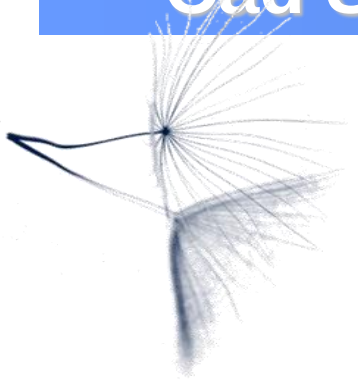
From Imagination to knowledge

Cad Systems in real word environments



Loris Vosilla

Softeco Sismat Srl
Research&Innovation
www.softeco.it
www.research.softeco.it

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information technology

Summary

- Softeco Sismat company profile
- Softeco CAD system key concepts description
  - Segmentation
  - Three dimensional rendering
  - Pathology assessment through quantitative parameters
- Applications
  - Ultrasounds
  - Magnetic resonance
    - Spine
    - Knee
    - Wrist

Mission

“Providing excellent solutions, for Enterprise Customers, making use of innovative technologies ”

Profile

Headquartered in Genoa, 230+ employees Softeco is operating on the National and International market since 1979

- Industry
- Service companies
- Finance
- Telco
- Defense
- Government
- Research

Research & Innovation

Innovation as a successful business development strategy

10% of resources dedicated to Innovation and Research

Significant and solid participation to EU RTD initiatives

- since EU JRCs' programmes and FP3 onwards

40+ collaborative projects

150+ European partners

- Research Centres, Universities, Large Industries,
- Public Organisations, SMEs

Regional Innovation Ecosystem

- SIIT: Sistemi Intelligenti Integrati & Tecnologie
- All hi tech Large Industry, Research Organisation, 80+ SMEs

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CAD Systems Expertise

2004 → 2012

EndoNav

- segmentation
- surface reconstruction
- virtual endonavigation
- knee/ shoulder (MRI)
- Esaote SpA

OrthoCAD

- segmentation
- surface reconstruction
- parameter evaluation
- data comparison
- diagnostic support (CAD)
- lumbar spine (MRI)
- Esaote SpA, SDN, IBB, ICAR, CINI

RHEUMAScore

- segmentation
- surface reconstruction
- parameter evaluation
- follow up
- diagnostic support (CAD)
- wrist/hand (MRI)
- DISI, DIMI

IMMERGO3D

- GPU computing for
  - filtering
  - segmentation
  - 3D visualization
  - CT, MRI, PET, US
- DISI
- E.O. Galliera (GE)

USCad

- segmentation
- surface reconstruction
- virtual endonavigation
- carotid (US)
- Esaote SpA

MultiScaleHuman

- Molecular scale (PET/CT, PET/MRI)
- Cellular scale (Biomaterials/electron microscopy)
- Tissue scale (Dynamic MRI, MRI)
- segmentation & surface reconstruction
- diagnostic support (CAD)
- HUGE, UMINHO, MIRALab, LBB-MHH, WelfenLab, CNR-IMATI

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Softeco CAD Systems

- **EndoNav (2004-2006)** Focused to the segmentation the measurement and the virtual navigation of the knee and the shoulder. Based on MRI images

- **UsCAD (2007-2008)** Focused to the segmentation the measurement and the virtual navigation of the carotid. Based on Ultrasound images

- **OrthoCAD (2006-2011)** For the segmentation the measurement and the virtual navigation of the spine pathologies. Based on MRI Images

- **RHEUMAScore (2011- today),** Focused to the quantitative evaluation of wrist pathologies i.e. rheumatoid arthritis. Based on MRI Images

Key pipeline in Softeco CAD systems

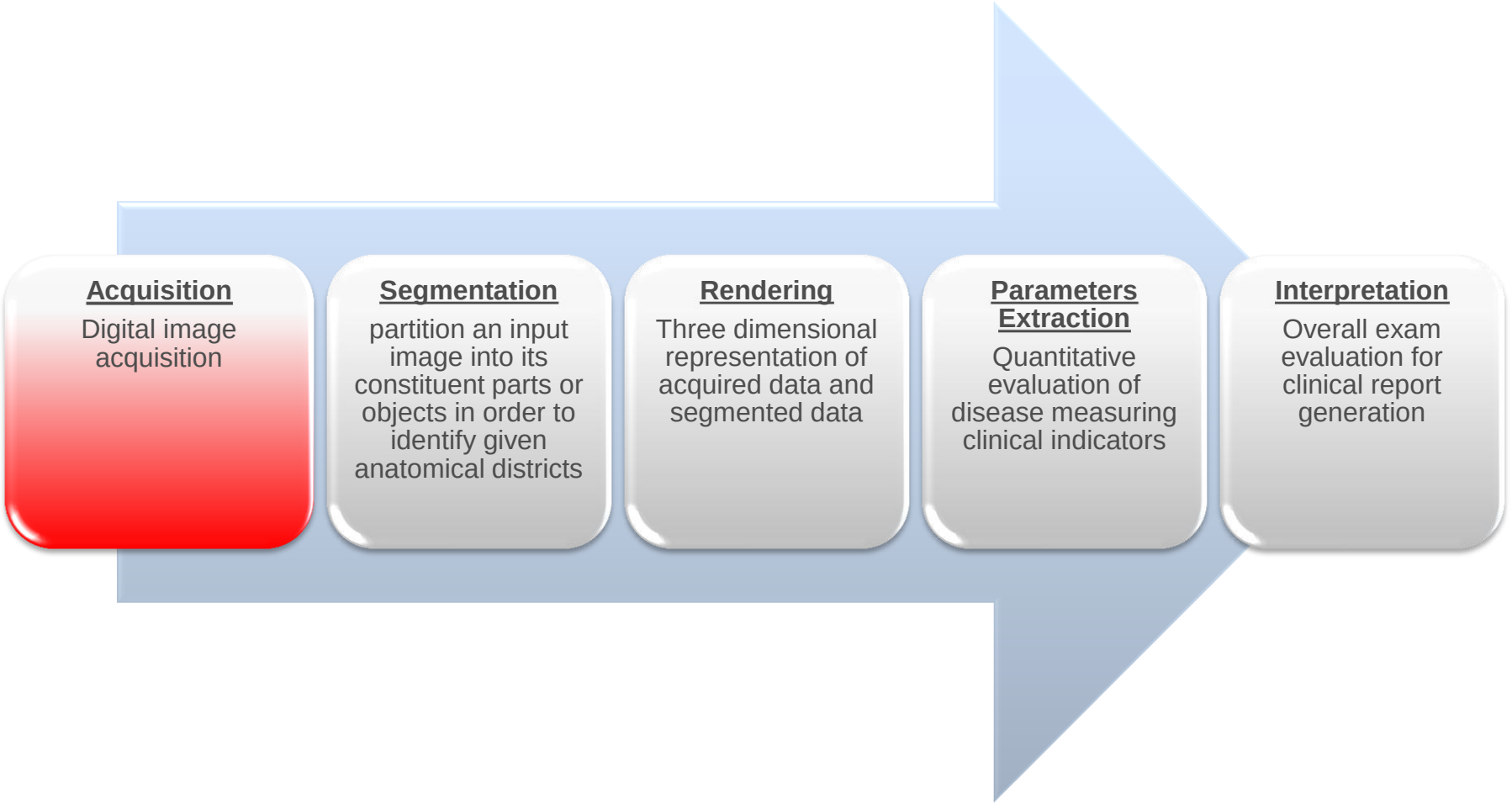
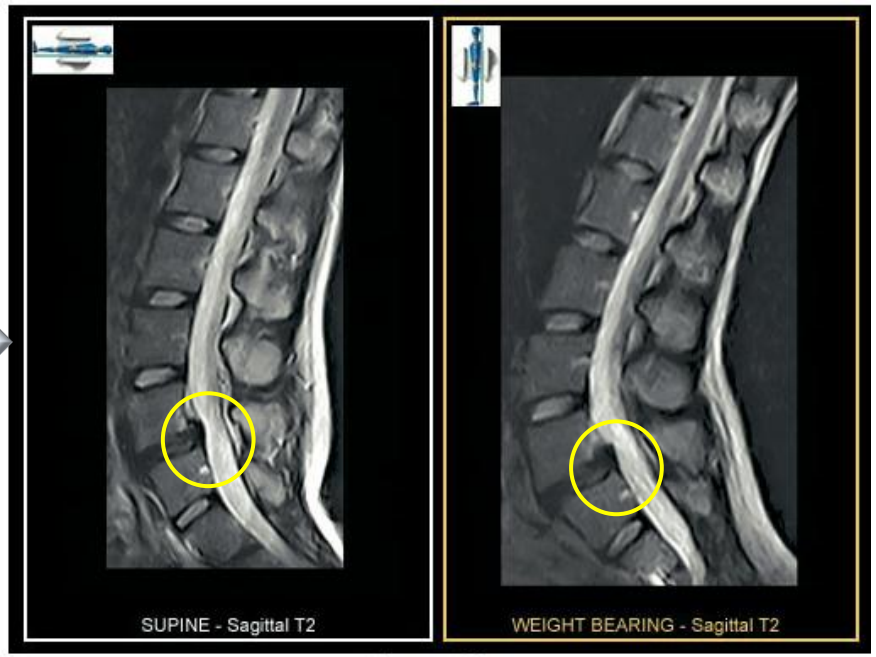
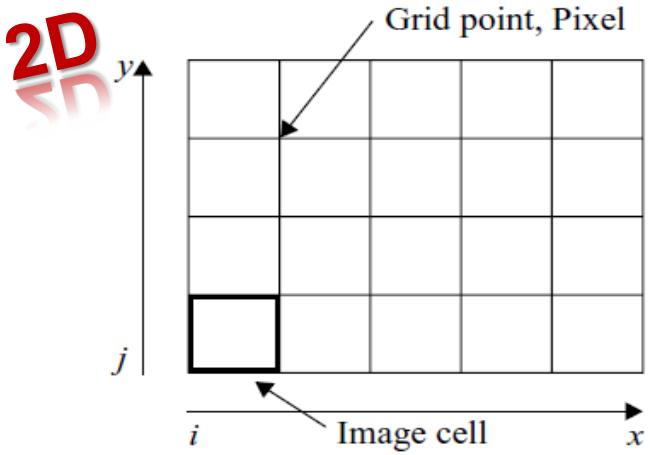


