



Medical Imaging Research Center

Head : Isabelle Magnin - Vice-head : Pierre Croisille

Research center affiliated with several institutes :
INSA Lyon, University Lyon 1,
CNRS (UMR 5220) and Inserm (U1044)



<http://www.creatis.insa-lyon.fr>

Present on 5 different sites in Rhône-Alpes



Pôle Est Hospital
Louis Pradel, Lyon



Campus LyonTech
La Doua



ESRF European Synchrotron
Radiation Facility, Grenoble



Saint-Etienne Hospital



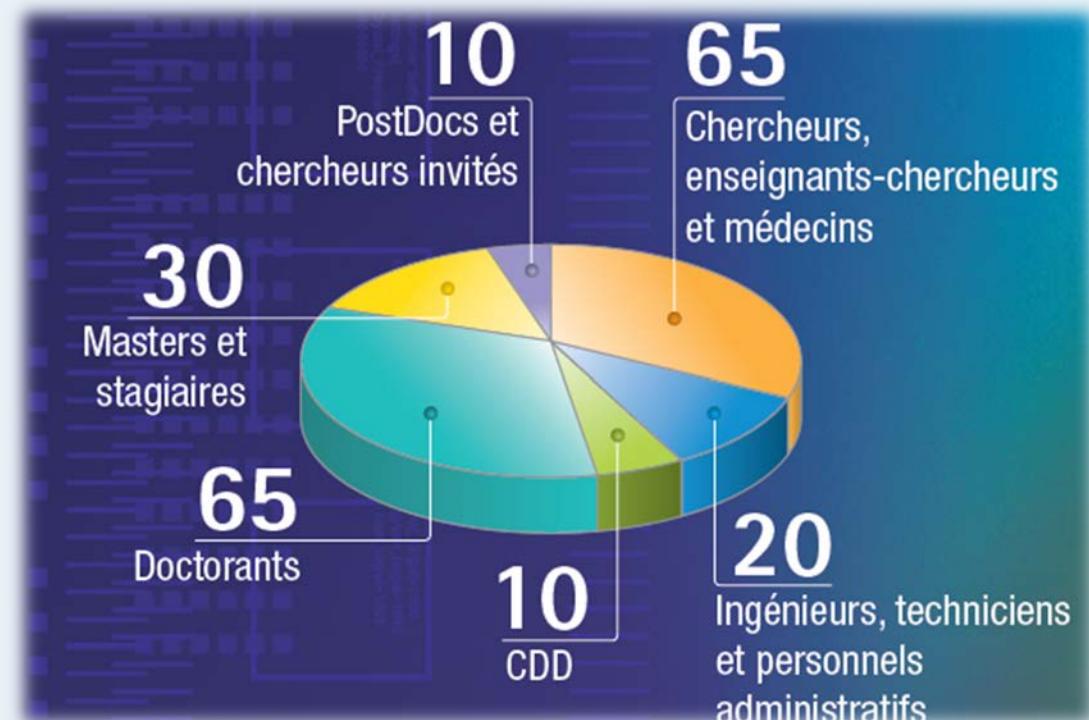
Hôpitaux de Lyon



Cancer Center
Léon Bérard, Lyon

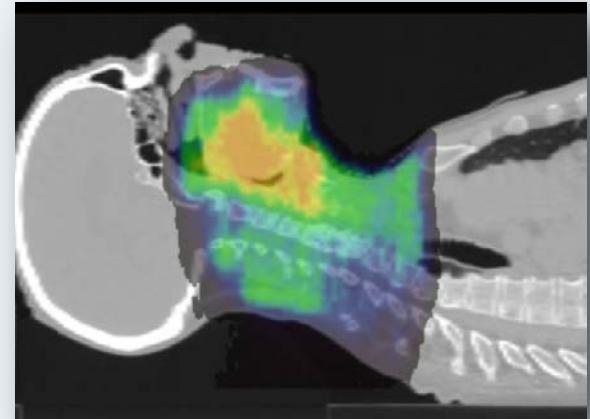
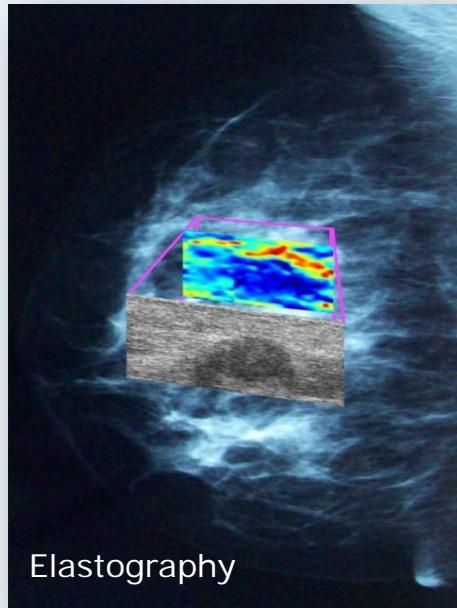
About 200 persons :

