Reconstruction of hv-Convex Binary Matrices from Horizontal and Vertical Projections Based on Simulated Annealing

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Tomography is a method of producing a three-dimensional image of the internal structure of an object from its projections, without damaging it. This is usually achieved by reconstructing 2D slices from the projections and then assembling them. In Binary Tomography we assume, that the examined object is homogeneous to reduce the number of projections needed for the reconstruction. In case of just two projections the task is usually extremely underdetermined. To overcome that problem we further assume that the reconstructed image satisfies certain geometrical conditions, such as hv-convexity. The reconstruction of hv-convex binary matrices from their horizontal and vertical projections is proved to be NP-hard. In this work we design and study two different algorithms is based on simulated annealing and compared them with a formerly published method. The first algorithm based on horizontal convex strips, and the second inverts pixels during the reconstruction process. We use a large set of test data, with different size and number of components. We stuidy two different methods to estimate the convexity of a binary image, the directional convexity measure and another one which calculates the number of the neighbouring object pixels. We deduce that the directional convexity measure is more efficient to analyse experimentally the performance of two appraches.

Acknowledgements

Péter Balázs was supported by the OTKA PD100950 grant of the National Scientific Research Fund, and the European Union and the State of Hungary co-financed by the European Social Fund under the grant agreement TÁMOP 4.2.4.A/2-11-1-2012-0001 ('National Excellence Program').