Image Acquisition

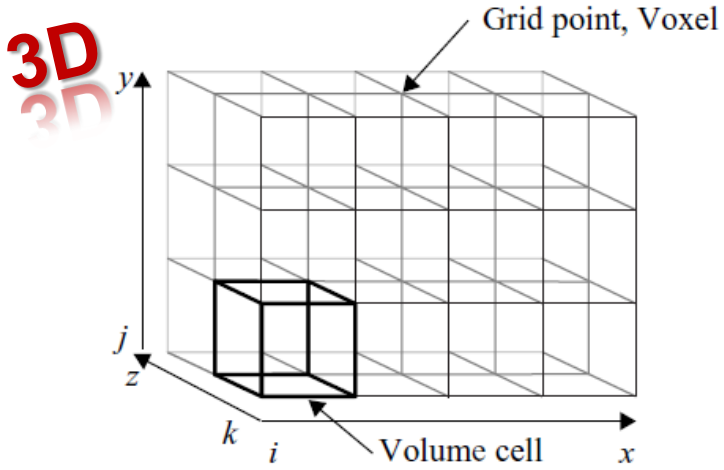


G-scan - Spine
Lumbar Spine - 2nd grade anterolisthesis of L4-L5 level with a large protruding hernia

Image Acquisition



- 2D Image → light intensity function f(x,y), where (x,y) denote spatial coordinates and the value of f at (x,y) is proportional to the brightness or gray levels of the image at that point.
- Digital image is an image discretized both in spatial coordinates and brightness.
- The elements of such a digital array are called image elements or ***pixels***.



- Stack of 2D image → 3D image → light intensity function f(x,y,z)
- The distance between two neighboring images (slices) is called ***slice distance***.
- The elements of such a digital array are called volume elements or ***voxels***.

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What is segmentation?

- Decomposing image data into meaningful structures relevant for a specific task and that have similar features according to a set of predefined criteria:
  - intensity
  - histogram
  - energy
  - …