250 publications per year, more than 100 peer review journals

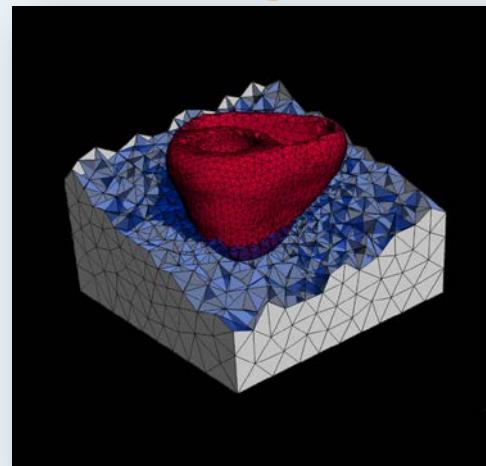


Budget :
9M€ : total including salaries
2M€ : research contacts

CREATIS is a key european
laboratory for biological and
medical imaging

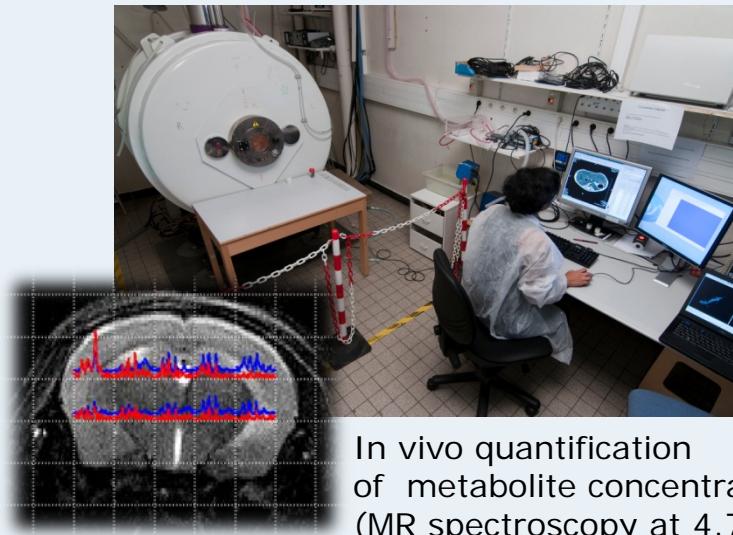


At the interface between
engineering, computer science
and **living science**

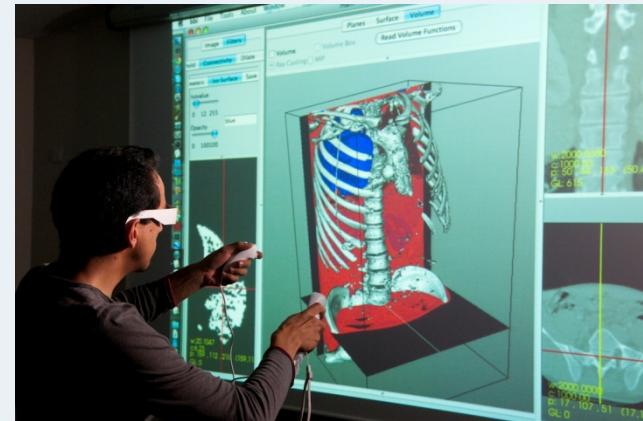




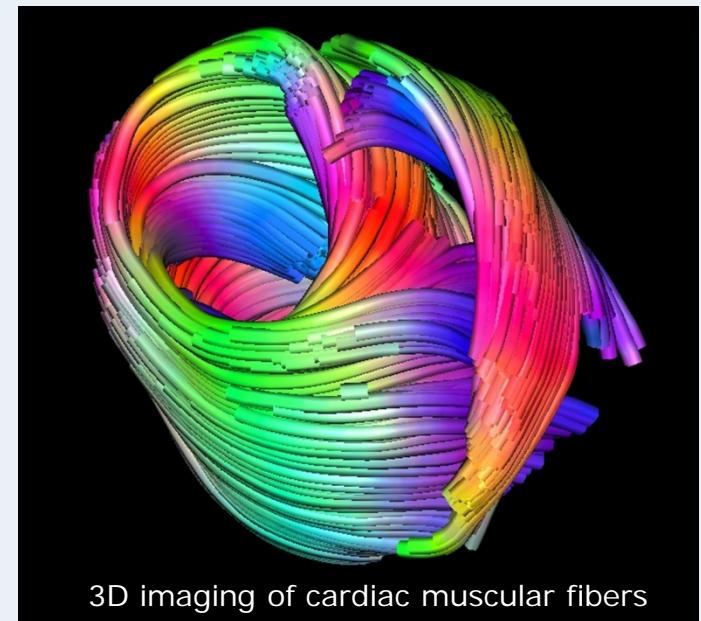
Development of
imaging methods,
new algorithms,
and **instrumental systems** to answer medical questions



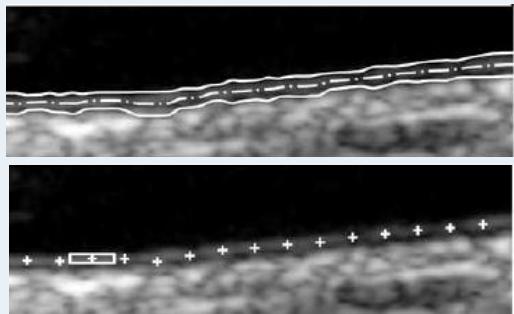
In vivo quantification
of metabolite concentration
