Generating and Reconstructing hv-convex 2-dimensional Discrete Sets

Emese Balogh

The reconstruction of 2-dimensional discrete sets from their projections has been studied in several classes. In certain classes the reconstruction is NP-hard, therefore the most frequently studied classes are those, where the reconstruction can be performed in polynomial time, like the hv-convex polyominoes and hv-convex 8-connected sets.

The reconstruction problem is to determine a 2-dimensional discrete set F from its two orthogonal projections H and V or report failure if such F does not exist. We have implemented and slightly modified a well-known algorithm in the literature for the reconstruction in the class of hv-convex polyominoes and in the class of hv-convex 8-connected sets. The algorithm approaches iteratively the solution by a nondecreasing and a nonincreasing sequence of discrete sets. The elements of the first sequence are called core sets and are subsets of F and the elements of the second sequence are called envelope sets and supposed to contain F.

In order to test the algorithm, we need to generate such sets at random. W. Hochstätter, M. Loebl, and C. Moll give a recursion formula for the number of hv-convex polyominoes, derive a bijection between an interval of natural numbers and the polyominoes of given perimeter which provides the possibility to generate them at random. In this paper we extend the recursion formula for the greater class of the hv-convex 8-connected sets, and using a similar bijection we are able to generate such sets at random.