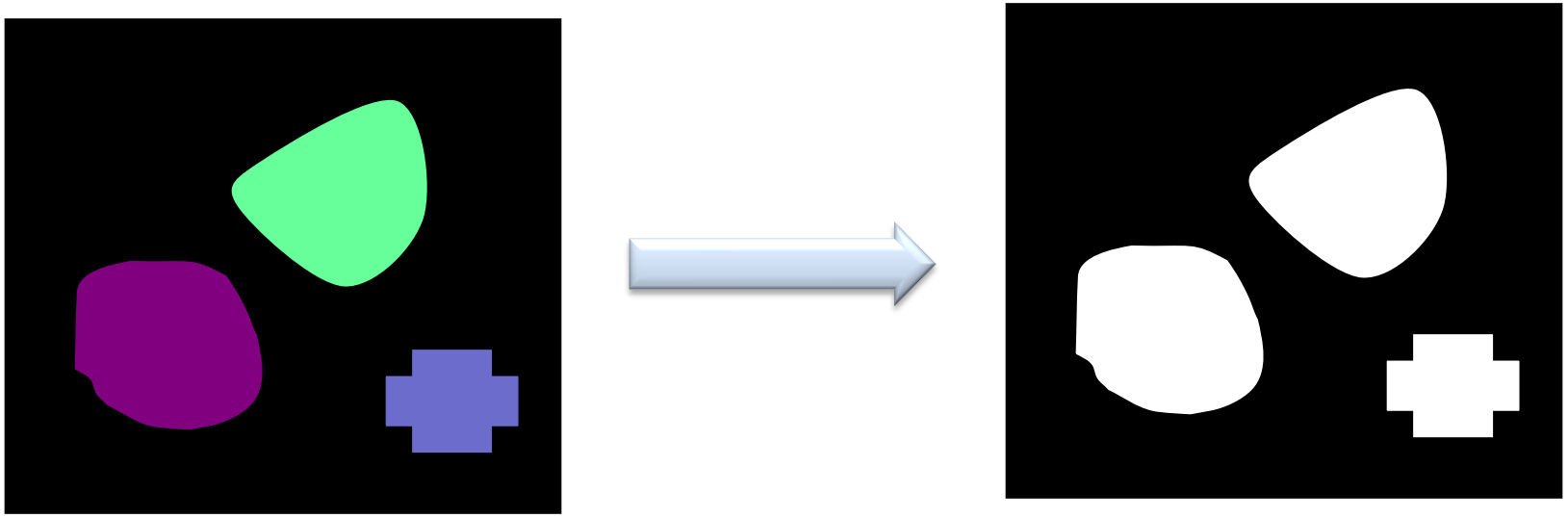
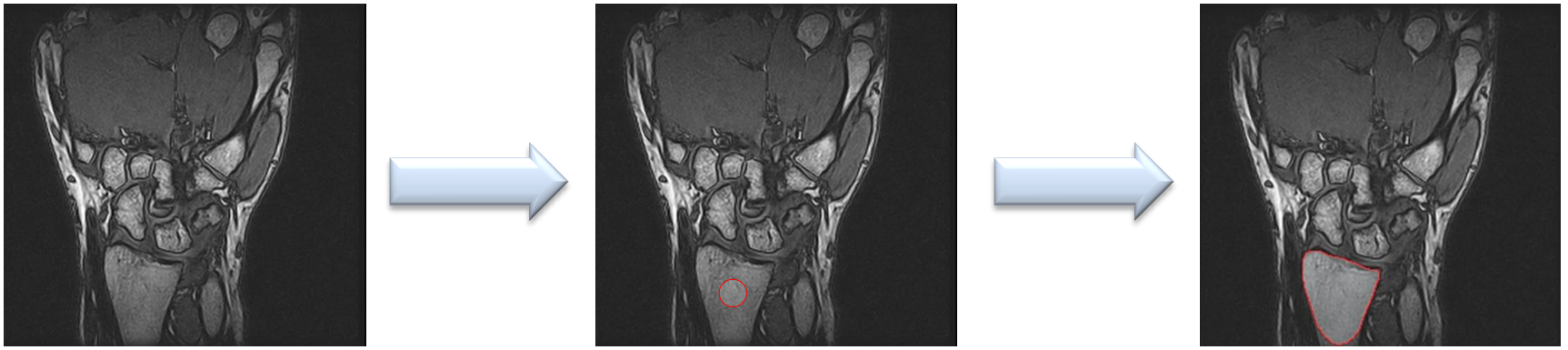
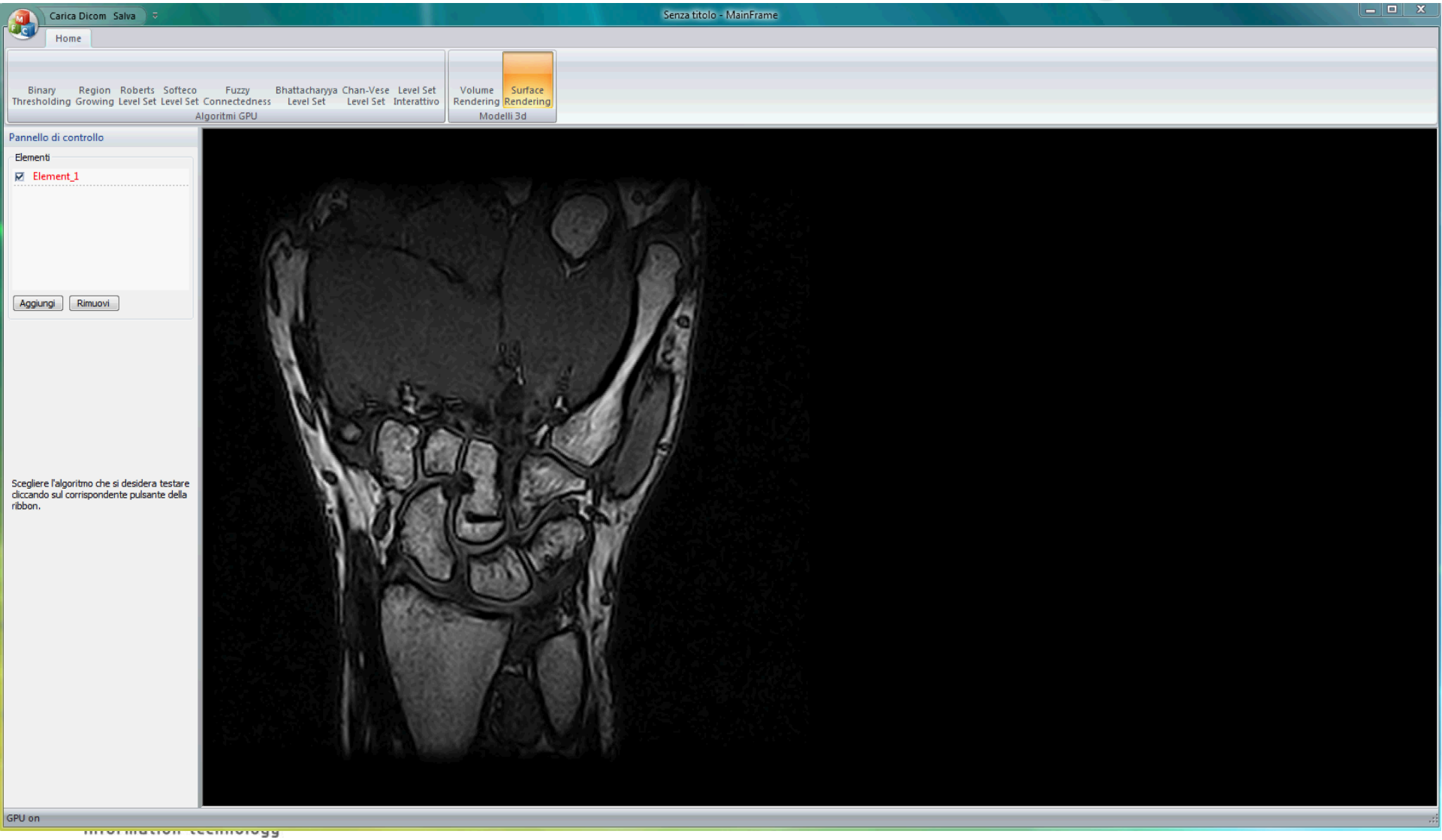


Image Segmentation



Real time segmentation



Using Segmentation Results: Visualization

The segmentation is the prerequisite for **visualization**. Segmentation information is required to selectively show certain (segmented) object or to suppress a structure that hampers the visualization.

