

# Introduction

Francesco Banterle, Ph.D.

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# Who

- Dr. Francesco Banterle
  - Researcher at Visual Computing Laboratory (ISTI-CNR)
  - Expertise: 2D/3D imaging, Computer Graphics
  - E-mail: [francesco.banterle@isti.cnr.it](mailto:francesco.banterle@isti.cnr.it)

# 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](mailto:gianpaolo.palma@isti.cnr.it)

# Appointment: Francesco Banterle

- Where:
  - On the Internet
- When:
  - send an e-mail to confirm an appointment:

***ONLY using your university e-mail:  
@studenti.unipi.it***

# Appointment: Francesco Banterle

- Communication about exams:
  - Send an email to **both** these email addresses:

[francesco.banterle@isti.cnr.it](mailto:francesco.banterle@isti.cnr.it)

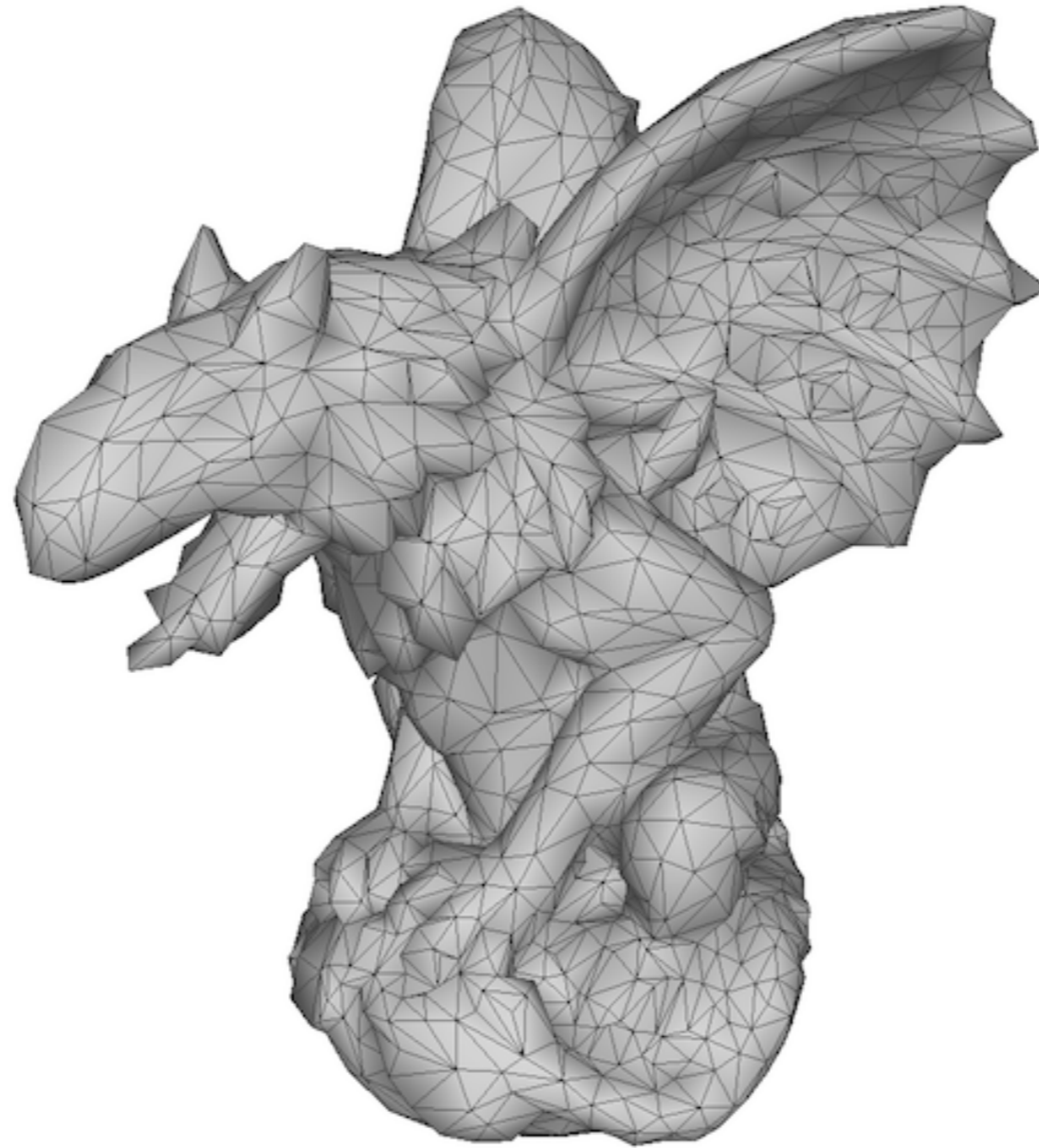
[gianpaolo.palma@isti.cnr.it](mailto:gianpaolo.palma@isti.cnr.it)

- Do **NOT** send emails via teams to some @unipi.it addresses!

