EQUIVALENT TRANSFORMATIONS IN ORTHOGONAL PACKING PROBLEM[1]

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We consider Minimum Raster Set Problem (MRSP) that can be formulated in the following way. Let we have the tuple $(L, \mathbf{l}) \in R_+ \times R_+^m$, where $0 < l_1 \le l_2 \le \ldots \le l_m \le L$. Define the raster set as

$$R(L, \mathbf{l}) = \left\{ \sum_{j=1}^{m} l_j a_j \ : \ \sum_{j=1}^{m} l_j a_j \le L, \ \mathbf{a} \ \in \{0,1\}^m \right\}.$$

Two tuples $(L, \mathbf{l})$ and $(\tilde{L}, \tilde{\mathbf{l}})$ are equivalent if:

$$P(L, \mathbf{l}) = P(\tilde{L}, \tilde{\mathbf{l}})$$

where

$$P(L, \mathbf{l}) = \left\{ \mathbf{a} \ : \ \sum_{j=1}^{m} l_j a_j \le L, \ \mathbf{a} \in \{0,1\}^m \right\}.$$

We need to find the tuple $(L^*, \mathbf{l}^*)$ equivalent to $(L, \mathbf{l})$ with minimum number of raster points $|R(L^*, \mathbf{l}^*)|$.

This problem arises in representation of defferent problems of discrete optimization as integer linear programs where number of variables depends on number of raster points (Arc-flow models [1,2,3]).

We propose a method for finding bounds for MRSP based on linear programming. We consider different ways of constructing the equivalent tuple $(L^*, \mathbf{l}^*)$ with different objective functions to get the upper bound. We also propose a method for estimating the lower bound. Computational results are presented as well.

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