Surface rendering

visual representation of object boundary (Marching Cubes algorithm)

Volume rendering

Volume rendering approaches simulate light equation (Ray casting algorithm)

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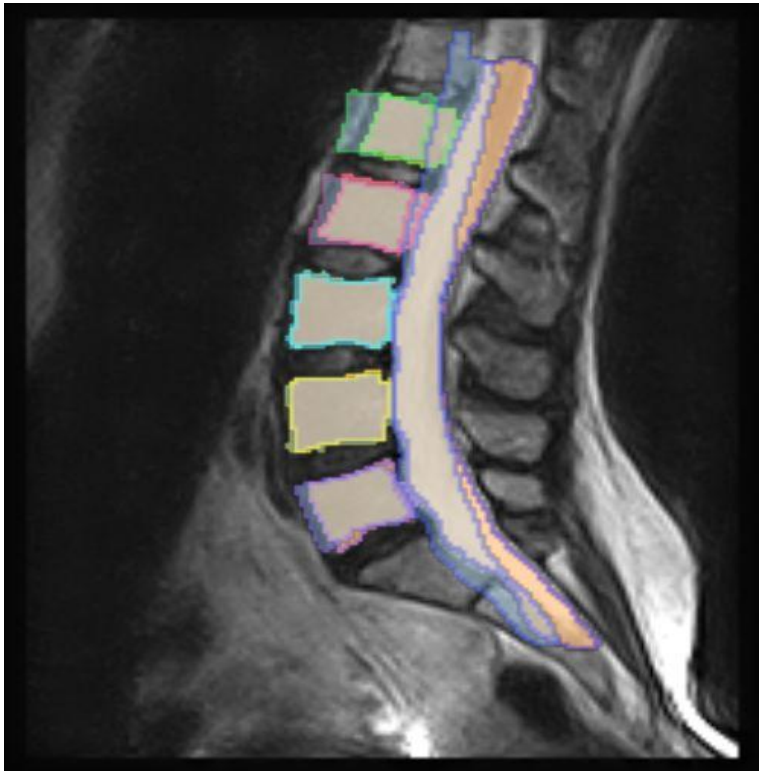
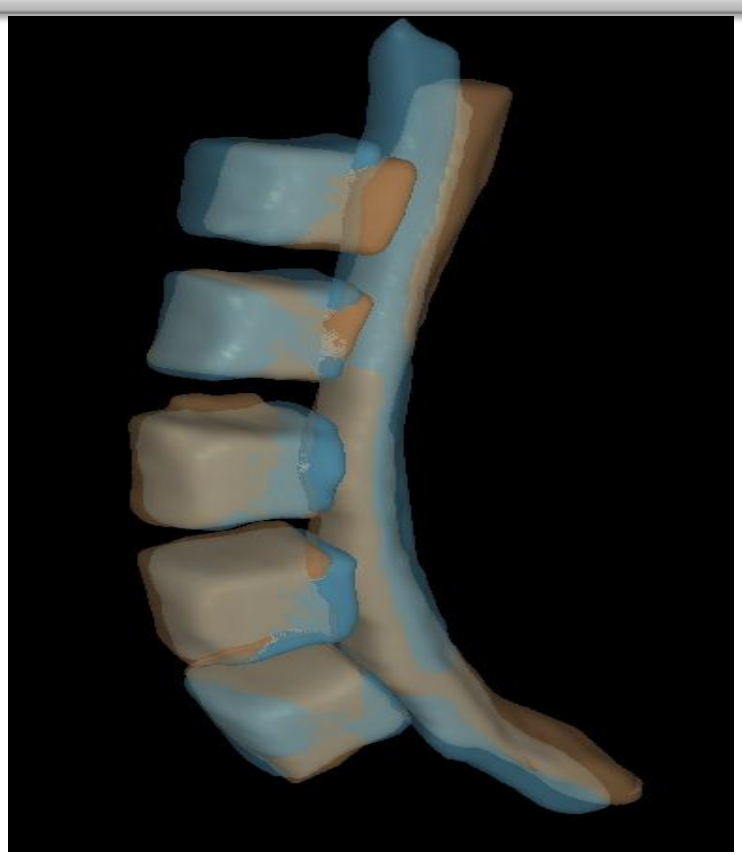
Using Segmentation Results : Anatomical indicators

The segmentation is the prerequisite for **measurement**. Segmentation information is required to selectively evaluate clinical indicators such as the angles between two vertebras acquired at different patient position





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14

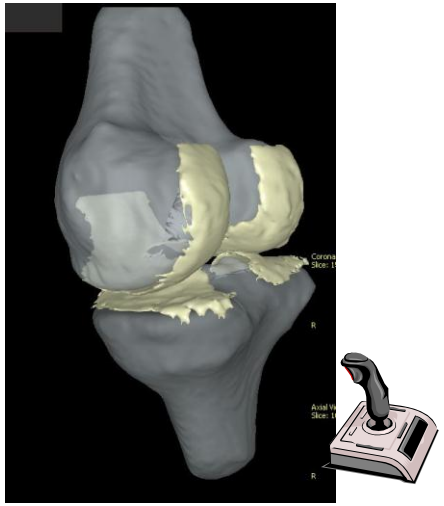
Softeco Real-world Applications: CAD systems (1)

