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Digital geometry. Geometric methods for digital picture analysis. (English)

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Digital geometry is about geometric properties of subsets of digital pictures, i.e., pictures residing on a grid. The book deals with concepts, methods and algorithms of digital geometry.

The first chapter provides a brief introduction to the subject as well as basic definitions. Also, a discussion on how digital geometry relates to other mathematical disciplines is given here.

The next seven chapters provide foundations for digital geometry. This part begins with Chapter 2, devoted to grids, digitization models, and property estimation. Then, Chapter 3 discusses metric spaces and metrics on pictures. The next two chapters treat pictures as graph-theoretic objects – Chapter 4 introduces graph-theoretic concepts that are used throughout the book, Chapter 5 presents spatial subdivisions with incidence pseudographs. Chapter 6 summarizes basic topological concepts, defines digital topologies and provides an introduction to combinatorial topology. This is followed by discussion on curves and surfaces in topological spaces (Chapter 7). Finally, Chapter 8 discusses geometric properties of curves and surfaces.

The next group of chapters deal with selected topics in digital geometry. Here, Chapter 9 discusses digital straightness in the grid point and grid cell models. Chapter 10 then deals with length and curvature of arcs and curves. Concepts, models and algorithms from these chapters are generalized in Chapter 11 that is devoted to the discussion of digital straightness and planarity in the 3D space. Length, curvature and torsion estimation for arcs in 3D spaces are then discussed in Chapter 12, followed by a discussion on estimation of the area or curvature of a surface. Finally, Chapter 13 deals with hulls and diagrams.

The last group of chapters deals with operations on pictures. Chapter 14 discusses transformation groups and symmetries, neighborhood-preserving transformations, applying transformations to pictures, magnification and demagnification, and digital tomography. In Chapter 15, morphologic operations are studied, namely dilation and erosion operations, their combinations, simplification, segmentation and decomposition. Operations that deform a picture while preserving geometric properties of the original picture form the subject of Chapter 16. Primary attention is given to deformations of 2D binary pictures, but two sections are devoted also to deformations of 3D pictures and deformations of multivalued pictures. Finally, picture properties and spatial relations are discussed in Chapter 17.

Each chapter contains exercises and references to related or more advanced work. An extensive bibliography completes this very useful resource for a wide variety of readers.

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