

Computer Graphics

Introduction

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SAPIENZA
UNIVERSITÀ DI ROMA

2nd semester a.y. 2018/2019 · February 27, 2019

Logistics

- **Lecturer:** Prof. Emanuele Rodolà
- **Assistant:** Dr. Arianna Rampini
- **When:** Wednesdays 10:30–13:00 and Thursdays 10:30–13:00
- **Where:** Aula 1 - Aule L di Ing., via del Castro Laurenziano 7a
- **Office Hours:** Drop me an email
- **Official website:** <https://erodola.github.io/CG-s2-2019/>
Check frequently for **news** and **material** (code, papers, ...)!

Disclaimer

This is a new course! Some key **differences** with last year:

- More **geometry** (3D shape processing and modeling)
- More **image processing**

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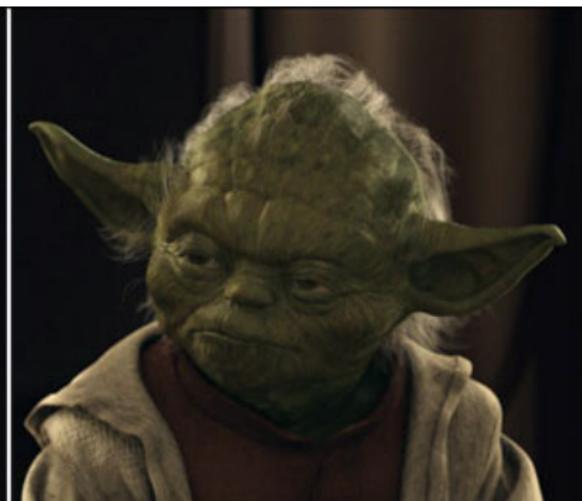
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Geometry



Pixels

Who am I?

- Had research positions at U Tokyo, TU Munich, U Lugano and visiting positions at Harvard, Stanford, Ecole polytechnique, Technion among others
- 3D computer vision, digital geometry processing, geometric deep learning
- Passionate about anything that is new, cool, and/or crazy
- Approach me for projects and theses!



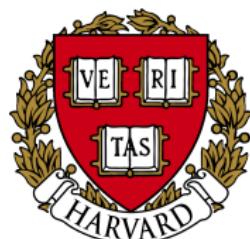
東京大学
THE UNIVERSITY OF TOKYO



Stanford
University



TECHNISCHE
UNIVERSITÄT
MÜNCHEN



Examples

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- (...and more depending on how we go)

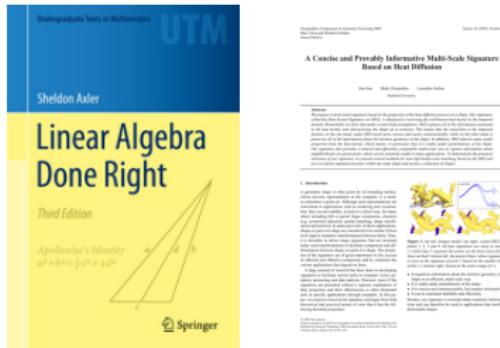


30 JULY - 3 AUGUST *Los Angeles*
SIGGRAPH 2017

AT THE  of COMPUTER GRAPHICS & INTERACTIVE TECHNIQUES

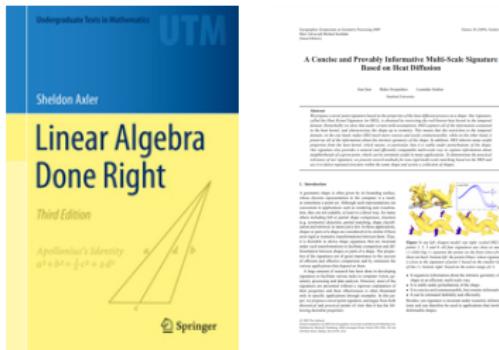
Pre-requisites and reading material

There is no official textbook. Specific references will be given throughout the course in the form of **book chapters** and **scientific articles**.



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Pre-requisites:

- **Programming fundamentals.** Any language is alright, although the course will mostly use **C/C++/Matlab**
- Welcome (not mandatory): linear algebra, calculus

Grading

Modality: Mid-term written exam + final written exam

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Optional:

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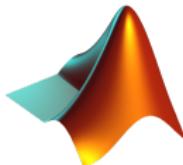
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- Download/print the slides beforehand
- Take notes: not everything will be on the slides
- Bring your laptop: we'll (almost) always do live coding sessions



Overall objective

What will you get out of this course?

