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Abstract

The book explains why the definition of the boundary by means of the 4- and 8-neighborhood is wrong and suggests the use of the classical topological definition of the boundary while the digital image should be considered as an abstract cell complex. This approach has great significance in digital image processing. It allows a topological justification of many terms used in image processing. However, what is more important from the practical point of view is that we show how to work with cell complexes without the need of a large additional memory. We also suggest a graphical representation of boundaries in a cell complex. Three algorithms for tracing and encoding boundaries in binary, indexed, or color images are described. The code is free of loss of information so that the image can be exactly reconstructed from the code. The book also describes the theory of digital straight segments and an algorithm for dissolving a digital curve in digital straight segments. Another approach for dissolving digital curves into line segment is the polygonal approximation which is also presented in the book. The book considers different approaches to the detection of edges and suggests a new efficient method of edge detection usable for two- and three-dimensional images. Methods of efficiently encoding edges are suggested. Also, boundaries of subsets in a 3D space called surfaces are considered. Algorithms for efficiently encoding surfaces and for reconstructing 3D sets from the codes of all surfaces contained in this set are suggested. In the last chapter, the author suggests discussing the use of the classical definition of the derivative as the limit of the relation of the increment of the function divided by the increment of the argument while the latter tends to zero. This definition cannot be used for estimations of derivatives of non-analytical functions because it becomes wrong at small increments of the argument. Suggested is a useful method using an optimal value of the increment.

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