Introduction

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Who

- Dr. Francesco Banterle

  - Researcher at Visual Computing Laboratory (ISTI-CNR)

  - Expertise: 2D/3D imaging, Computer Graphics

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Who

- Dr. Gianpaolo Palma

  - Researcher at Visual Computing Laboratory (ISTI-CNR)

  - Expertise: 3D scanning, Mesh Processing, Computer Graphics
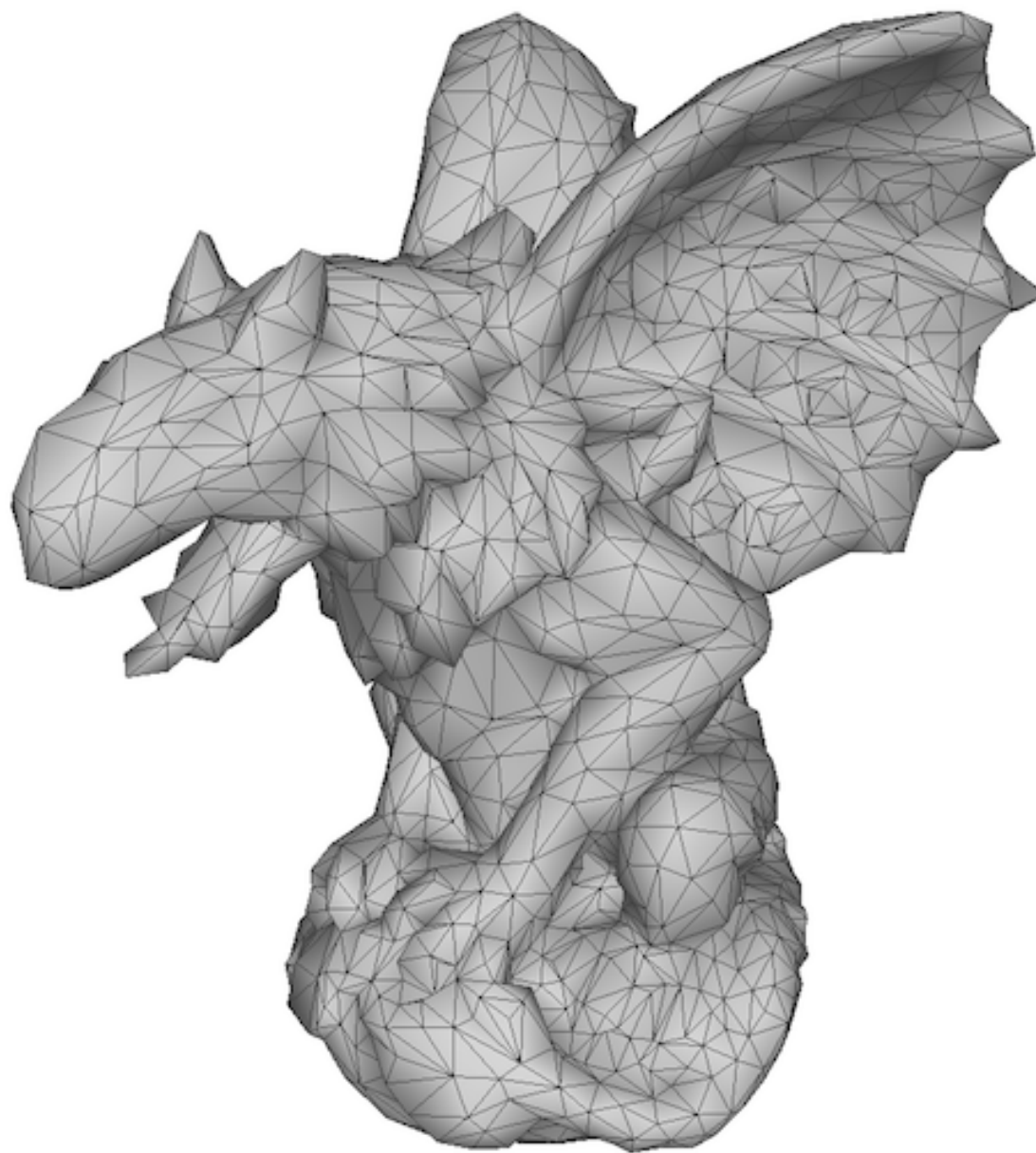
  - E-mail: gianpaolo.palma@isti.cnr.it