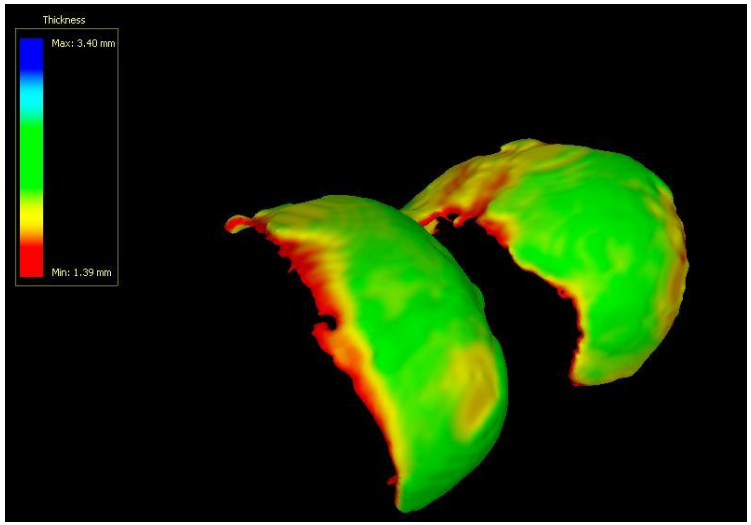
EndoNav

- MRI
- Knee, Shoulder

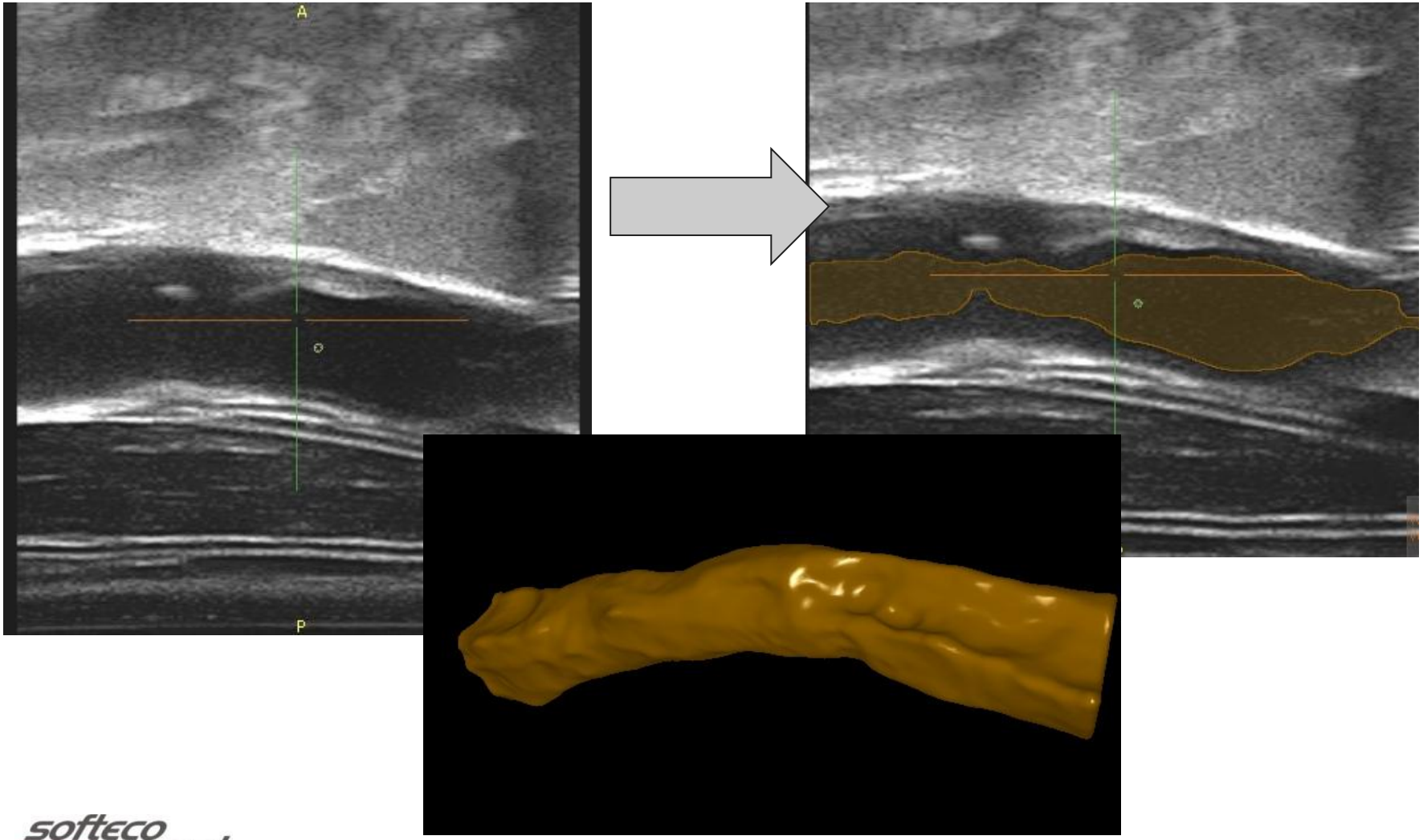
Functionalities

- segmentation
- surface reconstruction
- virtual guided endonavigation for surgical operations plan
- cartilage thickness

