Wednesday 1st October 2014

Time	*Speaker*	*Talk Title*
Session 1 - Chair: Ambros Gleixner		
09:00	Thorsten Koch	The SCIP Optimization Suite - Past, present and future
09:40	Jonas Witt	GCG: A generic branch-price-and-cut solver
10:20	Yuji Shinano	ParaSCIP and FiberSCIP libraries to parallelize a customized SCIP solver
11:00	Coffee Break	
Session 2 - Chair: Felipe Serrano		
11:20	Matthias Walter	Investigating mixed-integer hulls using a MIP solver
12:00	Pierre Le Bodic	Insights on branching in MIP solvers
12:40	Lunch Break	
Session 3 - Chair: Stephen Maher		
14:00	Ivo Nowak	The outer-point generation algorithm - A decomposition method for MINLP
14:40	Ingmar Vierhaus	Presolving for discretized control problems with SCIP
15:20	Robert Schwarz	Gas network optimization by MINLPs
16:00	Coffee Break	
Session 4 - Chair: Yuji Shinano		
16:20	Jens Leoff	The cutting stock problem with bounded open orders
17:00	Wolfgang Welz	Conflict-free routing with high determination costs
Social Event - Workshop Dinner		
19:00	Cum Laude	Platz der Märzrevolution 10117 Berlin Website: www.cum-laude.info/restaurant Map: https://goo.gl/maps/bRPFJ

Thursday 2nd October 2014

Time	*Speaker*	*Talk Title*
Session 5 - Chair: Matthias Miltenberger		
09:00	Krzysztof Węsek	On aircraft landing scheduling
09:40	Stephen J Maher	Solving the integrated airline recovery problem using column-and-row generation
10:20	Dimitri Knjazew	Application of SCIP within SAP products
11:00	Coffee Break	
Plenary Session - Chair: Marc Pfetsch		
11:30	Andrea Lodi	Indicator constraints in mixed-integer programming
12:40	Lunch Break	
Session 6 - Chair: Gerald Gamrath		
14:10	Tristan Gally	Mixed integer semidefinite programming with SCIP
14:50	Tobias Fischer	Using SCIP to solve linear programs with complementarity constraints
15:30	Moritz Firsching	Using SCIP in computational geometry
16:10	Thorsten Koch	Closing Address

Plenary Talk

Andrea Lodi

University of Bologna

Indicator constraints in mixed-integer programming

Mixed Integer Linear Programming (MILP) models are commonly used to model indicator constraints, which either hold or are relaxed depending on the value of a binary variable. Classification problems with Ramp Loss functions are an important application of such models. Mixed Integer Nonlinar Programming (MINLP) models are usually dismissed because they cannot be solved as efficiently. However, we show here that a subset of classification problems can be solved much more efficiently by a MINLP model with nonconvex constraints. This calls for a reconsideration of the modeling of these indicator constraints, and we present several new results and interpretations obtained by digging into the relationship between MILP and MINLP. (Joint work with A. Nogales-Gmez, P. Belotti, M. Fischetti, M. Monaci, D. Salvagnin, P. Bonami)

Abstracts

Moritz Firsching

Freie Universität Berlin

Using SCIP in computational geometry

Many problems from Discrete Geometry can be reformulated by writing down a semi-algebraic set and then optimizing polynomial functions over this set. SCIP can then be used to do the necessary calculations and guarantee global optima within a prescribed precision. Due to the non-linearity of the equations involved, we can not expect to alsways find solutions. We will look at some cases where SCIP was able to find solutions. I will also present how to get from the problem in geometry to the programming problem running in SCIP, using the open-source mathematics software Sage.

Tobias Fischer

Technische Universität Darmstadt

Using SCIP to solve linear programs with complementarity constraints

Complementarity constraints require that from two variables at most one may have a nonzero value. They are traditionally handled with a reformulation using auxiliary binary variables and big-M constraints. This results in a tighter relaxation of the feasible area, but at the cost of a larger problem size. In this talk, we further develop the well-known SOS1 branching approach of Beale and Tomlin that allows to omit the big-M constraints and to enforce the complementarity constraints directly by branching on sets of variables. In a computational study, we compare different parameter settings of our implementation in SCIP and examine their efficiency.

