Industrial Railroad Operations: Optimal Switching, Routing, and Scheduling

A. Ceselli[1], **M. E. Lübbecke**[2], **and I. Spenke**[3]

Abstract: Industrial switching involves moving materials on rail cars within or between industrial complexes and connecting with other rail carriers. Planning tasks include the making up of trains with a minimum shunting effort, the feasible and timely routing through an in-plant rail network on short paths, and assigning and scheduling of locomotives under safety and network capacity aspects. A human planner must resort to routine and simple heuristics, not least for the reason of unavailability of computer aided suggestions.

We propose integer programming models to capture both problems, shunting and routing/scheduling at a practical level of detail in order to obtain optimal or provably good, industrially usable solutions. The routing model is a set partitioning based formulation with an enormous number of variables. It is solved by a branch-and-cut-and-price algorithm, that is variables and constraints of the linear programming relaxation are dynamically generated at each node of the branch-and-bound tree. The so-called pricing subproblem is a tailored resource constrained shortest path problem. We discuss some generic issues of this increasingly popular general technique for solving large-scale integer programs and particularities of our approach like special branching rules.

Our work is based on recent practical data from a German in-plant railroad. We plan to report on first experience with a prototype installation of our algorithms in practice which is planned for spring 2006.

[1,2,3] Technische Universität Berlin
Institut für Mathematik, MA 6-1
Straße des 17. Juni 136
D-10623 Berlin, Germany
{*ceselli,m.luebbecke,spenke*}*@math.tu-berlin.de*