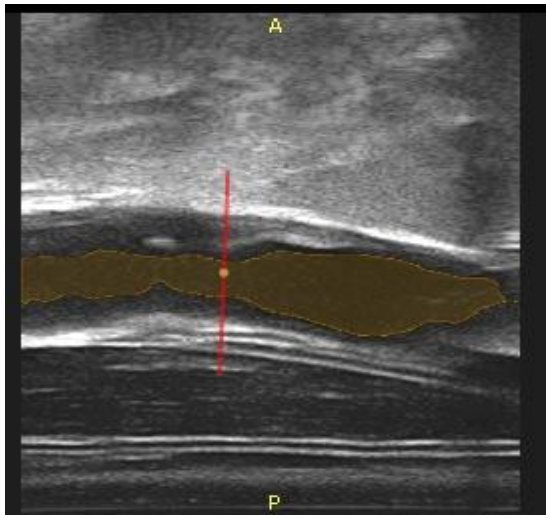


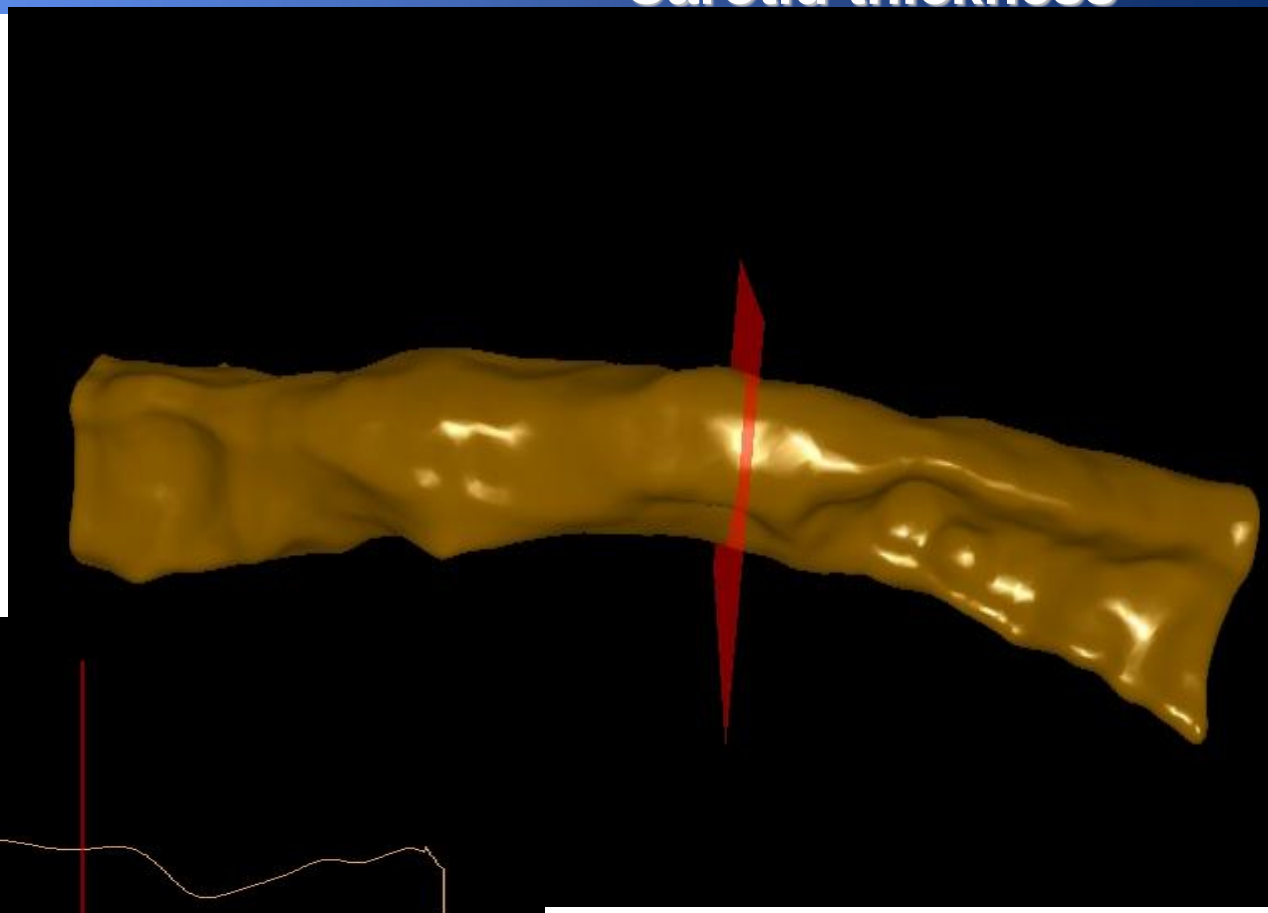


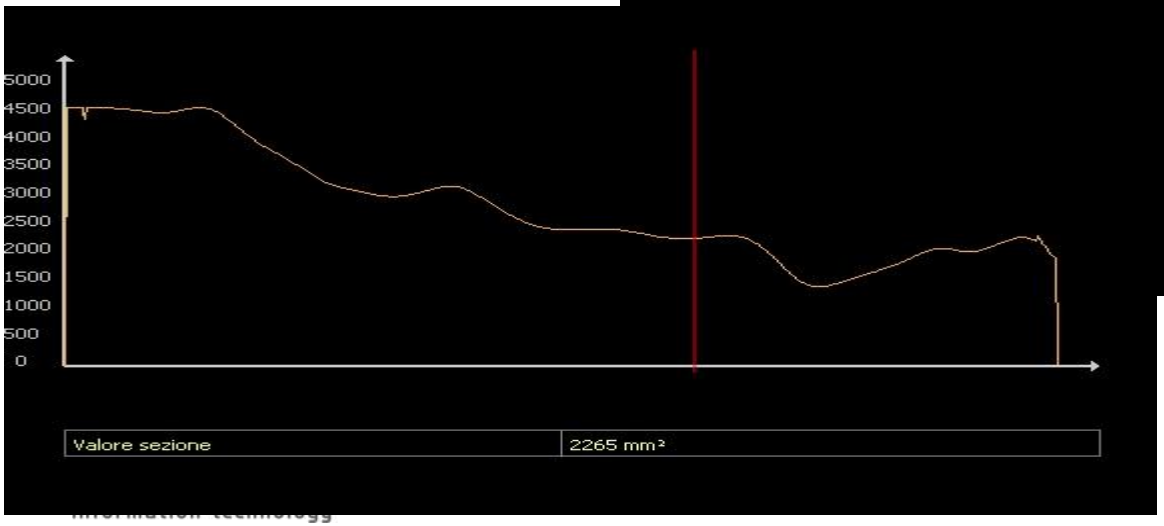
Softeco Applications CAD systems for ultrasounds

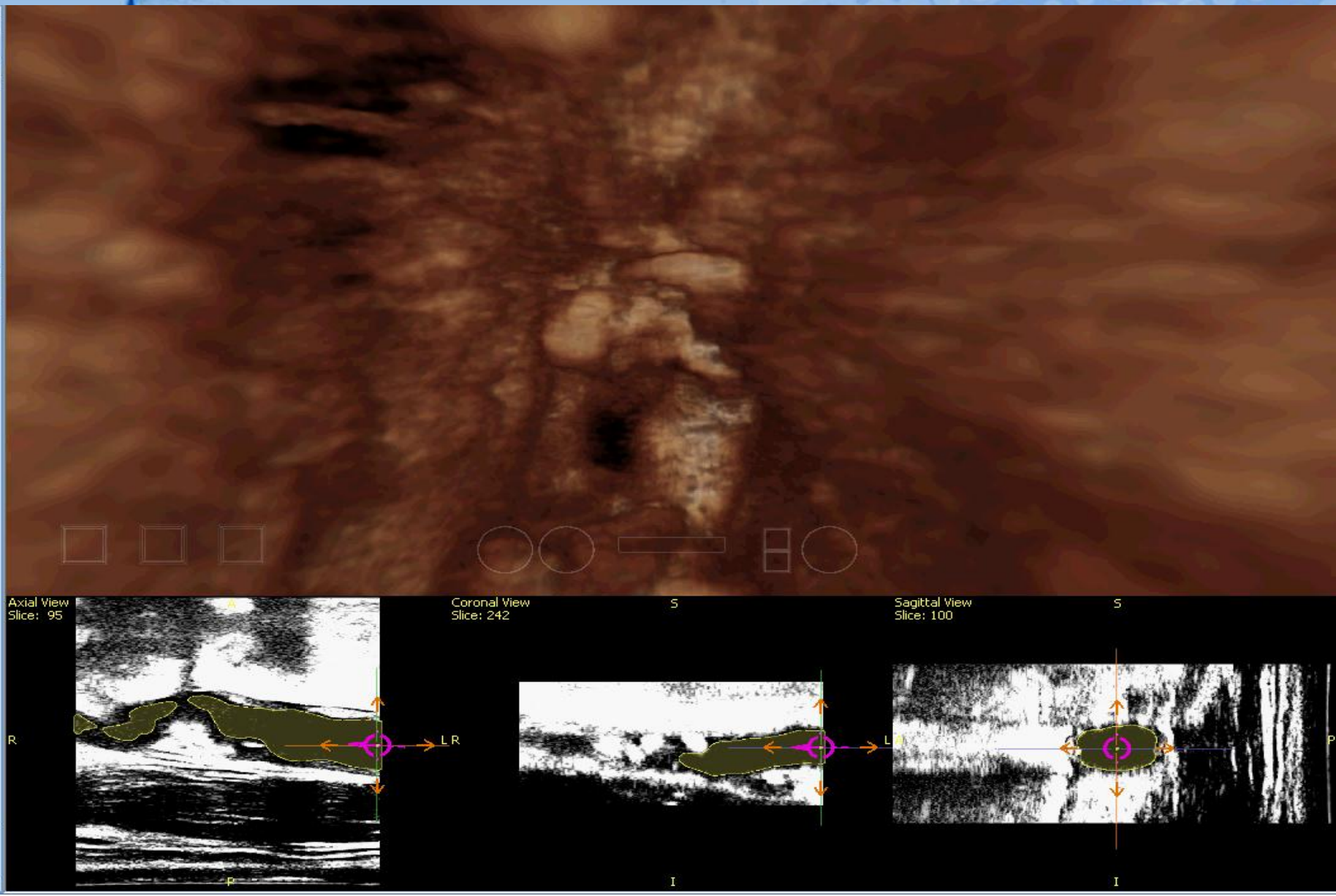


Carotid thickness








Axial View
Slice: 95
A
R
L R
P
Coronal View
Slice: 242
S
L
I
Sagittal View
Slice: 100
S
P
I