(MR spectroscopy at 4.7T)



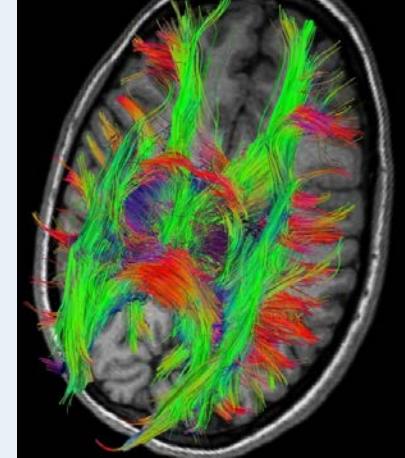
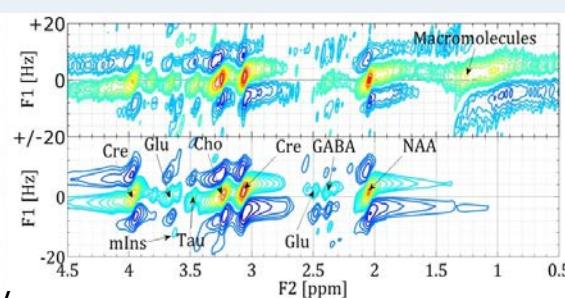
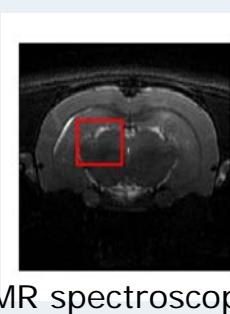
3D augmented reality



3D imaging of cardiac muscular fibers



Segmentation and tracking
of carotid artery wall in US

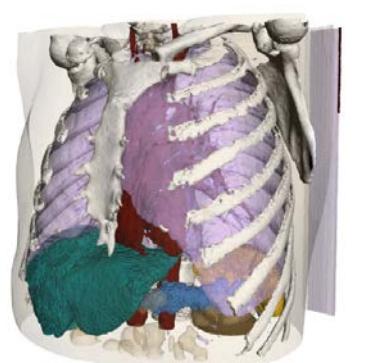


Diffusion Tensor Imaging
of the brain

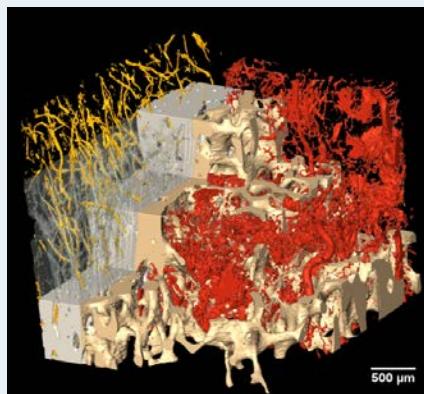
6 research teams

- 1 - Imaging of the Heart-Vessels-Lungs**
- 2 - Images et models**
- 3 - Ultrasound Imaging**
- 4 - Tomographic imaging and therapy with radiation**
- 5 - MRI and Optics : Methods and Systems**
- 6 - Brain imaging**