- You will **acquire the basics** of 3D-based technology
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- You will **acquire the basics** of 3D-based technology (analysis and synthesis)
- You will **acquire the basics** of image-based technology (mostly synthesis)
- You will get **solid fundamental skills** for more advanced topics in graphics



AUTODESK
MAYA®



Minority Report (20th Century Fox/Dreamworks) 2002



Microsoft Kinect 2010



>\$10K

2005



\$100

2010



\$20

2014

Deluge of geometric data



KINECT for XBOX 360  SoftKinetic™
The Interface Is You
intel REALSENSE

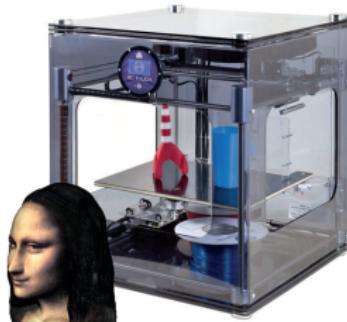
3D sensors



Google 3D warehouse

shapeways

Repositories



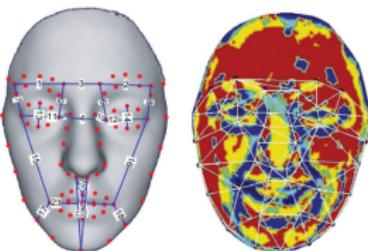
 Stratasys  3D SYSTEMS

3D printers

Applications



Reconstruction



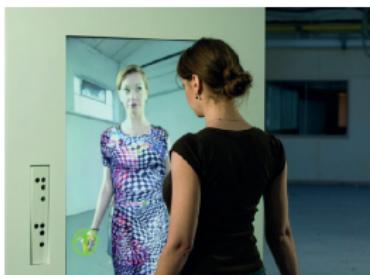
Recognition



Retrieval



Avatars



Virtual dressing



Gesture control

Images: Davison et al. 2011; Zaferiou et al. 2012; Kim et al. 2013; Faceshift; Fashion3D; Minority report



Microsoft

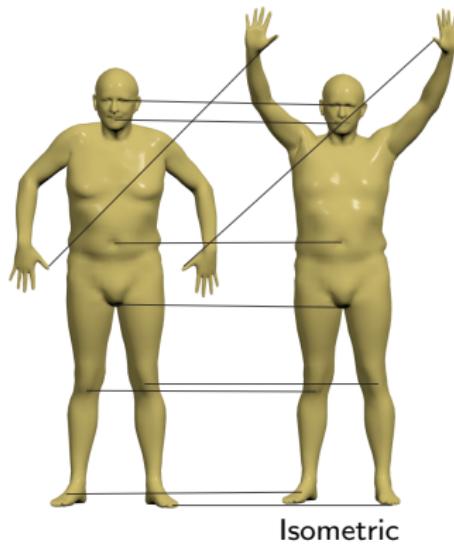


GDC

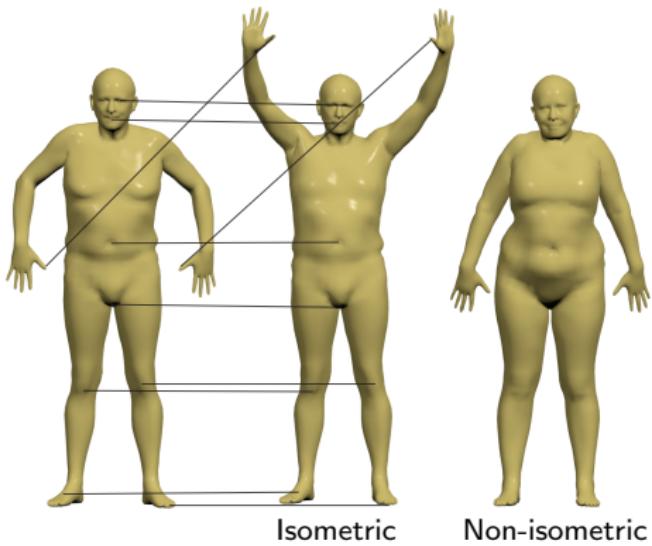


Faceshift (acquired by Apple in 2015)

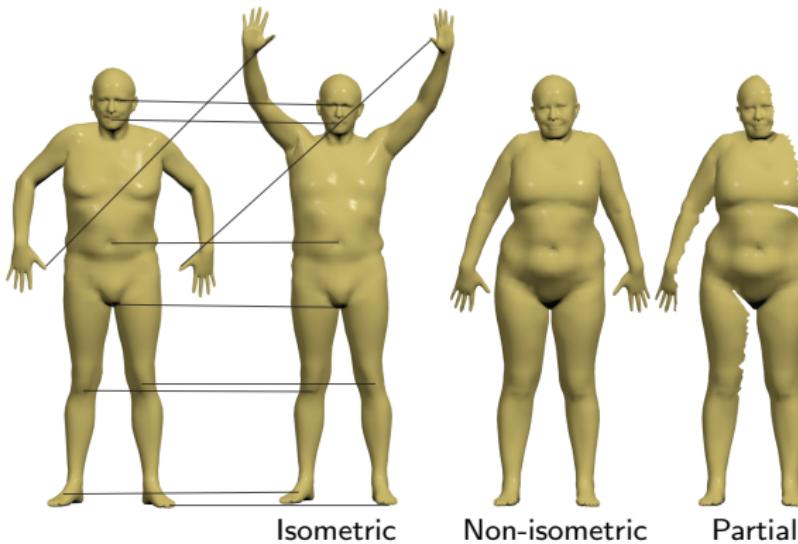
Basic problems: shape similarity and correspondence



