STSM Scientific Report

December 16, 2013

The aim of the STSM was to continue with the study of classification problems with the Ramp Loss. This is the second STSM with this purpose, the first one took place in July with one week duration. This second STSM has offered the possibility of developing the ideas from July, apply them and obtain computational results. The STSM was scheduled for three weeks, but it lasted finally one month, hence more research on the topic has been done.

The classification problems studied have been formulated as Mixed-Integer Convex Quadratic Programming (MIQP) problems, and only solved to optimality for small sizes. On one side, the purpose of the research was to develop an algorithm that iteratively solves MIP relaxations of the original MIQP problem until obtaining the optimal solution. On the other hand, we want to study a special class of those problems for which we proposed a nonconvex Mixed-Integer Nonlinear Programming (MINLP) formulation that can be solved more quickly than the MIQP formulation.

For the first research branch, from the previous STSM we proved that generating MIP relaxation of the MIPs in order to achieve good bounds was a good technique, but it remained open the question how to generate the first MIP relaxation, and if it was crucial in order to generate the next MIPs with the already designed procedure. This question has been answered after several computational experiments. The structure of the classification problem has been exploited, and tests are running in order to find better relaxations.

For the second research branch, Professor Andrea Lodi involved Professor Pietro Belotti, FICO, United Kingdom in the previous STSM. We wanted to study the fact that for the classification problem a specific MINLP solver behaves better than most MIQP (and thus MILP) solvers. By computationally analyzing one by one the major components of the MINLP solver and discussing their influence on the solving approach, we are able to shed some lights on the reasons of this unexpected success and to argue on how MIQP and MILP solvers could benefit from a tighter integration of the same components. Bound tightening as well as branching on continuous variables, are the two of the components we tried. The tests consisted of programming in MILP solvers bound tightening of MINLP solvers, and forcing branching on integer variables MINLP solvers, to see the difference

in behaviours. Similar classification problems but with different objective functions were tested.

The work done during the STSM made us submitting for the international conference Integer Programming and Combinatorial Optimization (IPCO 2014).