Scientific report of José Neto

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Field of Research:	Combinatorial Optimization
Topic:	Multiple-points separation
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Field of Research and results

When solving linear programs with a large number of constraints, constraint generation techniques are often used. They basically consist in iteratively solving a relaxation of the problem and adding to it an inequality that is violated by the current solution. This process is iterated until no violated inequality can be found, i.e. when the optimal solution of the relaxation is feasible, hence optimal for the original problem.

A modification of this basic scheme has been introduced recently [1]. Essentially, it consists in using several points in the separation process instead of a single one. And the main purpose during this program was to investigate potential extensions and of this preliminary work, both in theory and practice.

On the theoretical side we namely established some additional properties relating to multiple-points separation. Also, we investigated ways of performing a multiple-points separation different from what is presented in [1] that could potentially lead to improve practical performance. One way to do so could consist in replacing the resolution of a linear program as presented in the former reference, by a (possibly approximate) combinatorial procedure, this by taking profit from peculiar structures arising in the problems to be considered. For example, in the case of subproblems arising in the resolution of survivable network design problems or multicommodity min-cost flow (MMCF) problems, fully polynomial approximation schemes (to perform a particular multiple-points separation) can be derived from procedures developped to solve multiple-objective shortest paths problems (see, e.g., [3, 2]). Further investigations along those lines are under work.

With a more practical view and so as to better characterize the practical efficiency of the multiple-points separation approach (as introduced in [1]) we considered its use within column generation procedures. (The basic principle remains essentially the same as for the generation of constraints simply by

working with the dual problem.) We namely implemented and started some numerical experiments on MMCF problems.

Activities

- Attendance at the lectures and colloquia of the CGC program.
- One talk at the colloquium of the CGC program.

Preview

- Investigations are to be pursued further so as to improve the practical efficiency of constraint/column generation algorithms relying on a multiple-points separation process.
- We are working on the evaluation of a multiple-points separation approach within column generation procedures.

References

[1] W. Ben-Ameur and J. Neto, *A constraint generation algorithm for large scale linear programs using multiple-points separation*, (submitted), 2005.

[2] R. Hassin, *Approximation schemes for the restricted shortest path problem*, Tel-Aviv University, Israel, 1989.

[3] A. Warburton, *Approximation of Pareto optima in multiple-objective, shortest-path problems*, Operations Research 35(1): 70-79, 1987.