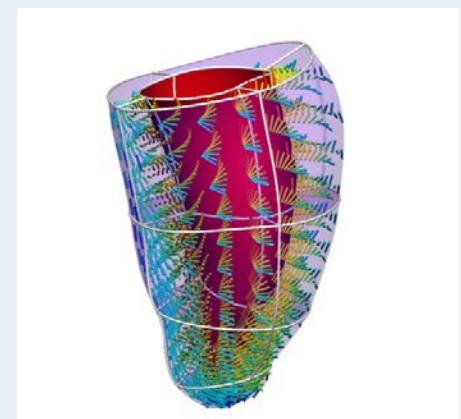
P. CLARYSSE
R. PROST
P. DELACHARTRE
F. PEYRIN
O. BEUF
N. NIGHOGHOSSIAN



Multi-organs segmentation

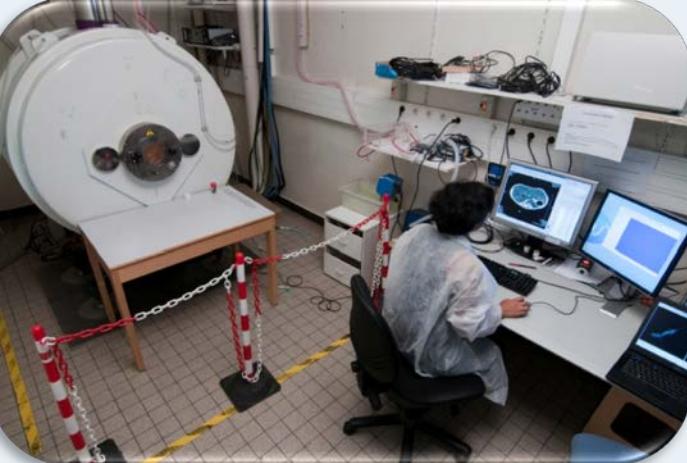


Microarchitecture and micro-vasculature
of bone(1 voxel=1,4μm)



Dynamic model of the heart

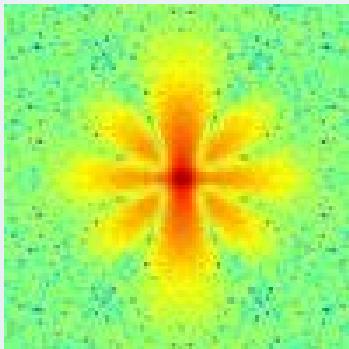
3 imaging platforms



Platform **MRI and MRS**
2 magnets 4.7T and 2T



Platform **ultrasound imaging**
3 research echographs,
motorized and automated acquisition



Technical platform for **optical imaging**



Platform **XRay imaging**
X Ray tubes 20 kV to 450 kV
Quick simulation

Creatis Access to imaging facilities of our partners



- ▶ Lyon Hospitals, HCL
- ▶ Cancer Center Léon Bérard
- ▶ CERMÉP, Life imaging

Radiotherapy, Elekta, CLB

**Clinical imaging CT, CT 4D,
IRM, TEP, TEP-CT, US**



SIEMENS Avanto 1,5T, Hôp. Neuro-cardio, HCL



**Permanent access to ESRF
(European Synchrotron Radiation
Facility), Grenoble**



Cluster for intensive computing

► At CREATIS

- 27 multiprocessor computers, 120 processor cores

► Access to computing center IN2P3

- 1344 computers, 17142 processor cores (2011)

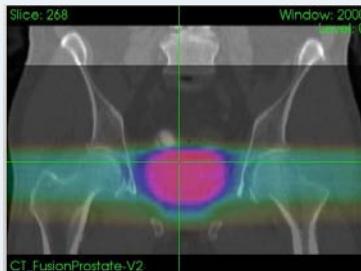


► EGI (European Grid Infrastructure).