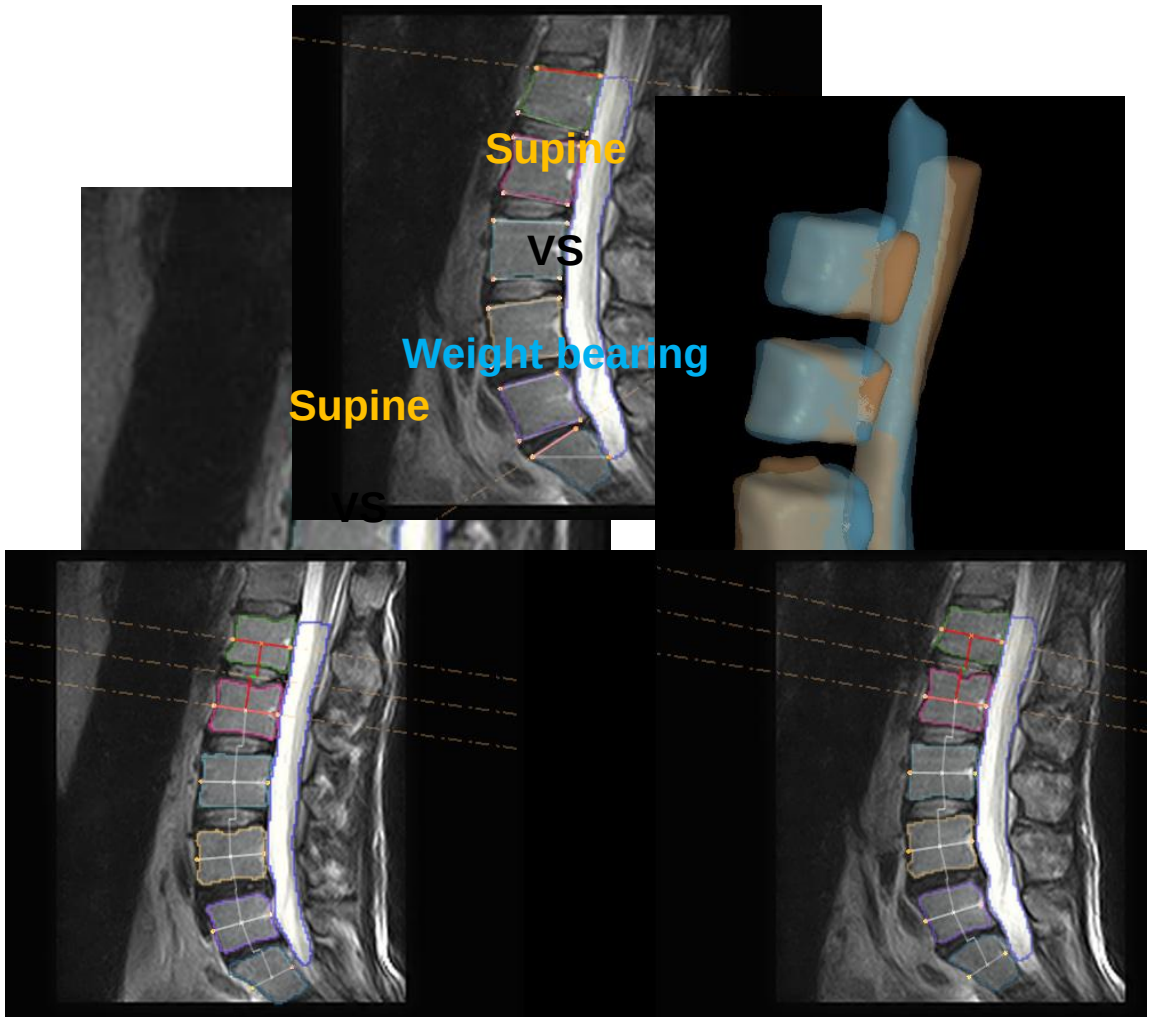
Softeco Real-world Applications: CAD systems (2)

OrthoCAD

- MRI
- Lumbar spine

Functionalities

- segmentation
- surface reconstruction
- Supine / Weight bearing comparison
  - Quantitative (Parameters)
  - Qualitative (3D model visualisation)



Softeco Real-world Applications: CAD systems (3)

RHEUMAScore

- MRI
- Wrist, Hand

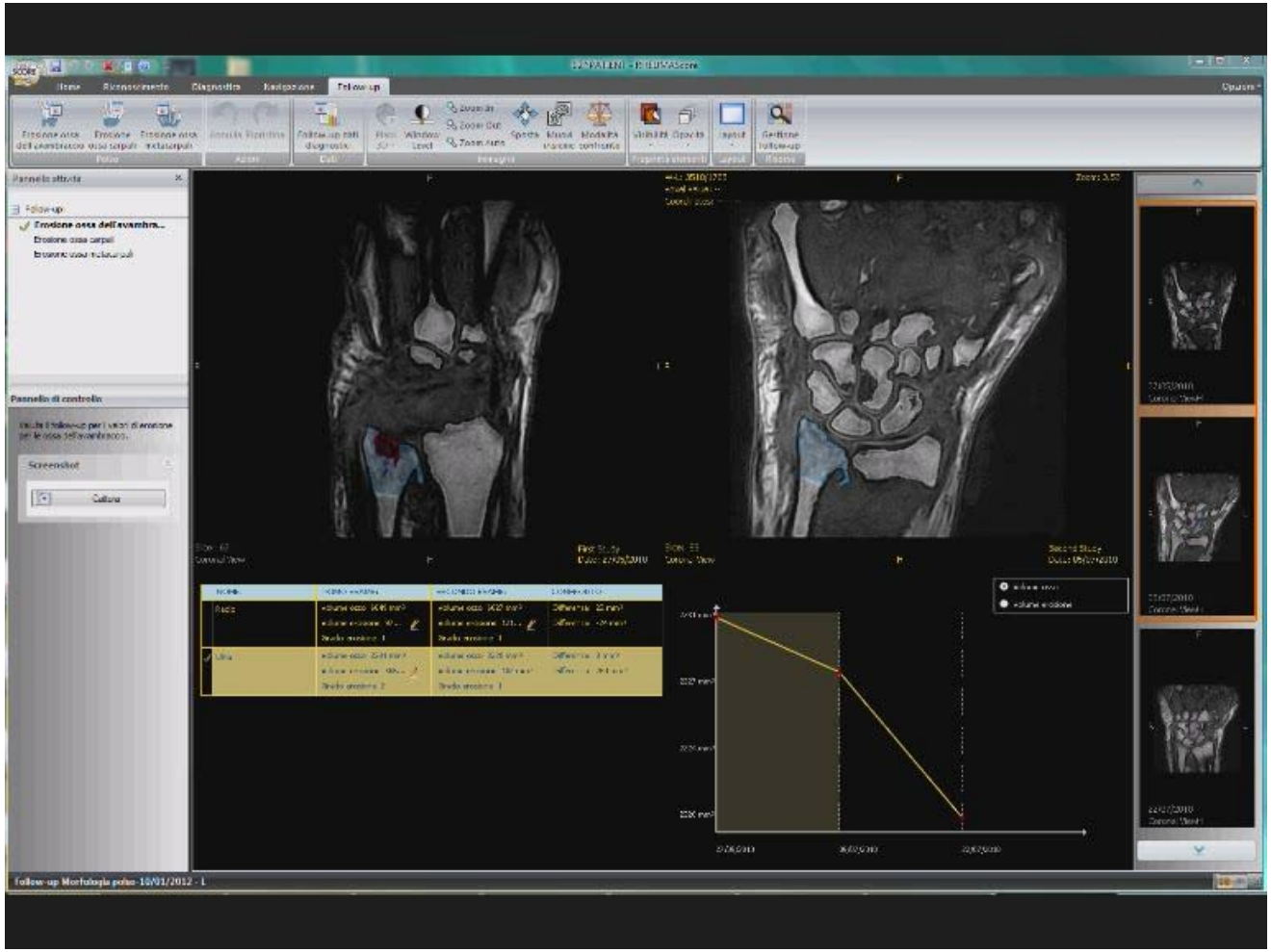
Functionalities

- segmentation
- surface reconstruction
- automatic erosion scoring
- follow-up
- diagnosis support with knowledge management

Collaboration

Department of Internal Medicine, Rheumatological Clinique, Genoa University

(EULAR Congress, 2012, Berlin)