Appointment:
Francesco Banterle

- Where:

  - On the Internet

- When:

  - send an e-mail to confirm an appointment:

    - *using your official @studenti.unipi.it e-mail*

Prerequisites

- Linear Algebra and Geometry

- Calculus

- 1D/2D Filters (Signal Processing)

- Basic programming in MATLAB

The Main Goal

Goals

- To know and to understand theory and practice for generating 3D models:

  - Techniques and algorithms

  - Acquisition processes

  - Existing open source software
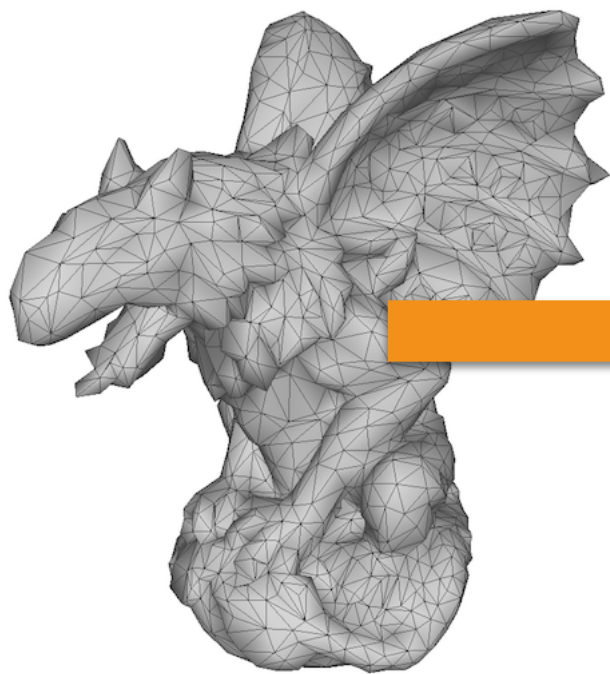
Why 3D Models?

Simulation for training (VR OR by 3D Systems)

Why 3D Models?

- As they are:

  - reference/teaching

  - simulations: VR, AR, and classic visualization

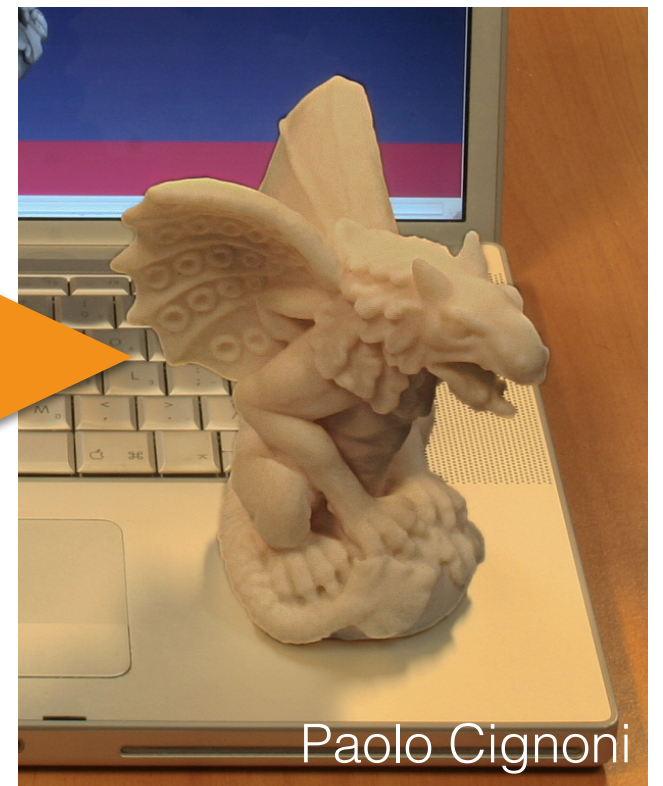 - remote/accurate real-life surgeries

Why 3D Models?

