

Preface

In July 2013, a group of around 30 women researchers in shape modeling attended the Women in Shape Modeling (WiSh) workshop at the Institute for Pure and Applied Mathematics (IPAM) in the University of California Los Angeles (UCLA) campus to begin research collaborations on some of the major problems in shape analysis and modeling. Participants from North America, Asia, Europe, and the Middle East lived, ate, slept, and worked together for one week at IPAM, then continued their collaborations from a distance. This proceedings volume contains preliminary results from those collaborations and related work. We look forward to future papers on these topics as participants continue their contributions to the growing body of work on mathematical shape modeling.

WiSh participants worked on one of the four research questions below.

1. *Team Leaders: Luminita Vese, Sibel Tari.* Simultaneous spectral and spatial analysis of shape, investigating a new distance-like shape operator from the spectral point of view, adopting signatures developed in the spectral literature, and solving similar symmetry detection problems. We also develop a connection to image segmentation and registration using the yet unclear connection of the new operator to the Ambrosio-Tortorelli functional.
2. *Team Leaders: Aasa Feragen, Megan Owen.* Dimensionality reduction and visualization of data in tree-spaces, studying dimensionality reduction in shape spaces where the shapes have the structure of a tree, such as classes of anatomical trees like airways and blood vessels, medial axes of 2D shapes, or phylogenetic trees. We develop techniques for low-distortion embedding into open books and hyperbolic spaces whose geometric structure is similar to that of tree-space.
3. *Team Leaders: Kathryn Leonard, Erin Wolf Chambers.* Geometric shape segmentation, exploring shape segmentation from a Gestalt perspective, using information from the Blum medial axis of edge fragments in an image. We combine existing edge saliency measures together with medial data to increase support for or against hypothesized edge interpolation and develop techniques for considering related appearance cues.

4. *Team Leaders: Marie-Paule Cani, Raphaele Chaine.* Representing and editing self-similar details on 3D shapes, studying shape deformation and editing techniques, such as elongating or compressing parts of a shape while maintaining local style, copy-pasting details from one shape to another, or changing the scale of details without changing lower resolution geometry. All are essential for interactive shape design. Blending properties of implicit surfaces make them good candidates for solving this problem. We explore the extension of multi-resolution analysis to these surfaces and their deformations, enabling us to characterize repetitive self-similarities, and develop methods for filtering details out and generating them again after low resolution shape editing. An extension studies multi-resolution editing of animated shapes.

It has been an honor to work with this exceptional group of women and with the efficient staff at IPAM. We are grateful to IPAM, the National Science Foundation, Microsoft Research, and the National Geospatial Agency for providing funding for the workshop, and to the UCLA Department of Mathematics for sharing space with us. In addition, the Association for Women in Mathematics (AWM), and President-Elect Kristin Lauter in particular, played a key role in encouraging me to organize a research collaboration workshop in conjunction with AWM. These workshops are now a regular part of AWM's offerings, and AWM activities at the annual Joint Mathematics Meetings center on research topics emerging from collaboration workshops.

Special thanks is due to my coeditor, Sibel Tari, who provided useful insights during the workshop and invaluable help during the preparation of this manuscript, and to Stacey Beggs at IPAM who worked creatively to solve several unexpected issues during the course of the workshop.

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Kathryn Leonard

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