Tristan Gally

Technische Universität Darmstadt

Mixed integer semidefinite programming with SCIP

In this talk we present a methodology to solve MISDPs (Mixed Integer Semidefinite Programs) with SCIP, using branch-and-cut. It consists of a constraint handler for presolving purposes, a relaxation handler, a general interface for solving SDPs and solver specific interfaces. It currently interfaces to the interior-point SDP-solvers DSDP, SDPA and Mosek. One important task is the preprocessing in each node to keep the Slater condition intact, which is a prerequisite for most SDP solvers. We will also shortly discuss two applications of MISDPs. The plugin was originally developed by Sonja Mars and Lars Schewe.

Thorsten Koch

Konrad-Zuse-Zentrum für Informationstechnik Berlin

The SCIP Optimization Suite - Past, present and future

In this talk, we give an overview of the SCIP Optimization Suite. We start with a discussion of the constraint integer programming concept and how it influenced the design of SCIP. Then, we show various projects in which SCIP has been used and how they gave rise to new developments within the SCIP Optimization Suite. We close with an overview over current projects and research directions.

Dimitri Knjazew

SAP

Application of SCIP within SAP products

This talk gives an overview on the usage of SCIP/Soplex within various SAP products, in particular for solving Mixed-Integer Linear Problems for business applications.
We describe the application areas where SCIP is used, and present structure and sizing of MILP models in typical customer scenarios.
Finally, we show how SCIP is technically embedded inside the SAP software.

Pierre Le Bodic

Georgia Institute of Technology

Insights on branching in MIP solvers

We will exhibit a family of instances for which a fixed-size branch-and-bound tree exists, but for which SCIP and other state-of-the-art MIP solvers need an increasing amount of resources.

Jens Leoff

Fraunhofer-Institut für Techno- und Wirtschaftsmathematik

The cutting stock problem with bounded open orders

We consider an integrated CuttingStock Problem and Sequencing Problem. The input for our problem is a set of orders, each order consisting of multiple itemtypes and quantites, i.e. we have a partition of the usual CuttingStock input. An order is open as soon as its first item is produced, and until all of its demands are fulfilled. The patterns in a CuttingStock solution have to be sequenced such that they respect a further constraint: There may at most be k open orders at any time. I will present an MIP formulation for the Cutting Stock Problem with Bounded Open Orders and outline how I want to approch the problem: The method of choice is Branch & Price, using Vanderbecks branching scheme to enforce integrality. The additional variables and constraints modelling the sequencing part of the problem are adressed with branching on constraints. Implementation details and first numberical results are presented.

Stephen J Maher

Konrad-Zuse-Zentrum für Informationstechnik Berlin

Solving the integrated airline recovery problem using column-and-row generation

A fundamental aspect of airline operations is the recovery process. Due to the complexity of the complete recovery process, its execution typically involves solving a series of sequential optimisation problems. This paper attempts to improve upon the sequential approach by developing an optimisation problem that integrates many aspects of the complete recovery process, namely the schedule, aircraft, crew and passenger recovery. However, the integrated problem is much more complex than the sequential problem due to the additional constraints required to link each individual recovery process. To address this complexity a column-and-row generation solution approach is developed. The problem complexity is reduced by eliminating a set of structural constraints that are dynamically reintroduced to the problem using a row generation procedure. The results will demonstrate the runtime improvements of column-and-row generation compared to standard column generation. Additionally, a number of enhancement techniques for column-and-row generation are introduced and discussed.

Ivo Nowak

HAW Hamburg

Outer-point generation - A decomposition algorithm for solving MINLPs

Column Generation (CG) uses a linear master problem for generating inner approximation points of a quasi-separable optimization problem. If the duality gap is not too large, it can be used for solving huge discrete optimization problems.

In this talk we shortly describe how huge airline scheduling problems with hundred millions of variables are solved using CG. Motivated by these results, we present a new MINLP decomposition algorithm, called Outer-Point Generation (OG).

Similar as CG, the OG algorithm generates inner approximation points of a polyhedral outer-approximation. But in contrast to branch-and-price, it uses a nonconvex polyhedral master problem for closing the duality gap. We finish with a discussion how the OG algorithm can be implemented using SCIP/MINLP/GCG.

