CS 468 — Differential Geometry for Computer Science

Spring Quarter 2013

Information about the course project

- The final requirement for CS468 is a course project. For this, you should choose a paper describing a discrete application of differential geometry from the research literature, understand the theory behind it, and implement and test its algorithm.
- Some possible topics are listed below. You may also choose your own topic in consultation with the CS468 teaching staff. We are happy to provide standard references for any topic listed below.
- What you should hand in is a short write-up (5-8 pages) describing (in your own words!) the theoretical foundations of the paper you've chosen and discussing the results of your tests.
- You should also hand in a working implementation and some test data.
- You may work in teams of up to two people. The amount and sophistication of material that you hand in should be commensurate with the size of your group.
- Please register your choice of topic on the course website to avoid duplication. A link will be provided on the course Piazza page.
- The project is due at 11:59pm on June 6, 2013. It should be emailed to all members of the course staff.

Possible topics

- Mesh deformation: as-rigid-as-possible, elastic models, conformal deformation, cage-based methods, deformation transfer
- Bending energies: cloth/fluid/rod simulation, medical applications
- Vector field design, the Hodge decomposition
- Surface parameterization: harmonic/elastic/conformal energies, cutting surface into patches that can be parameterized
- Mapping between surfaces: near-isometric maps (e.g. one-point heat kernel method), near-conformal maps (e.g. "Blended Intrinsic Maps"), elastic deformation
- Differential operators: modal analysis "Beyond the Laplacian," Killing vector fields, Dirac operator
- Surface modeling techniques: shape space modeling, morphing
- Shape descriptors (should implement several and compare): heat/wave kernel signatures, robust curvatures, extrinsic descriptors
- Point cloud/triangle soup processing, robust geometry: Laplacian operators, Poisson reconstruction
- Surface analysis: intrinsic symmetry detection, regular pattern extraction