3D Model

3D Printer
(UltiMaker)
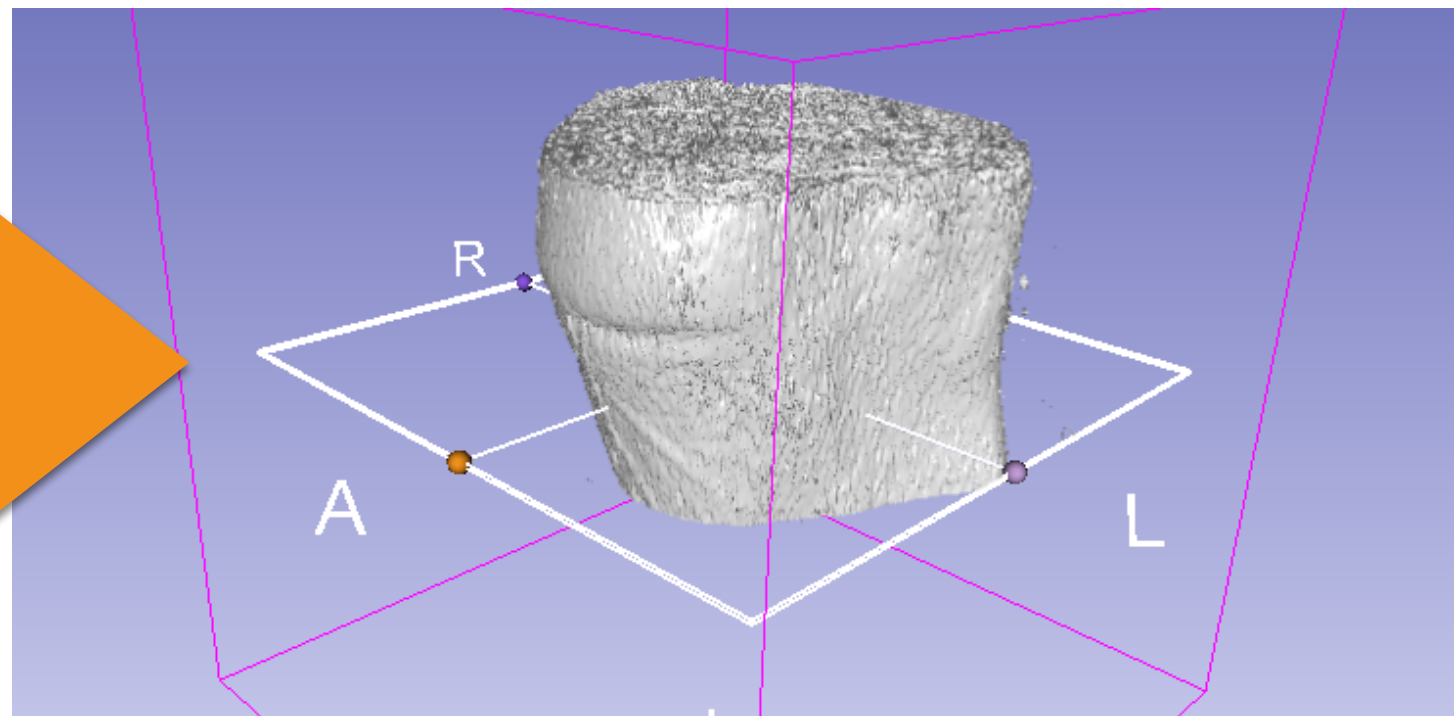