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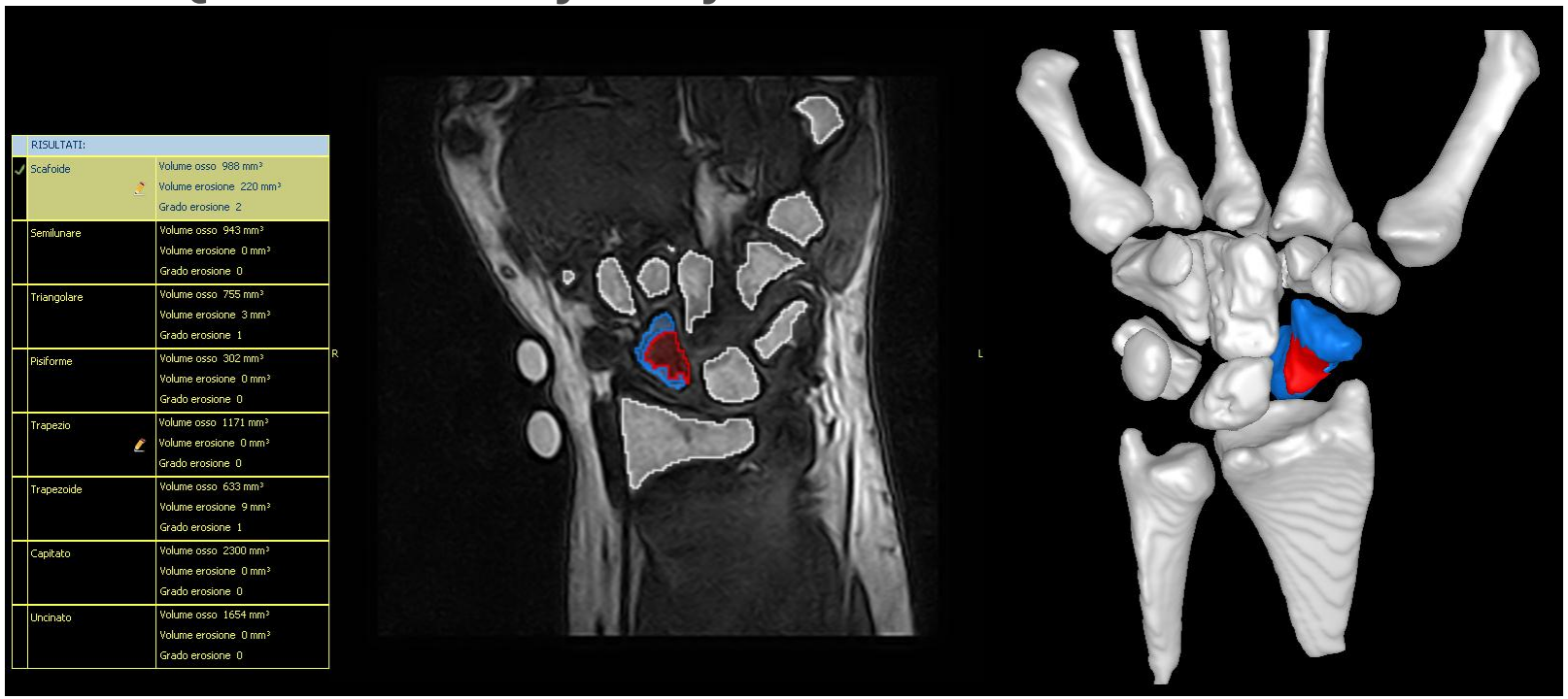
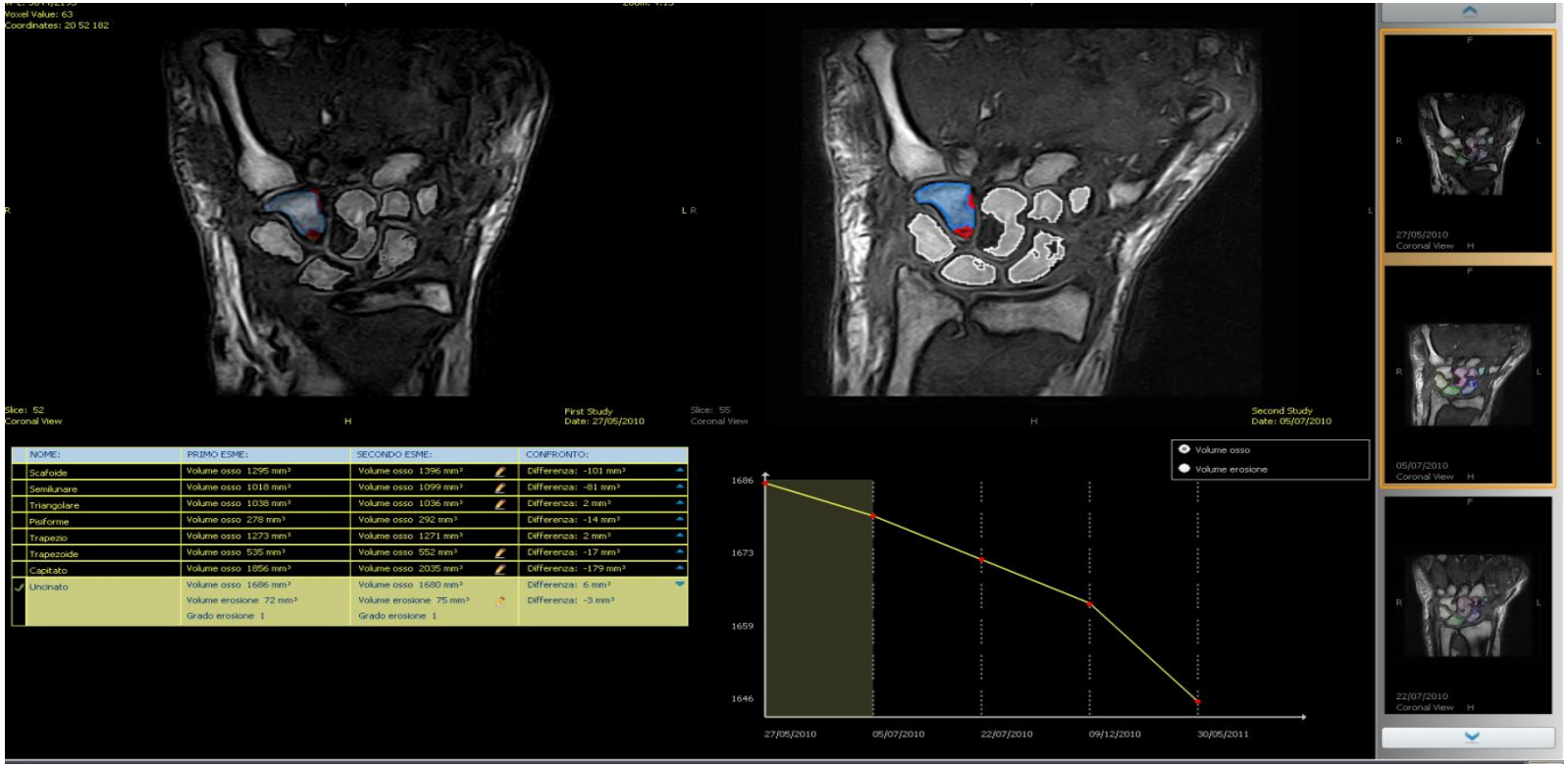
Automatical evaluation of the bones erosion scoring, using OMERACT RAMRIS criterion

- Quantitative analysis by numerical results
- Qualitative analysis by interactive visualization



Automatic comparison among the parameter results

- Difference between couple of contiguous in time result values with interactive chart



Thanks for your attention!

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