as simplifications to make a problem tractable, and the user of the optimization system is able to identify them. In this case, the interaction should prevent unrealistic or unfeasible solutions to be adopted.

Interactive optimization approaches range from rudimentary trial-and-error approaches to more sophisticated approaches such as interactive multiobjective optimization, human-guided search or long-term preference inference. Most of the optimization procedures implemented for these interactive approaches are heuristics and metaheuristics. In fact, interactive optimization is often used when optimization models or problem data need to be enriched by the user. In this context, an optimal solution with respect to the problem model may not be worth the computational time because the solution may not be optimal from a user's perspective. Therefore, metaheuristics are particularly attractive for interactive optimization as they provide good solutions in reasonable time.

We recently proposed a classification to better understand the interaction mechanisms in interactive optimization. This classification considers four aspects of the interaction: the role of the user, the type of feedback integration (model-free or model-based), the lifetime of preference information (step-based, short or long-term), and the type of optimization procedure. In this presentation I detail this classification and illustrate it with interactive metaheuristics applied to network optimization problems.

■ TA-13

Thursday, 9:00-10:30 - Seminarraum 204

Error Bounds and Algorithms

Stream: Control Theory and Continuous Optimization
Chair: *Andreas Fischer*

1 - Convergence of Newton-Type Methods for Degenerate Complementarity Systems
Andreas Fischer, Markus Herrich, Alexey Izmailov, Mikhail Solodov

We consider complementarity systems with nonisolated solutions which, for example, may come from Karush-Kuhn-Tucker (KKT) systems of nonlinear programs or generalized Nash equilibrium problems. The complementarity systems are reformulated as systems of piecewise continuously differentiable equations. Then, the local convergence of appropriate Newton-type techniques applied to these nonsmooth systems is dealt with. It is shown that the only structural assumption needed for rapid local convergence of such methods is the piecewise error bound, i.e., a local error bound holding for the branches of the solution set resulting from partitions of the bi-active complementarity indices. The latter error bound is implied by various piecewise constraint qualifications, including relatively weak ones. We apply our results to KKT systems arising from generalized Nash equilibrium problems.

2 - A Globally Convergent LP-Newton Method for Constrained Piecewise Differentiable Systems of Equations
Markus Herrich, Andreas Fischer, Alexey Izmailov, Mikhail Solodov

The LP-Newton method has been recently proposed for the solution of constrained systems of equations. It turned out that this method has very strong local convergence properties. In fact, it converges locally quadratically under assumptions implying neither differentiability nor the local uniqueness of solutions.

However, the question concerning a suitable globalization was not satisfactorily answered yet. In this talk an algorithm based on the LP-Newton method is presented which uses a linesearch technique for the natural merit function. The new algorithm keeps the strong local convergence properties but has, in addition, global convergence properties.

3 - Projected Levenberg-Marquard methods under the constrained error bound condition
Klaus Schönefeld, Roger Behling, Andreas Fischer, Gabriel Haeser, Alberto Ramos

We consider a smooth system of nonlinear equations subject to a closed convex feasible set. The projected Levenberg-Marquard method projects the result of a classical Levenberg-Marquard step onto the feasible set. This method is known to be Q-superlinearly convergent to a (possibly nonisolated) solution of the constrained system of equations if an error bound condition holds locally both for feasible and infeasible points. It was proved recently that a combination of two weaker local error bound conditions guarantees at least R-linear convergence. In this contribution, we show that one of these conditions can be omitted without loosing the linear convergence. What is still needed is the constrained error bound condition, i.e. a condition for feasible points only. The derivation of this result led to the interesting fact that under the constrained error bound condition the solution set of the constrained system can be locally represented as an intersection of a differentiable manifold with the feasible set.

■ TA-14

Thursday, 9:00-10:30 - Seminarraum 206

Scalarizations, Bounds and Mathematical Programming Methods

Stream: Decision Theory and Multiple Criteria Decision Making
Chair: *Nikolai Krivulin*

1 - Efficient Bound Computations in Multiobjective Optimization
Kathrin Klamroth, Kerstin Daechert, Renaud Lacour, Daniel Vanderpooten

Given some (partial) knowledge on the nondominated set of a multiobjective optimization problem, the search region corresponds to that part of the objective space that potentially contains additional nondominated points. We consider a representation of the search region by a set of tight local upper bounds (in the minimization case). While the search region can be easily determined in the bi-objective case, its computation in higher dimensions is considerably more difficult and gives rise to an interesting relation to computational geometry. We discuss the usefulness of local upper bounds in Branch and Bound type algorithms as well as in scalarization based solution methods, aiming at concise representations of the nondominated set.

2 - Methods of tropical optimization in rating alternatives based on pairwise comparisons
Nikolai Krivulin

We consider unconstrained and constrained optimization problems in the framework of the tropical (idempotent) mathematics, which focuses on the theory and applications of semirings with idempotent addition. The problems are to minimize or maximize functions defined on vectors over idempotent semifields (semirings with multiplicative inverses). We examine several problems of rating alternatives from pairwise comparisons, including problems with constraints on the final scores of alternatives, and multi-criteria rating problems. We reduce the problems to the log-Chebyshev approximation of pairwise comparison matrices by reciprocal matrices of unit rank, and then represent the approximation problems as optimization problems in the tropical mathematics setting. To solve these problems, methods of tropical optimization are used to provide direct, complete solutions in a compact vector form. We discuss the applicability of the results to real-world problems, and provide numerical examples.

■ TA-15

Thursday, 9:00-10:30 - Seminarraum 305

Flows and Queues

Stream: Project Management and Scheduling
Chair: *Martin Josef Geiger*