# 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?

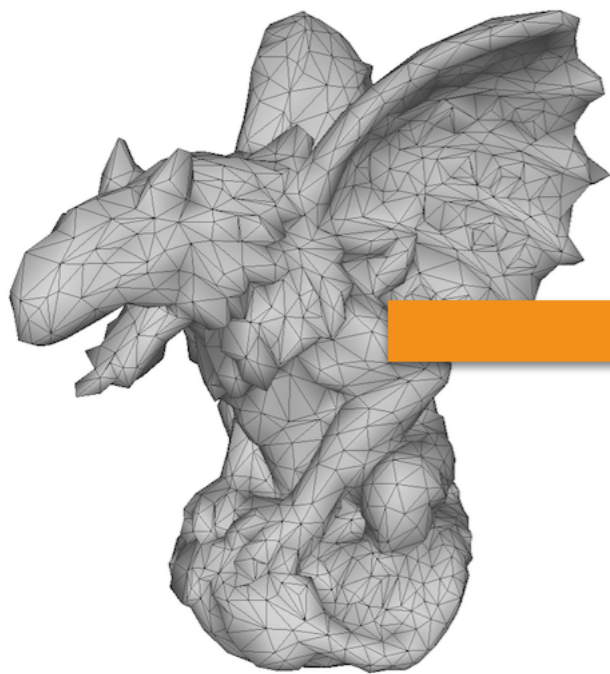


Simulation for training (VR OR by 3D Systems)

# 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)



3D Print

Paolo Cignoni

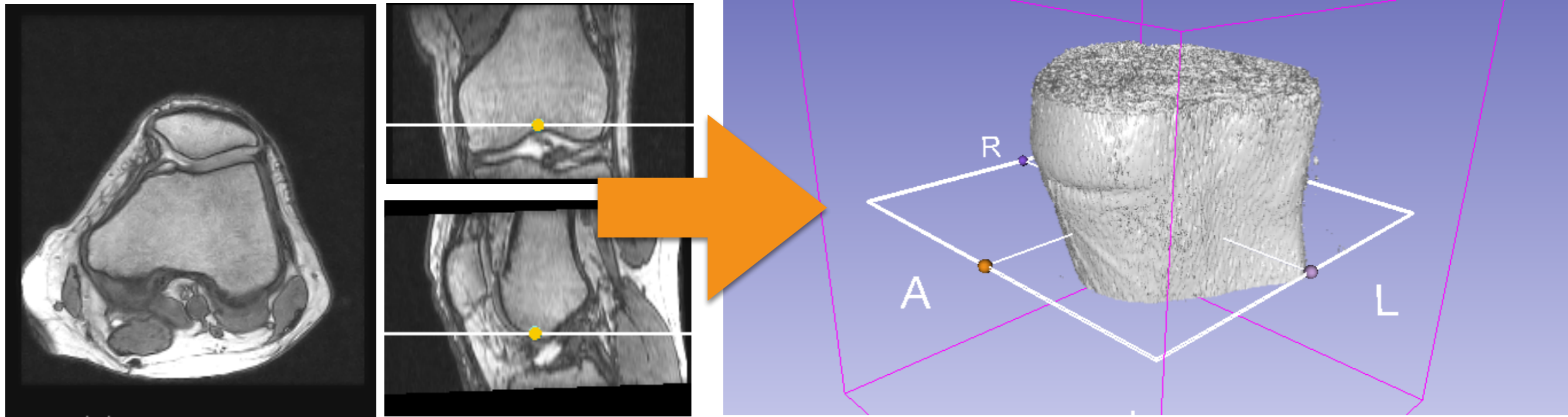
# Why 3D Models?

