Scientific Report

STSM on Multi-Objective Mixed Integer Non-Linear Programming Problems

In this document we describe the work carried out during the short-term scientific mission from the 17th to the 23rd of May 2014 of Dr. Valentina Cacchiani to LIX, Ecole Politechnique. The research was done together with Dr. Claudia D'Ambrosio.

Purpose of the STSM and description of the work carried out during the STSM

The work carried out during the STSM has followed two directions.

On one hand, we have investigated techniques for improving a branch-and-bound algorithm for Bi-objective Mixed Integer Non-Linear Programming (MINLP), that we have developed in a STSM in October 2013. The proposed algorithm has been applied to a real-world problem in energy production, studied in A. Borghetti, C. D'Ambrosio, A. Lodi, S. Martello. A MILP Approach for Short-Term Hydro Scheduling and Unit Commitment with Head-Dependent Reservoir, IEEE Transactions on Power Systems 23 (3), pp. 1115–1124, 2008. The studied problem consists of a unit commitment problem whose aim is to find the optimal scheduling of a multi-unit pump-storage hydro power station for a given time horizon of one week.

On the other hand, we have studied multi-commodity flow problems. We have started from a work developed at LIX by Luca Mencarelli (PhD student at LIX) on Matheuristics for Multicommodity Flow Problems, in which several methods are proposed for tackling linear multi-commodity flow problems. We have studied how the proposed methods can be extended to deal with a real-world application in railway optimization, which consists of a multi-commodity flow problem with additional constraints defined on a time-space graph.

Description of the main results obtained

We have improved a general branch-and-bound algorithm for bi-objective convex MINLP problems. We have studied how to extend multi-commodity flow algorithms to deal with a real-world application in railway optimization.

Future collaboration and foreseen publications

The collaboration will continue with the goal of applying multi-commodity flow algorithms to a real-world application in railway optimization, namely the Train Timetabling Problem. A paper has been submitted on bi-objective convex MINLPs.

Confirmation by the host institution of the successful execution of the STSM

See the attached document.