for multi-stage road traffic surveys

Marcus Camara, Glaydston Ribeiro, Thayse Ferrari

The Multiobjective Problem of Support Unit Location for Road Traffic Surveys (MPSULRTS) aims to determine, from a set of roadside traffic survey stations and a set of candidate facilities (support units) that will provide needed survey appliers and resources to these stations, which support units must be selected to serve each station and in which time period. This decision considers the minimization of costs with travels of the survey teams and minimization of the number of support units used. The NSGA-II has been successfully used in several multiobjective applications, but in large scale real-world problems, the algorithm can show results with low diversity and distant of the Pareto optimality. Concerning the MPSULRTS, as the instance size increases, the structure of chromosomes expands significantly, increasing computational time and decreasing the algorithm efficiency. Thus, this paper proposes a modified NSGA-II which uses new strategies for the MPSULRTS. A new chromosome representation is proposed as well as new strategies for generating the initial population and new crossover and mutation operators. The computational experiments were conducted using 38 instances and the algorithm was implemented using Python. The results show that our new strategies generate good solutions when they are compared against the exact ϵ-Constraint method. Considering the hypervolume metric, our algorithm shows a hypervolume of 94% on average

3 - Application of tropical algebra techniques in bi-objective optimization problems

Nikolai Krivulin

We consider constrained bi-objective optimization problems in the framework of tropical mathematics, which focuses on the theory and applications of semirings and semifields with idempotent operations. The problems are to minimize two objectives, given as functions on vectors over an idempotent semifield (a semiring with idempotent addition and invertible multiplication), subject to constraints on the feasible solution in the form of vector inequalities. We apply a solution technique that reduces the bi-objective problems to a system of parametrized inequalities, where the parameters represent the values of the objective functions. The necessary and sufficient conditions for solutions of the system serve for evaluation of parameters to specify the Pareto frontier for the optimization problem. Given the optimal values of parameters, the solution vectors of the system are obtained to form all Pareto-optimal solutions. With this approach, we derive a complete Pareto-optimal solution of the problem in an explicit analytical form, ready for formal analysis and numerical calculations. As real-world applications, we present solutions to constrained bi-criteria problems in time-constrained project scheduling, decision making with pairwise comparisons and minimax single-facility location.