Digital Geometry Processing

236329

http://webcourse.cs.technion.ac.il/236329

Miri Ben-Chen
Objective

• Theory and algorithms for efficient analysis and manipulation of complex 3D models

• Hands-on experience
Requirements

Prerequisites:
- Some experience with programming
- Background in geometry or computational geometry helpful, but not necessary.

Grade (3 points):
- Programming exercises
  - Intro to Matlab (10%)
  - Mesh processing basics (20%)
  - Discrete differential geometry (20%)
  - Final project (code, report and class presentation) (50%)

Use Matlab
References

• Book
  “Polygon Mesh Processing”
  by Mario Botsch, Leif Kobbelt, Mark Pauly, Pierre Alliez, Bruno Levy

• Eurographics 2008 course notes
  “Geometric Modeling Based on Polygonal Meshes”
  by Mario Botsch, Mark Pauly, Leif Kobbelt, Pierre Alliez, Bruno Levy, Stephan Bischoff, Christian Rössl
Teaching Staff

Lecturer:  Prof. Miri Ben-Chen
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– Tue 11:30-12:30 (Taub 8)

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What is Geometry Processing About?

• Acquiring
• Analyzing
• Manipulating
• Fabricating
Applications

Medical Engineering

E-Commerce

Culture 1, 2

Simulation
Applications

Games

Movies

Architecture
Creating

Architecture
Reverse Engineering
And DL of course...
A Geometry Processing Pipeline
Low Level Algorithms

Input Data
- Range-Scan
- CAD

Removal of topological and geometrical errors

Analysis of surface quality

Surface smoothing for noise removal
A Geometry Processing Pipeline

- Simplification for complexity reduction
- Parameterization
- Remeshing for improving mesh quality
A Geometry Processing Pipeline
High Level Algorithms

Freeform and multiresolution modeling

Deformation and editing

Extracting shape structure
Acquiring 3D Geometry
Range Scanners
Acquiring 3D Geometry
Range Scanners
Acquiring 3D Geometry
Structured Light Sensors
Acquiring 3D Geometry

Photogrammetry
Acquiring 3D Geometry
Real time photogrammetry

DEMO
Acquiring 3D Geometry
Tomography
Simplification
Applications

Multi-resolution hierarchies for

– efficient geometry processing
– level-of-detail (LOD) rendering
Parameterization

3D space \((x,y,z)\)

2D parameter domain \((u,v)\)

boundary
Application - Texture Mapping
Remeshing
More Remeshing

demo
Quad Remeshing
Symmetry Detection
Segmentation
Shape Correspondence
Fabrication – Make It...

Stand

Spin

Float
Virtual

Mixed

Augmented

... Reality
What’s Next?

• Learn some geometry basics

• Go into detail of a few representative algorithms

• Code them up!

• Have fun with geometry 😊