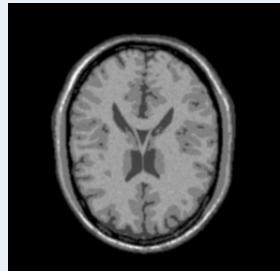
- GIS FranceGrille, STReP EGEE (2001-2010)



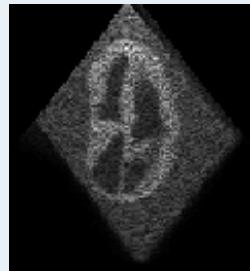
Medical applications of CREATIS on the grid



GATE : Dose Simulator
for radiotherapy

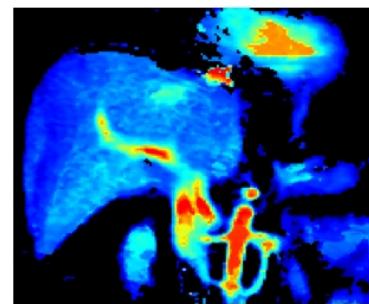


SIMRI
MRI simulator

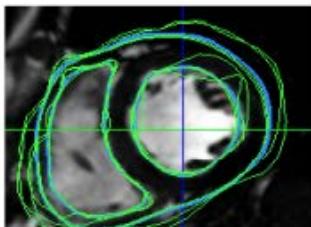
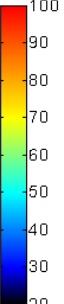
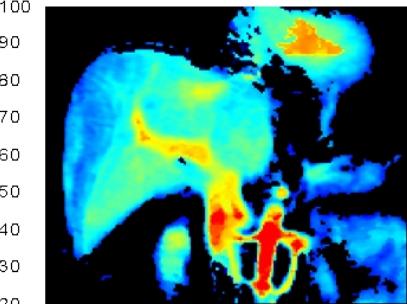


Field : ultrasound
simulator

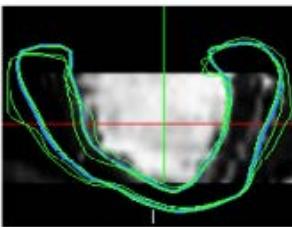
Débit artériel ($\text{mL} \cdot \text{min}^{-1} \cdot 100\text{g}^{-1}$)



Débit portal ($\text{mL} \cdot \text{min}^{-1} \cdot 100\text{g}^{-1}$)

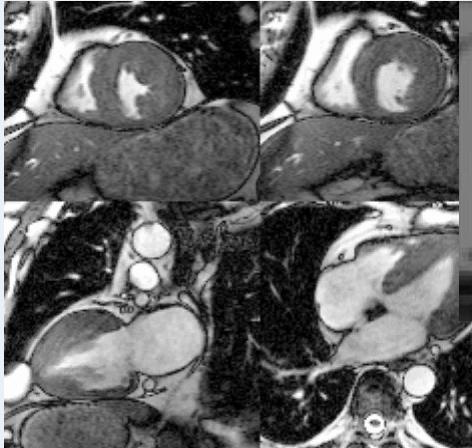


CAVIAR: dynamic cardiac segmentation

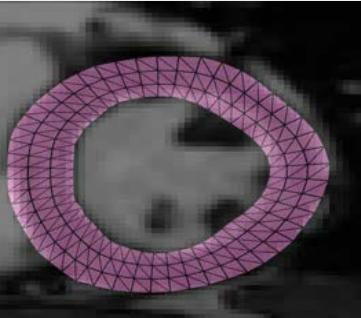


Cartography of hepatic perfusion
3D dynamic data are acquired by MRI
Open monocompartmental model
adapted to double hepatic blood income

Project **ANR VIP** : Integration Platform for medical
imaging applications on the GRID



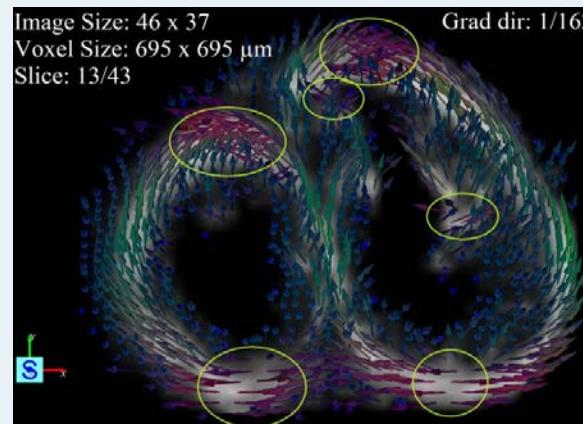
MRI sequences for cardiac function quantification