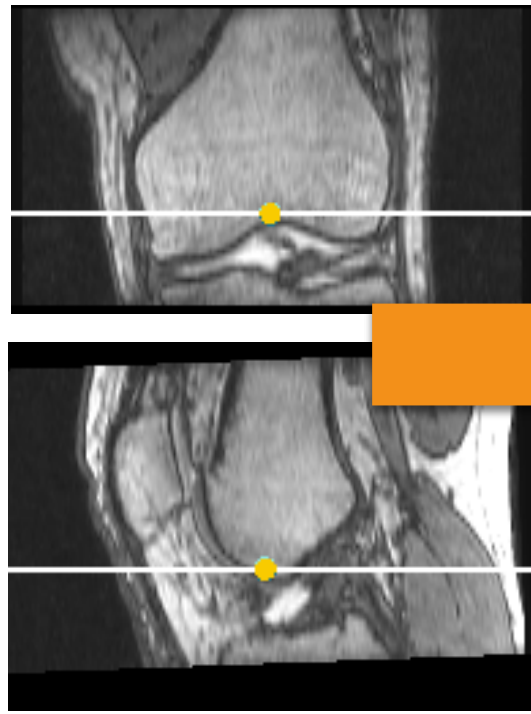
Paolo Cignoni
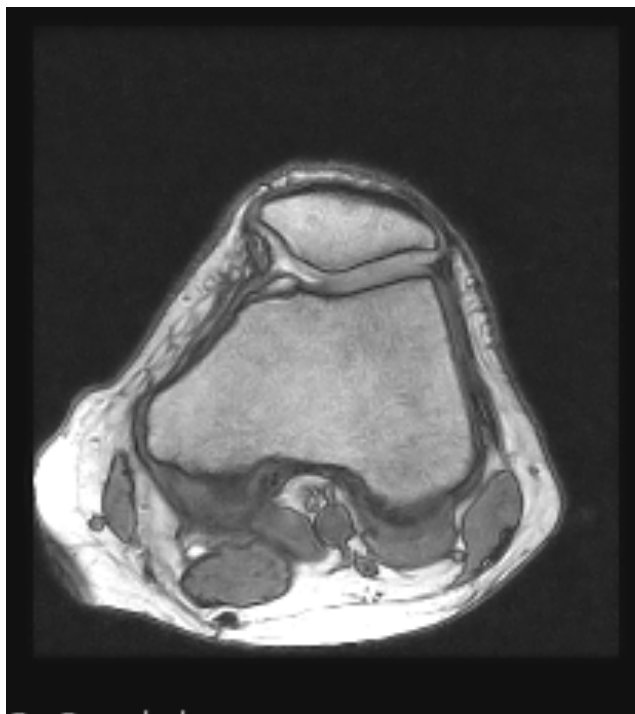
3D Print

