

1-D Morphological Image Processing Architectures

March, 1996

Shoji Kojima

Mathematical morphology is extremely useful theoretical method for image processing and has many applications. In this type of processing, however, since computational cost increases with both of the area of original image and structuring element, it is difficult to utilize large sized structuring element.

In the past study, specialized hardware had been built for fast morphological processing. Cytocomputer architecture, for example, makes fast morphological image processing by 3 x 3 window but it is hard to implement large sized structuring element, because a lot of devices are needed.

In this study, new architectures to implement fast morphological processing are proposed. The base concept of these architectures is one-dimensional morphological processing manner and horizontal to vertical scan conversion of image data. As a result, since $O(M^2)$ of computational complexity is reduced to $O(M)$, fast processing and great reduction of hardware were both achieved.

Three types of prototype machines based on one-dimensional morphological processing were developed in this study. The first one is real-time binary morphological image processor used for eye-gaze point detection. The second one is experimental gray-scale morphological processing architecture with one-dimensional 16 stage pipelined dilation processor. The third one is gray-scale morphological processor with "Conversion Table" which makes it possible to utilize many types of structuring element shapes. Also this architecture has the useful function for mathematical geometry application.

Each of these architectures performs several times decade faster than ordinary computer architecture, so that efficiency of these architectures were confirmed.