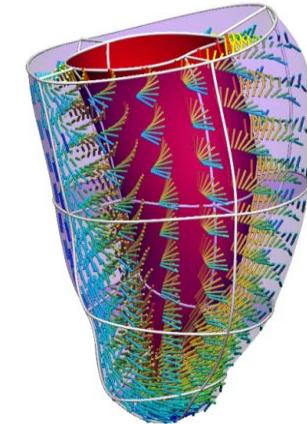
Cardio-vascular: atherosclerosis and ischemia (Teams 1, 2, 3)



3D tomographic reconstruction of a stent, Coll. GEHealthcare

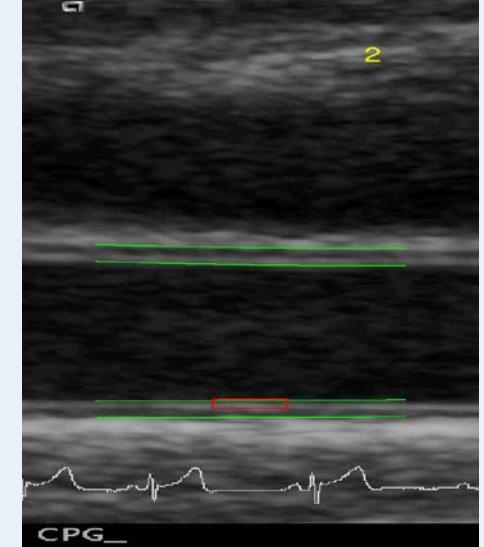


High resolution simulation of diffusion tensor imaging
Coll. Harbin Institute of Technology



3D dynamic model of the heart including fiber orientation.

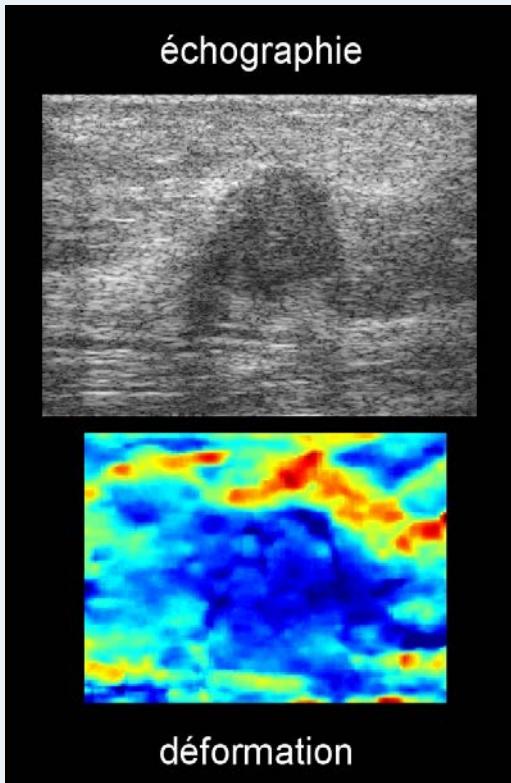
Coll. Auckland Bioengineering Institute



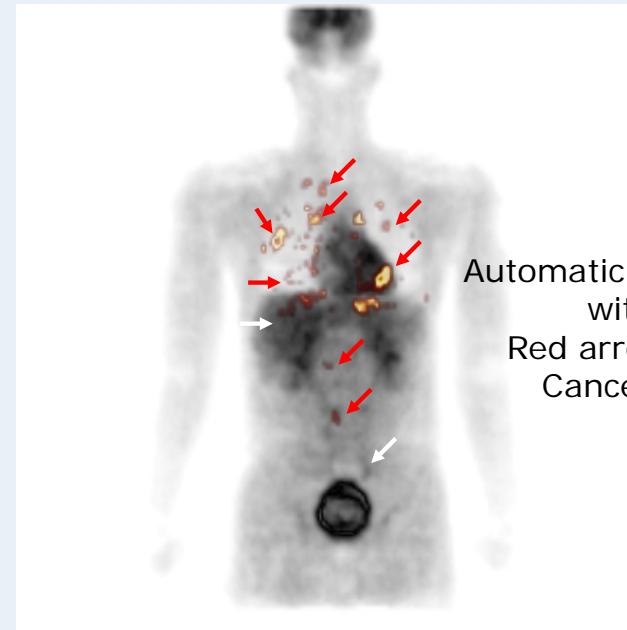
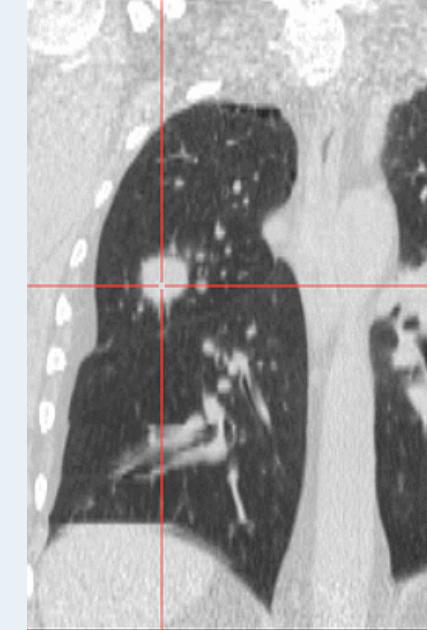
Real-time quantification of Carotid wall movement
Coll. HCL and Univ. Hopital Sydney Clinical protocol SARD

