

STSM SCIENTIFIC REPORT

August 8, 2013

The aim of the STSM was to continue with the study of classification problems with the Ramp Loss. These problems 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, the host, Professor Andrea Lodi, invited Professor Robert Weismantel, ETH, Switzerland. During the STSM computational tests were run, and it seems that the MIP relaxations involving a small number of variables were indeed effective in providing good bounds for hard MILPs / MINLPs in which the continuous relaxation is weak. As the convergence rate of the method is nice, in a relatively small number of iterations we can get a very strong bound that a general solver would achieve in a longer time. Two questions were deeply studied: how to generate the MIP relaxation of the MIPs in order to achieve good bounds without increasing the difficulty of the MIP relaxations, and how and when to do a crossover when we achieve good enough bounds and we want to move back and solve the original model exploiting the bound information stored from the MIP relaxations.

For the second research branch, Professor Andrea Lodi invited Professor Pietro Belotti, FICO, United Kingdom. We wanted to study the fact that bound reduction, a fundamental component of any MINLP solver, helps finding an optimal solution. After imposing the reduced bounds to the MIQP formulation, the solution time decreases dramatically, which suggests that MIQP (and thus MILP) solvers would benefit from an enhanced bound reduction, or at least from a limited variant thereof.

The work carried out during the STSM will be continued in the future, as another STSM of 3 weeks has been approved and will take place.