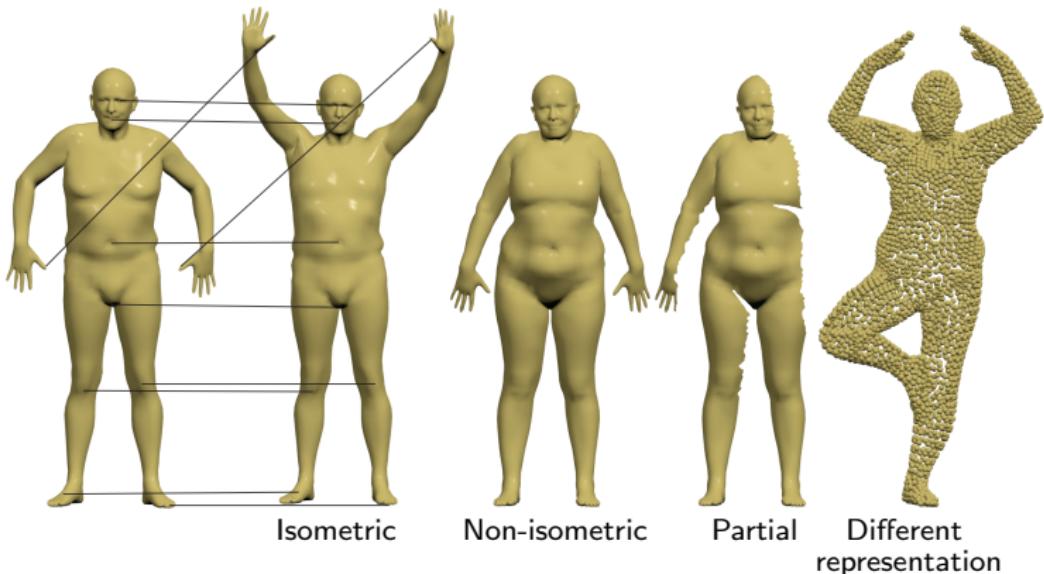
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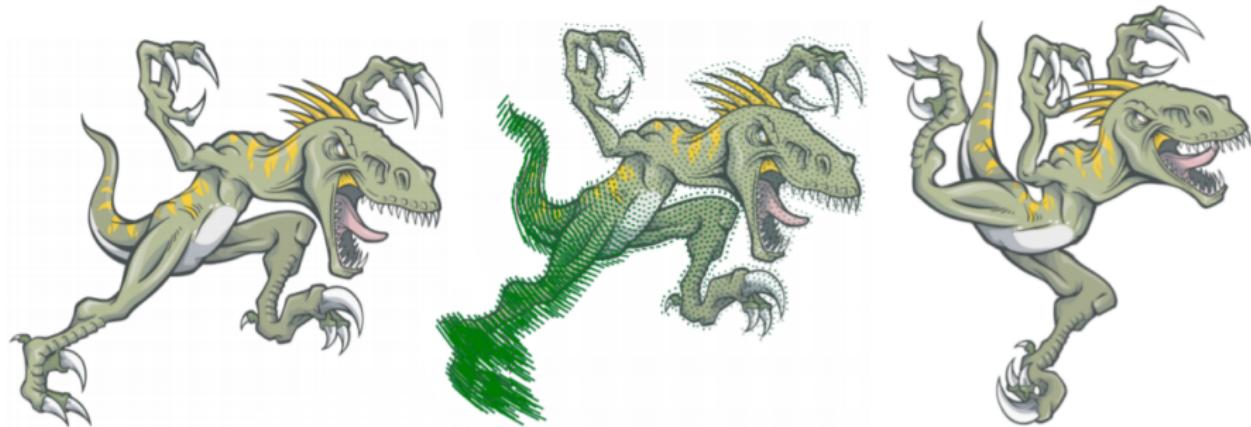
Basic problems: shape similarity and correspondence



Basic problems: shape similarity and correspondence



Drawing as a shape modeling problem



Colorization as a histogram matching problem



Input



Color source



Result



Mathematical tools

- Linear algebra
- Metric spaces
- Differential geometry
- Partial differential equations
- Optimization

But...

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- Linear algebra
- Metric spaces
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But...

90% of the time we will be able to
visualize what we are doing!

Example

“Vector-valued function on a 2-Riemannian manifold”

Example

“Vector-valued function on a 2-Riemannian manifold”
= A color for each point of a 3D shape