Medical applications

Cancer (teams 1, 2, 3, 4, 5)

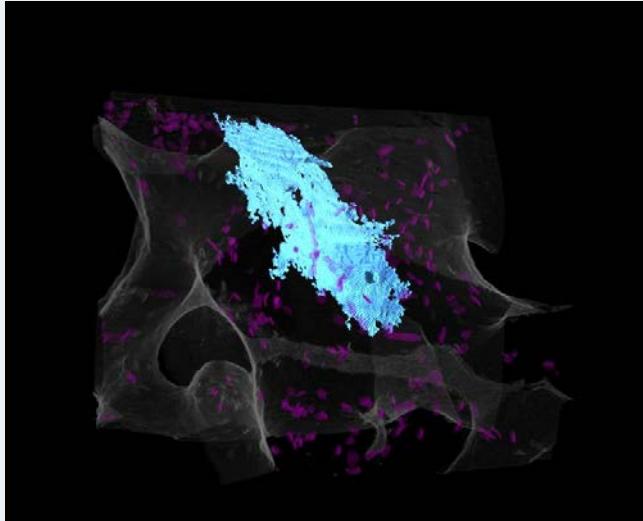


Radiotherapy guided by image
New acquisition protocols **4D X-ray CT** (CLB)
Clinical project « MidP » with
industrial partners ELEKTA, IBA, Philips



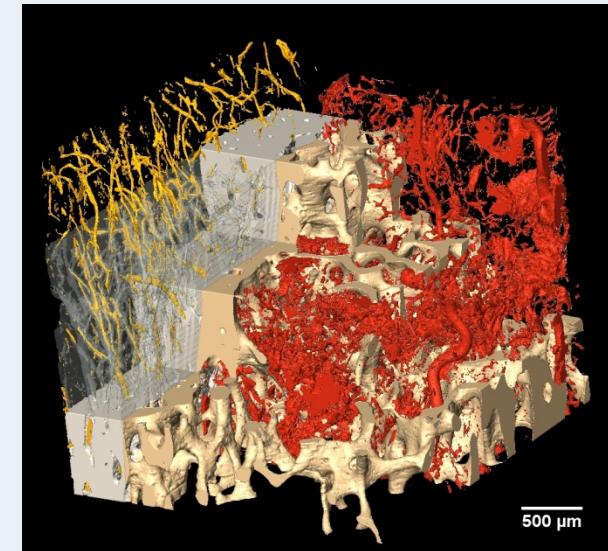
Automatic detection of tumor lesions
with **3D TEP** imaging
Red arrows : correct detections
Cancer diagnosis, coll. HCL

Imaging biological deformation in vivo
2D ultrasound **elastography**
Breast cancer, Coll. HCL and
Institute of Cancer Research, Londres

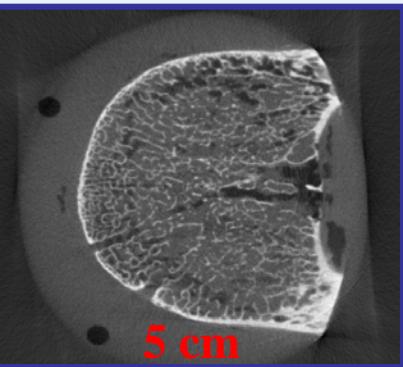


Micro-CT synchrotron microcracks (blue),
osteocytes lacunae (pink), human trabecular
bone (gray) (voxel size: 1.4 μ m)

