Digital Convexity based on Path Counting

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Digital geometry differs from Euclidean geometry as digital objects built up by pixels and it is not straightforward to define the digital analogs of various geometric concepts. For example, the Gauss digitization of a convex shape may not be connected [3]. Thus, there are various approaches to define digital convexity [1, 2].

The usual definition of convexity in the Euclidean plane is as follows: for any two points of the object all points of the shortest path between them belong to the object. However, in the digital scenario, in a grid, usually the shortest path is not unique. Thus, we may allow various digital analogue definitions. Obviously, we may define a (maximal) digital convexity, by requiring the object to contain the points (i.e., pixels, in this case) of each shortest path between any pairs of pixels of the object. On the other hand, a (minimal) digital convexity can be defined by requiring that the object contains the pixels of at least one shortest path between any pairs of pixels. Between this two extremal cases, we also show a digital convexity concept where the object must have at least the pixels of the half of the possible shortest paths between any two pixels. The shapes of these convex objects are characterized.

References

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