Determination of Geometric Features of Binary Images from Their Projections by Using Decision Trees

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Binary tomography produces two-dimensional cross-sections of three-dimensional homogeneous objects from their projections. Several algorithms developed for solving this task. Most of them presume that the binary image to be reconstructed has some special geometric features. In order to choose the appropriate reconstruction algorithm it is necessary to have a priori information of the image to be reconstructed. In this way we can improve the speed and reduce the ambiguity of the reconstruction.

Our work is concerned with the problem of retrieving geometrical information from the projections themselves. We investigate whether it is possible to evolve geometric features of binary shapes if only their projections are known. Most of the reconstruction algorithms based on geometrical information presuppose hv-convexity or connectedness about the image to be reconstrcuted. We investigate those properties in detail, and also the task of separating 4- and 8-connected shapes. We generate experimental images, then we try to retrieve the proper information just from the projections of the generated images.

For the classification we use decision trees. We decided to apply this learning method for three main reasosns. Our goal is to improve the speed of the reconstruction by finding the appropriate reconstruction algorithm. Thus, the determination of the feature must not take much time. Furthermore, in practice usually just a limited number of training data is available, so the learning must be able to work well even with relatively few training data. Finally, we want to exploit that classifications given by decision trees can be expressed by if-then rules.

We show that the separation of hv-convex images from randomly generated ones just by studying their projections is quite an easy task. Surprisingly, we obtain good results for classifying hv-convex and "almost" hv-convex images as well. Those experiments help us to gain useful information concerning the characterization of the discussed and other geometrical properties.