Computer Graphics at University of Toronto
Dynamic Graphics Project
EST. 1967
Modeling
Geometry Processing is biology
Geometry processing studies the life of a shape

e.g., scan of a physical object or modeling in Maya
Geometry processing studies the *life of a shape*.
Geometry processing studies the *life of a shape*

3d printing
Prerequisites:
- Linear Algebra,
- Calculus
- Computer Programming

Weekly, small coding assignments
Problems in Geometry Processing...
dgp
dynamic graphics project

- Alec Jacobson
- University of Toronto
Physical Simulation
Solid-fluid density ratio
1.3 : 1

Solid-fluid density ratio
1000 : 1
Really ... its like Graphics

LLC: Walk

The LLC is first trained to locomote while following random footstep plans.
Computational Fabrication
3D Printing = Additive Manufacturing

https://commons.wikimedia.org/wiki/File:3D_printing_on_replicator_2.webm
Additive Manufacturing Technologies

Fused deposition modeling (FDM)
Stereolithography (SLA)
DLP 3D printing
Selective laser sintering (SLS)
Direct metal laser sintering (DMLS)
Plaster-based 3D printing (PP)
Photopolymer Phase Change Inkjets
Thermal Phase Change Inkjets
Laminated object manufacturing (LOM)
3D Printing Process

Slice 3D model into layers
3D Printing Process

Slice 3D model into layers
Manufacture layers one by one (e.g., bottom-up)

https://commons.wikimedia.org
Applications: Dental and Medical Industries

- Implants
- Crowns, copings, bridges
- Prosthetics

Source: Envisiontec, on3dprinting.com
Applications: Architecture & Design
Applications: Automotive

Source: www.uprint3dprinting.com, gizmodo.com
Applications: Aerospace

3D printed fuel injection nozzle for a jet engine

Airbus wing brackets

Source: GE, 3dprintingindustry.com
Applications: Jewelry

Direct metal printing and casting patterns

Source: Shapeways, replicatorinc.com
Applications: Footwear
Applications: Consumer Home Products
Applications: Toys & Gadgets

Source: Shapeways, singularityhub.com, MyRobotNation.com
Applications: Art

Source: Shapeways, Carlo Sequin, techdigest.tv
Applications: Education
Self Assembly
Self Assembly
Solid Modeling

Represent solid interiors of objects
Why Volumetric Representations?

Some acquisition methods generate solids

- Magnetic Resonance Imaging (MRI)
- Computed Tomography (CT/ CAT)
Why Volumetric Representations?

Some applications require solids

- CAD/CAM
- material(s) need to be specified inside the object
Challenges: Materials

Functional Materials
Large Material Library for AM

Courtesy of Stratasys
Challenges: Modeling Materials

Focus on 3D geometry
Currently one material per part
How to model parts composed of many materials?
Challenges: Fast and Accurate Simulation
Challenges: Fast and Accurate Simulation
Interactive Design

x5 Concurrent Flight Simulation

- 3D Preview (TrackBall View)
- Top View
- Side View
- Drag
- Sketch
- Smooth
- Current editing mode: Drag
- Delete Selected Wing
- Weight:
  - 0g
  - 1g
  - 2g
  - 3g
  - 4g
  - 5g
- Mounting angle: -2.5 deg
- Mass: 9.3 g
- Make it Fly
Jumpers

Results

Starting Position

Ending Position
And More !!!

Megaro et al.
Computational Design and Fabrication Course

David Levin
Course Code: CSC2521
Half-Lecture, Half-Seminar Course, final project only
Interactive Techniques
Course on interactive modeling and animation

Karan Singh
Seminar style course

What is it about?

Creative visual communication

The transformation of a creative vision into a digital reality, that is easy to refine and reuse.
Humans have an audio IN and OUT, a video IN but no explicit video OUT!
[Schmidt, Singh, MeshMixer SIGGRAPH 2010 talks]
www.meshmixer.com (acquired by Autodesk Inc.)
[Takayama, Schmidt, Singh, Igarashi, Boubekeur, Sorkine, GeoBrush: interactive mesh geometry cloning. Eurographics 2011]
Augmented and Virtual Reality
What is Virtual Reality?

virtual reality

noun

Simple Definition of VIRTUAL REALITY

: an artificial world that consists of images and sounds created by a computer and that is affected by the actions of a person who is experiencing it

Source: Merriam-Webster's Learner's Dictionary

a computer technology that replicates an environment, real or imagined, and simulates a user's physical presence and environment to allow for user interaction. (Wikipedia)
What is Virtual Reality?

In general VR is any variant of R where our stimuli and responses are natural or easily learnt!

Popular perception of VR is a 360 image viewed in an HMD.
Augmented Reality

• Combines Real and Virtual Images registered in 3D.

• Interactive in real-time for virtual content.
Pokemon GO..
SymbiosisSketch = 2D sketching + 3D sketching + more
Course on AR/VR

Karan Singh
Seminar style course
Rendering
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