Computing the discrete Voronoi diagram with only double precision David L. Millman (University of North Carolina at Chapel Hill)

Abstract

The nearest neighbor transform of a binary image assigns to each pixel the index of the nearest black pixel – it is the discrete analog of the Voronoi diagram. Implementations that compute the transform use numerical calculations to perform geometric tests, so they may produce erroneous results if the calculations require more arithmetic precision than is available. Liotta, Preparata, and Tamassia, in 1999, suggested designing algorithms that not only minimize time and space resources, but also arithmetic precision.

A simple algorithm using double precision can compute the nearest neighbor transform: compare the squared distances of each pixel to all black pixels, but this is inefficient when many pixels are black. We develop and implement efficient algorithms, computing the nearest neighbor transform of an image in linear time with respect to the number of pixels, while still using only double precision.