LP-based branching in the interval graph algorithm for orthogonal packing

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April 9, 2008

Consider the d-dimensional orthogonal packing problem (OPP-d): given a set of orthogonal objects, n items and a container, it is to answer if the items can be packed in the container. No rotation is allowed. Fekete et al proposed to represent a feasible packing by a system of intersection graphs. Moreover, they defined 3 sufficient properties for an arbitrary system of d graphs to represent a valid packing: each graph should be interval (P1); each stable set of the k-th graph should have the sum of its weights not greater than the container size in dimension k (P2); the intersection of the graphs should be empty (P3). Fekete et al (2007) proposed a combinatorial enumeration scheme to construct such a system or to state that none exists. They used the so-called dual-feasible functions for bounds. This algorithm seems to be the most effective exact algorithm today.

We propose a Branch-&-Bound algorithm calculating in each node the d one-dimensional bar relaxations using LP with column generation. It is then checked if the obtained graphs represent a packing class. P2 is satisfied automatically. We discuss the main concepts of the branching strategy. Belov (2007) showed that P1 can be reduced to property P1': each graph is a cocomparability graph. We compare both variants and provide numerical results.

References

[1] G.Belov and G.Scheithauer. Extending Rectangular Packing Classes to Cocomparability Graphs. 22nd European Conference on Operational Research EURO XXII, Prague 2007.

[2] S. P. Fekete, J. Schepers, and J. C. van der Veen. An Exact Algorithm for Higher-Dimensional Orthogonal Packing, *Operations Research* 55(3), 2007, pp. 569-587.