

**Final report of the STSM in University of La Laguna
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Purpose of the STSM

The main objective of the STSM was to initiate collaboration with researchers from the University of La Laguna by presenting them my research interests and recent results as well as getting interested in details of their investigations thus organizing a discussion on common research interests as foundations for further collaboration. According to the current and expected research results the STSM work plan was organized as follows:

- to organize presentations of research interests of both parts and initiate a discussion on common research interests and plans for further collaboration;
- to discuss on the tasks planned for both collaborating sides and on primary results expected from the collaboration;
- perform some primary investigation activities requiring close collaboration in order to get prepared for further remote collaboration.

Description of the work carried out during the STSM

Several meetings with the researchers from the host institution have been organized and devoted for the exchange of the research interests in the area of mathematical optimization and recent research results. During the meetings I have presented my recently developed algorithms for discrete optimization whereas the host researchers presented their interests in solution of Container Loading Problem (CLP) and solution methods they are currently applying.

The discussion on possibilities to apply my research results in order to improve the efficiency of solution of various CLP instances provided by the host institution has been also organized.

Some working sessions devoted for primary design of new algorithms have been organized and tasks for further work have been formulated in order to prepare for the fluent remote collaboration.

Description of the main results obtained

The main result expected from the STSM – to initiate the collaboration with researchers from the University of La Laguna – has been successfully achieved. It was agreed to start the joint research work and the following major issues giving foundations for fluent collaboration have been achieved:

- The exact formulation of CLP will be used in further research have been described and the list of problem instances for experimental investigation have been prepared. The

joint research will be focused on solution of the bi-objective CLP related to loading to a container a box-shaped items of different dimensions considering their orientation and position in the container subject to maximize volume and weight of the packed items. The heuristic algorithm for evaluation of objective values, proposed by the host researchers in [1], will be used for the experimental investigation. A set of problem instances has been selected considering different levels of similarity of the items to be loaded.

- The plan for improving the solution of the formulated CLP has been prepared, where the following research lines has been planned:
 - Apply the our proposed strategies for dynamic adjustment of Genetic Algorithm parameters [2] to the implementation of Non-dominated Sorting Genetic Algorithm, the host researcher are currently applying to solve CLP.
 - Apply to bi-objective CLP our developed (but not published yet) strategy for ranking of the search space elements, which is already applied to solve single objective discrete Competitive Facility Location problems.
 - Develop a permutation-based combinatorial optimization algorithm for efficient determination of the optimal sequence of items to be loaded, on the basis of results of the above research lines.
- The lists of tasks to be made in remote collaboration have been prepared for both collaborating parts.
- Some initial experimental investigation activities have been performed in order to master main concepts of dealing with CLPs and the heuristic container filling algorithm provided by the host researchers.

Future collaboration with the host institution

It was agreed to start the long-term collaboration in developing heuristic algorithms for discrete optimization. It is expected to organize the second face-to-face meeting to discuss obtained results by inviting the corresponding researcher from the host institution to visit research group in Vilnius University, Lithuania.

Foreseen publications/articles resulting from the STSM

It is expected that collaboration will issue relevant results which will be presented in scientific conferences and published in scientific publications. It is expected to prepare and submit the first publication before the end of 2016.

References

- [1] Yanira González, Gara Miranda, and Coromoto León. A multi-level filling heuristic for the multi-objective container loading problem. In *International Joint Conference SOCO'13-CISIS'13-ICEUTE'13: Salamanca, Spain, September 11th-13th, 2013 Proceedings*, pages 11–20. Springer International Publishing, 2014.
- [2] Algirdas Lančinskis, Pascual Fernández, Blas Pelegrín, and Julius Žilinskas. Improving solution of discrete competitive facility location problems. *Optimization Letters*, pages 1–12, 2015. ISSN 1862-4472. doi: 10.1007/s11590-015-0930-3.