- 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



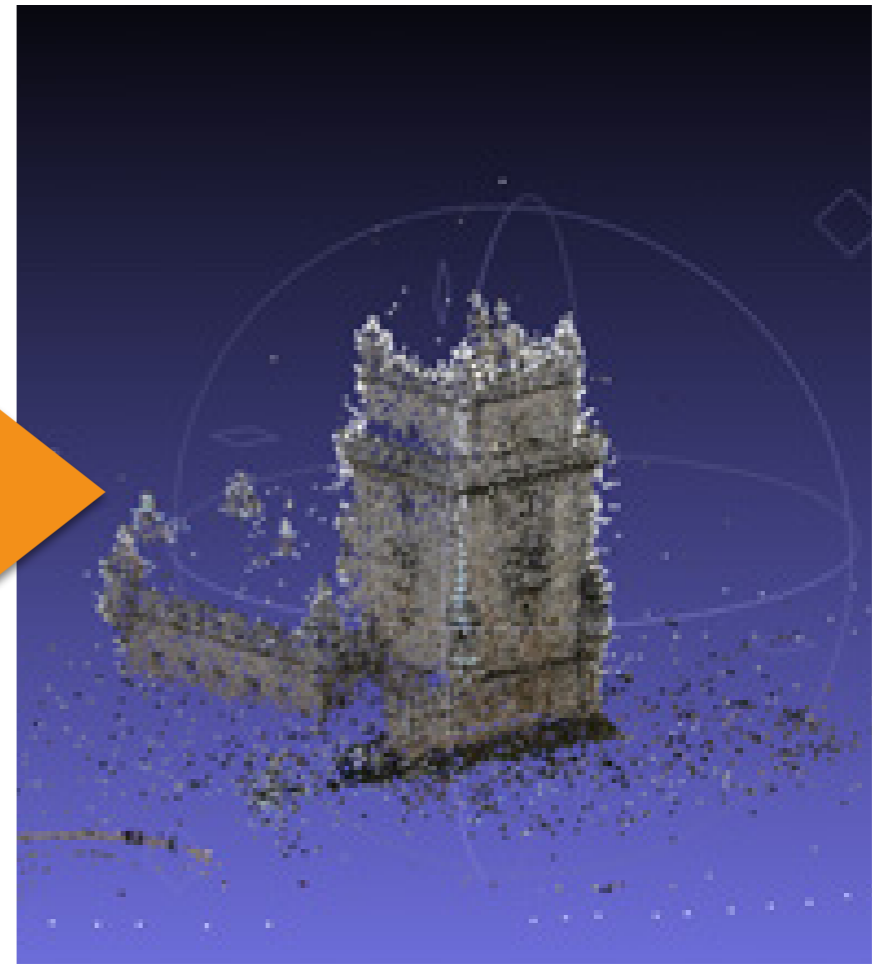
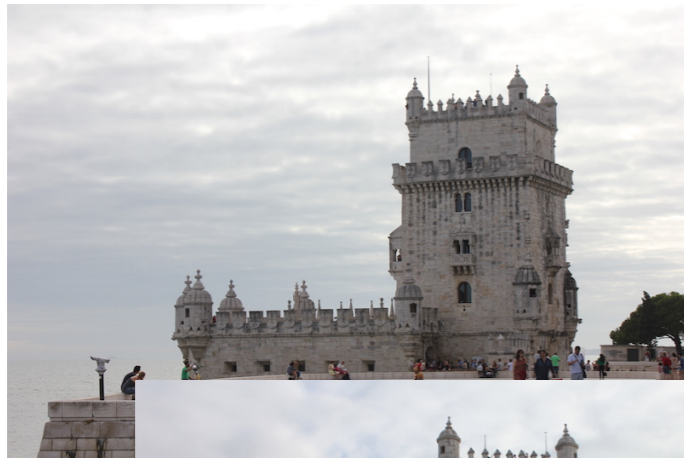
MRI stacks

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

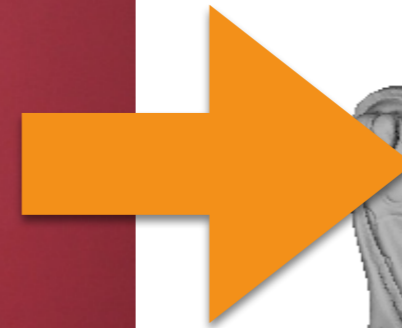




# Course Overview: 3D from Range



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

- A written (theory) exam:
  - Three open questions - 30 minutes each.
- 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
- Extra exam sessions:
  - November —> **YES**
  - April —> **NO**
- We do **NOT** know when/where the exam is, so please do not send us email about when/where.

# The Exam

- Theory and practice are separate:
  - You do not have to pass both exams in the same session.
  - You can do both exams in the order that you like.
  - You can redo just one.
- You do not have to tell us that you decline your score or you want to redo the exam.
- When you redo an exam:
  - Theory: if you submit the paper the old score is lost.
  - Practice: when the interview starts the old score is lost.

# 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](http://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/2024/be\\_3drec/](http://www.banterle.com/francesco/courses/2024/be_3drec/)

- Mailing list:

[sviluppodimodelli3d@gmail.com](mailto:sviluppodimodelli3d@gmail.com)

***ALWAYS CHECK SPAM FOLDER!***