Kernel search: A general heuristic approach to MILP problems

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In this talk a general heuristic approach, known as Kernel Search, will be presented that has been successfully applied to several MILP problems. The Kernel Search is a general and simple heuristic framework that has been introduced in [1] and [2] for the solution of MILP problems with binary variables, in particular of a portfolio optimization problem and the Multidimensional Knapsack Problem. The original idea was to consider all the problem variables through the solution of a sequence of MILP problems, each problem restricted to a subset of variables. This restriction is equivalent to setting to 0 a subset of variables. In the sequence of restricted MILP problems the size of the solved problems is increasing because at each iteration new variables may be added to the subset and none is removed. Some enhancements of the Kernel Search have been proposed in Guastaroba and Speranza [3], where the removal of variables is allowed and applied to an index tracking problem. Moreover, a new variant is proposed that refines the solution found through the first sequence of restricted problems. The idea of the variant is to perform variable fixing (binary variables set to 1) in the original MILP problem on the basis of the solutions found in the first sequence, and to solve to optimality the MILP problem restricted to the remaining variables. The Kernel Search has been further developed in [4] to be applicable to problems where a large number of continuous variables are associated with each binary variable, in particular to the Capacitated Facility Location Problem.

References

[1] Angelelli, E., Mansini, R. and Speranza, M.G., "Kernel search: A general heuristic for the multi-dimensional knapsack problem", *Computers and Operations Research*, 37(11), 2010, 2017–2026.

[2] Angelelli, E., Mansini, R. and Speranza, M.G., "Kernel search: A new heuristic framework for portfolio selection", *Computational Optimization and Applications*, 51(1), 2012, 345-361.

[3] Guastaroba, G. and Speranza, M.G., "Kernel Search: An application to the index tracking problem", *European Journal of Operational Research*, 217(1), 2012, 54–68.

[4] Guastaroba, G. and Speranza, M.G., "Kernel Search for the Capacitated Facility Location Problem", to appear in *Journal of Heuristics*.