Why 3D Models?

- 3D printing uses:

  - reference

  - prototyping

  - orthopedic cast custom designed

  - prosthetics custom designed

Course Overview

- Part I: 3D models from medical images

- Part II: 3D models from photographs

- Part III: 3D models from range sensors

Course Overview:
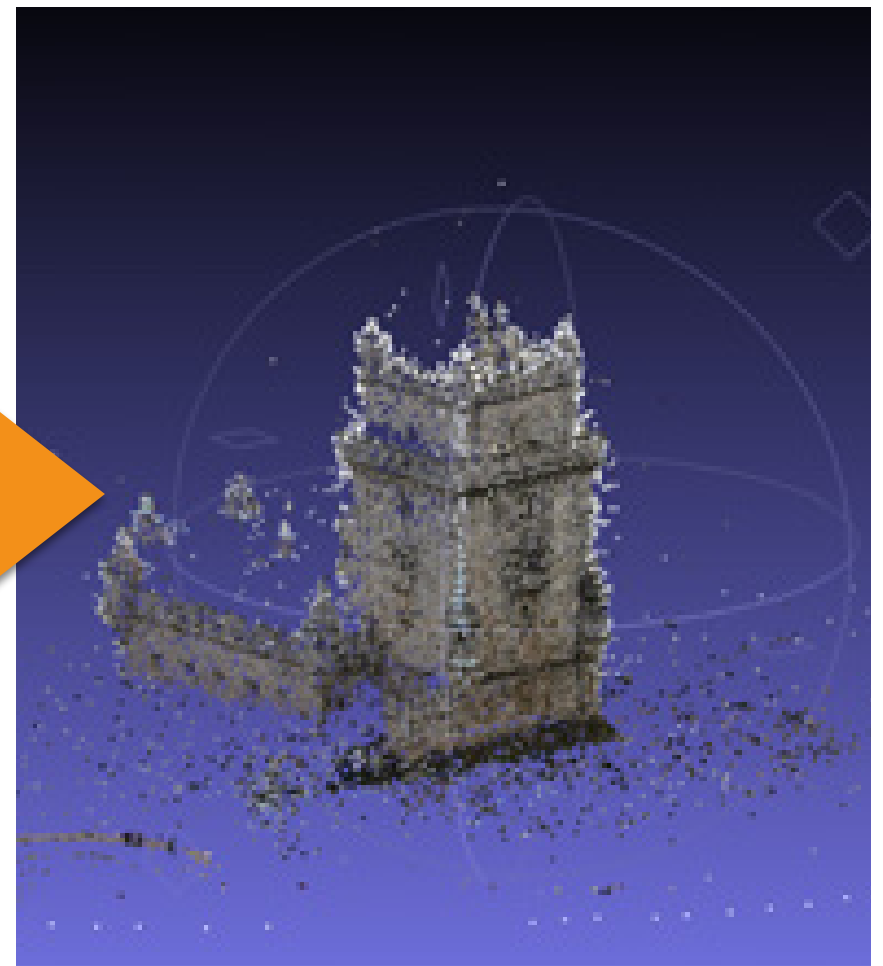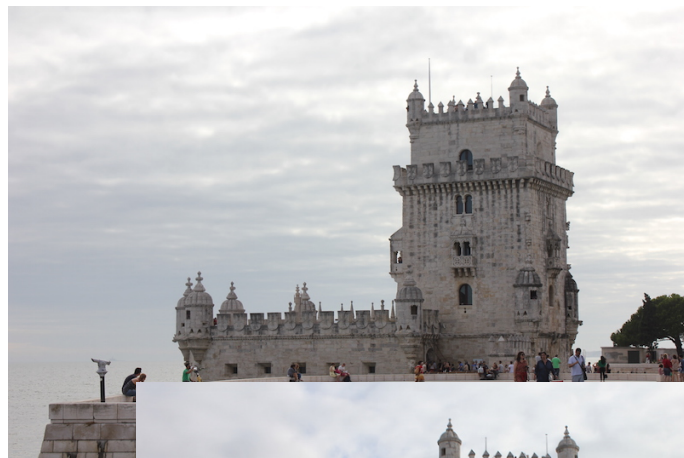# 3D from Volumes

MRI stacks   3D Model

Why?

- 3D volumes are the main source of 3D data in the medical domain.

