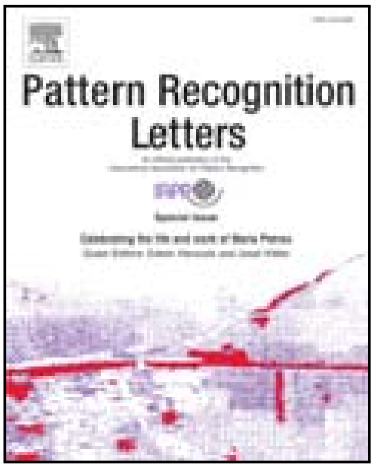

Skeletonization and its application

Punam Kumar saha , Saha Gunilla Borgefors

PII: S0167-8655(16)00009-X
DOI: 10.1016/j.patrec.2016.01.005
Reference: PATREC 6427

To appear in: *Pattern Recognition Letters*

Skeletonization and its application

Editorial

Punam Kumar Saha Gunilla Borgefors

The notion of *skeletonization* was introduced by Blum in nineteen sixties using an analogy of the *grassfire propagation* that generates a compact yet effective representation of an object referred to as its *skeleton* consisting of medial structures of lower dimensionality. Together with the distance information at its points from the object boundary, a skeleton allows the exact reconstruction of the original object. Over the last several decades, numerous fundamentally different computational approaches have been reported to extract skeletons of two and three-dimensional objects. Several skeletonization methods are developed using continuous representations of object boundaries, while a few other approaches are based on a discrete realization of some underlying principle in the continuous space. The most primitive, yet popular, approach of skeletonization is based on simulating the Blum's grassfire propagation in a digital grid as an iterative erosion process under certain digital topologic and geometric rules. Significant research efforts have been dedicated toward enhancing the performance of skeletonization algorithms in terms of parallel implementation, noisy branches, sharpness at corners, invariance under image transformation, reconstruction of original objects, etc. Creation of noisy skeletal branches has remained a major challenge and a comprehensive multi-scale solution to this problem is yet to emerge.

Skeletonization has been popularly used in many image processing and computer vision applications, including shape recognition and analysis, shape decomposition, character recognition, fingerprint analysis, animation, motion tracking, registration, interpolation, path-tracking, medical imaging applications etc. Skeletonization has been widely applied in various medical imaging areas, including pulmonary, cardiac, mammographic, abdominal, retinal, bone imaging, etc. A recent trend in medical imaging applications indicates an elevated interest on quantitative morphometry of biological objects through *in vivo* and *ex vivo* imaging coupled with advanced processing and analytic methods. A significant fraction of these research works adopt skeletonization as the core method facilitating efficient assessment and hierarchical representation of a rich set of regional object-structure properties including local geometry, topology, scale, and orientation.

Evaluation of the performance of skeletonization algorithms is an overarching research challenge that emerges from the lack of definition of the "true" skeleton for a digital object. A comprehensive and consensus framework for evaluating skeletonization algorithms providing structured knowledge of understanding of their performance under various categories at different imaging conditions is yet to emerge. Such performance analyses will be helpful in selecting the right category of skeletonization algorithms for a given application focusing on some specific object properties.

This special issue on skeletonization and its applications has collected original papers with innovative contributions to the research and development related to theory, methods, algorithms, evaluation, and applications of skeletonization. Eleven papers have been accepted for publication by taking into account the technical quality, the originality, and the innovation of the presented ideas, solutions, and applications—one of them is a review article, while ten others are regular articles with original contributions advancing the state-of-the-art of related topics.

The sole review paper "A Survey on Skeletonization Algorithms and Their Applications" by Saha, Borgefors, and Sanniti di Baja presents a comprehensive and concise survey of different skeletonization