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Polynomial Time Reconstruction of Regular Convex Lattice Sets from their Horizontal and Vertical X-Rays

Abstract

We consider a problem of Discrete Tomography that has been open for 20 years: the reconstruction of convex lattice sets from their horizontal and vertical X-rays. We prove that it can be solved in polynomial time for a subclass of lattice sets that we call regular.

Regularity is a property related to the relative position of the points of the set with extreme abscissa and ordinate (the feet of the sets). By following the classical strategy initiated by E. Barcucci et al. for the reconstruction of horizontally and vertically convex 4-connected lattice sets, the reconstruction of regular lattice sets leads to regular switching components. Structural properties of regular switching components have been proved recently. By using them for the last step of the algorithm i.e. the convex aggregation of the switching components, the reconstruction of a convex solution can be reduced to the research of a path in a DAG whereas the classical approach leads to a 3-SAT instance expressing convexity (that cannot be solved in polynomial time). It provides a polynomial time algorithm of reconstruction for the subclass of the regular convex lattice sets.