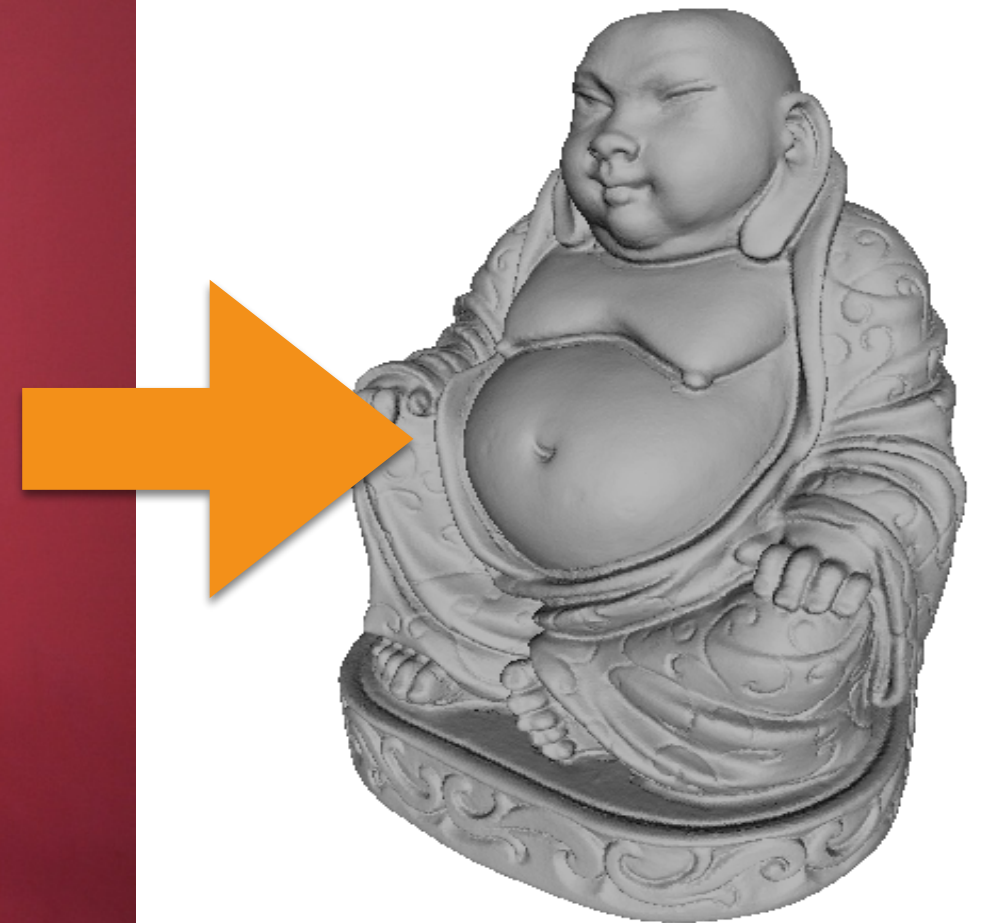- They capture the geometry, but NOT the appearance of the model!

Course Overview: 3D from Photographs

Course Overview:
3D from Range

Range scans

3D Model

Why?

- Both 3D from Photographs and 3D from Range can be also used in the medical domain.

- Why?

  - 3D from Range capture the surface at high resolution adding the extra details to make the surface to look good.

  - 3D from Photographs captures well the appearance; i.e., material optical properties of the person/object to scan.

  - For example, these may be important for creating prosthetics for a face that has been very damaged due acid attacks, car accidents, bomb blasts, etc.

The Exam

- With COVID restrictions in place:

  - A single interview

- Without COVID?

  - A written (theory) exam.

  - An interview-style (practice) exam at computer:

    - 3D Slicer

    - 3D Reconstruction

    - Meshlab

The Exam

- What to do for being admitted to the exam:

  - Online registration

  - Be there on time with an ID

Books

- Digital Image Processing for Medical Applications:

  - http://www.cambridge.org/it/academic/subjects/engineering/biomedical-engineering/digital-image-processing-medical-applications?format=HB&isbn=9780521860857#a6LCHeY5fSWYmBC8.97

- **Extra**: Image Processing for Radiology:

  - http://www.springer.com/gp/book/9783540259152

Books

- Computer Vision: Algorithms and Applications:

  - http://szeliski.org/Book/

- Polygon Mesh Processing:

  - https://www.crcpress.com/Polygon-Mesh-Processing/Botsch-Kobbelt-Pauly-Alliez-Levy/p/book/9781568814261

Tools

- MATLAB/Octave: please read "MATLAB Primer" (just google it) or :

    - www.math.toronto.edu/mpugh/primer.pdf

- MeshLab:

    - http://www.meshlab.net/

- 3D Slicer:

    - https://www.slicer.org/

Tools

- VisualSFM:

  - http://ccwu.me/vsfm/

- Regard3D

  - http://www.regard3d.org/

Course Material

- Slides will be uploaded at:

  http://www.banterle.com/francesco/courses/2020/be_3drec/

- Mailing list:

  sviluppodimodelli3d@gmail.com