Foreword

The sampling lattice used to digitize continuous image data is a significant determinant of the quality of the resulting digital image, and therefore, of the efficacy of its processing. The nature of sampling lattices is intimately tied to the tessellations of the underlying continuous image plane. To allow uniform sampling of arbitrary size images, the lattice needs to correspond to a regular - spatially repeatable - tessellation. Although drawings and paintings from many ancient civilisations made ample use of regular triangular, square and hexagonal tessellations, and Euler later proved that these three are indeed the only three regular planar tessellations possible, sampling along only the square lattice has found use in forming digital images. The reasons for these are varied, including extensibility to higher dimensions, but the literature on the ramifications of this commitment to the square lattice for the dominant case of planar data is relatively limited. There seems to be neither a book nor a survey paper on the subject of alternatives. This book on hexagonal image processing is therefore quite appropriate.

Lee Middleton and Jayanthi Sivaswamy well motivate the need for a concerted study of hexagonal lattice and image processing in terms of their known uses in biological systems, as well as computational and other theoretical and practical advantages that accrue from this approach. They present the state of the art of hexagonal image processing and a comparative study of processing images sampled using hexagonal and square grids. They address the hexagonal counterparts of a wide range of issues normally encountered in square lattice-based digital image processing - data structures for image representation, efficient pixel access, geometric and topological computations, frequency domain processing, morphological operations, multiscale processing, feature detection, and shape representation. The discussions of transformations between square and hexagonal lattice-based images and of hybrid systems involving both types of sampling are useful for taking advantage of both in real-life applications. The book presents a framework that makes it easy to implement hexagonal processing systems using the square grid as the base,

e.g., to accommodate existing hardware for image acquisition and display, and gives sample computer code for some commonly encountered computations.

This book will serve as a good reference for hexagonal imaging and hexagonal image processing and will help in their further development. I congratulate the authors on this timely contribution.

Professor Narendra Ahuja
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