Robert Schwarz

Konrad-Zuse-Zentrum für Informationstechnik Berlin

Gas network optimization by MINLPs

We present a procedure for capacity planning of large-scale real-world distribution networks. It decides which combination of network extensions such as additional pipelines, compressors or valves should be added to increase the networks capacity or enhance its operational flexibility. We model this problem by a mixed-integer nonlinear program. A combination of linear outer approximation and NLP solution techniques is used to solve the model. Computational results demonstrating the benefit of our approach are obtained by a special tailored combination of the solvers SCIP and IPOpt. Real-world data with several hundred nodes and about 3000 arcs are provided by Open Grid Europe GmbH (OGE), the leading German gas transportation company.

Yuji Shinano

Konrad-Zuse-Zentrum für Informationstechnik Berlin

ParaSCIP and FiberSCIP libraries to parallelize a customized SCIP solver

In order to make a solver for a specific problem, users of SCIP often write their own user defined plugins. With the parallel extension libraries ParaSCIP and FiberSCIP, extendability of the SCIP library is preserved. Thus, a parallelization of SCIP plus problem specific code can be obtained by only adding a small glue code and linking to one of the libraries. In this talk, we introduce the Ubiquity Generator Framework (UG) to parallelize branch-and-bound based solvers and its instantiations ParaSCIP and FiberSCIP briefly and explain how to develop parallel version of a customized SCIP solver by using an example.

Ingmar Vierhaus

Konrad-Zuse-Zentrum für Informationstechnik Berlin

Presolving for discretized control problems with SCIP

We consider the optimal control of dynamical systems, given in terms of a set of ordinary differential equations. We allow non-smooth functions in the model equations. Systems of this type can be transcribed into MINLPs and can then theoretically be solved globally with standard branch-and-bound solvers. However, in practice this is only feasible for very small instances. To improve the solution process, we have developed two plugins that exploit the problem structure introduced by the time-discretization: A bound propagation method used in presolving and a simulation-based heuristic. The talk will present the plugins as well as numerical results for a test instance. We will also discuss some details of the implementation and some tools we use to treat dynamical systems with SCIP.

Matthias Walter

Otto-von-Guericke-Universität Magdeburg

Investigating mixed-integer hulls using a MIP-solver

We present work in progress which is about identifying and certifying some facets and all equations valid for the mixed-integer hull of a given IP model. The only requirement is an oracle which solves the IP for arbitrary objective functions. Related work was done by Buchheim, Liers and Oswald on Target Cuts although for another motivation.

Wolfgang Welz

Technische Universität Berlin

Conflict-free routing with high determination costs

In this talk we consider one particular optimization problem as it occurs for welding cells in the automotive industry: In these cells several robots perform spot welding tasks on the same component within the cycle time. Given the data of the workpiece, the task is to find a feasible sequence of weld points as well as the trajectory planning for all robots such that the robot arms do not collide with each other. This problem represents a combination of discrete (sequencing and scheduling) and continuous optimization (robot motion planning), where the exact trajectory calculations are usually computationally much more expensive. It is therefore crucial to avoid unnecessary exact distance computations when possible. In this context we propose a constraint integer programming formulation that efficiently integrates the robot motion planning into a branch-and-price approach for the underlying routing problem. It allows us to drastically reduce the number of exact trajectory computations, while at the same time as much information of the routing as possible can be reused. This approach has been tested and evaluated on 2D and 3D-instances using the SCIP framework.

Krzysztof Węsek

Warsaw University of Technology

TITLE: On aircraft landing scheduling

We consider the problem of scheduling aircraft landings at an airport. The aim is to decide landing times for each plane, such that separation rules between landings are satisfied and each plane lands in a given time interval. The problem is intensively studied, with various aproaches and objectives. Our work concerns not only the order of landings, but also the landing routes and speeds, which are assigned to planes - we model it with a graph and mixed integer programming tools.

Jonas Witt

RWTH Aachen University

GCG: A generic branch-price-and-cut solver

Reformulating a given mixed integer program (MIP) by the use of Dantzig-Wolfe decomposition leads to a potentially stronger linear programming relaxation. The reformulated problem can be solved by applying a branch-price-and-cut algorithm. Our generic branch-price-and-cut solver GCG, which is based on SCIP, automatically detects the structure of the constraint matrix belonging to a given MIP, performs the decomposition, and solves the reformulated problem via branch-price-and-cut. We give an overview on the implemented features and present computational results.