

COMPUTATIONAL MATHEMATICS
COLLOQUIUM

Geometry + Optimization: towards computational anatomy

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Abstract: Geometric shape-processing lies at the heart of various branches of science: from finite element simulation in engineering, through animation of virtual avatars, to applications such as the analysis of anatomical variations, or detection of structural anomalies in medicine and biology. The demand for such computational approaches in geometry is constantly growing, as 3-dimensional data becomes readily available and is integrated into various everyday uses.

I will begin my talk with a brief overview of optimization-based approaches for geometric problems, such as identifying pointwise correspondences between exemplars in a collection of shapes, or deforming shapes to satisfy prescribed constraints in a least-distorting manner. After discussing some of the theoretical and computational challenges arising in these optimization problems, I will focus on large-scale geometric problems and efficient first- and second-order algorithms for their optimization. Then, motivated by anatomical shape analysis, I will show applications of these computational approaches for shape characterization and comparison in evolutionary anthropology.

I will finish with briefly presenting two related but tangential works: a theoretical work on the characterization of planar harmonic maps into non-convex domains, and a clinical work on the prediction of thyroid cancer from biopsy images.

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