Reconstruction of Discrete Sets from Four Projections: Decomposable Cases

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One of the most frequently studied problems in the area of discrete tomography is the reconstruction of 2-dimensional discrete sets from few (usually up to four) projections. This problem is usually underdetermined and the number of solutions can be very large. Moreover, the reconstruction in certain classes of discrete sets can be NP-hard. In order to keep the reconstruction process tractable and to reduce the number of solutions a commonly used technique is to suppose having some a priori information of the set to be reconstructed, such as convexity, connectedness and directedness.

In [1] the authors gave an algorithm for reconstructing hv-convex 8-connected but not 4-connected discrete sets from two projections. This algorithm takes the so-called equality positions and checks whether they can be the source position of the first component of a solution. The worst case time complexity of this algorithm due to the possible number of the equality positions is of $O(mn \cdot \min\{m, n\})$ and in some cases the solution is not uniquely determined.

We show that using also the diagonal projections the algorithm can be speeded up having complexity of $O(mn)$ and in this case uniqueness also holds. Then, we consider the possibility to generalise our results to adapt the algorithm to work for broader classes. It is shown that equality positions together with the diagonal projections can be a useful tool to decompose discrete sets into components to facilitate the reconstruction.

References

[1] P. Balázs, E. Balogh, A. Kuba, A fast algorithm for reconstructing hv-convex 8-connected but not 4-connected discrete sets, Lecture Notes in Computer Science **2886** (2003) 388-397.