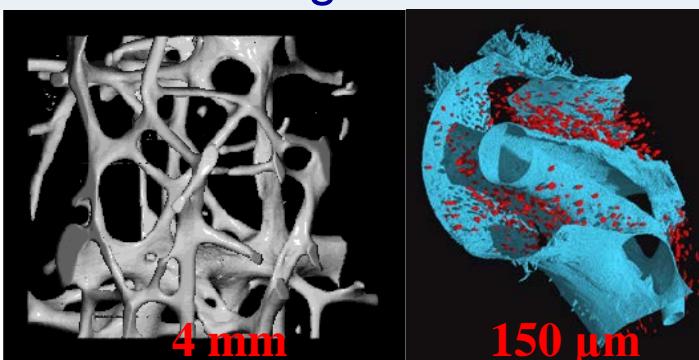
Bone microstructure (team 4)



Bone microstructure through the scales



Clinical scanner



Synchrotron imaging

150 μ m

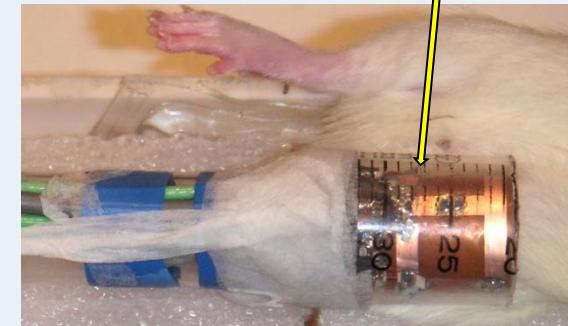
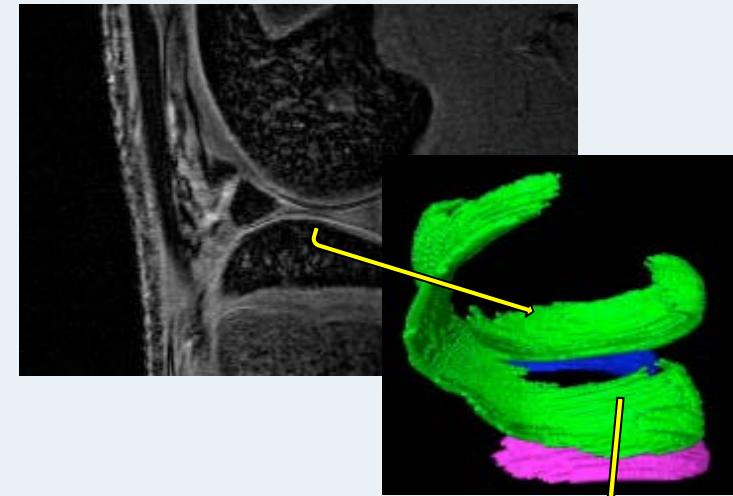
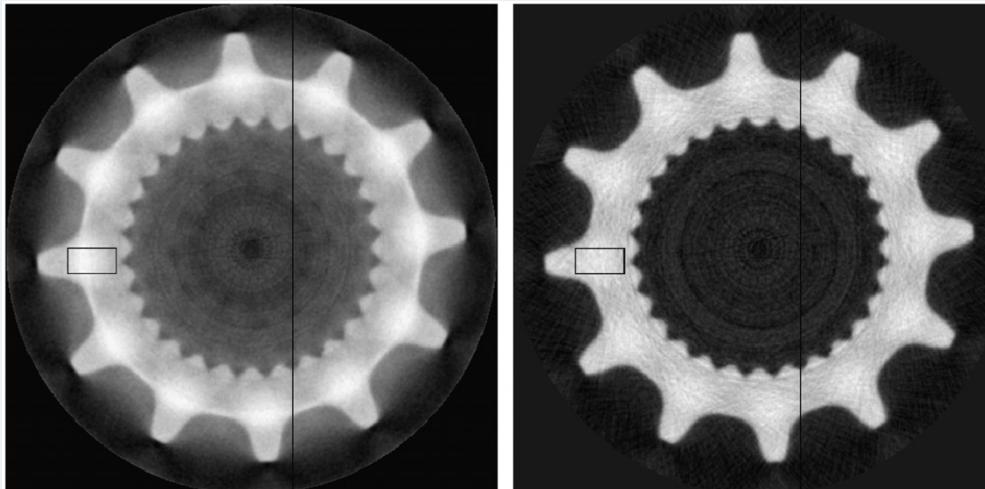
Simultaneous visualisation and analysis
of bone microstructure
and microvascular system
(voxel size: 1.4 μ m)

Collaboration ESRF, Grenoble and
LTBO, Inserm U1044, Saint-Etienne

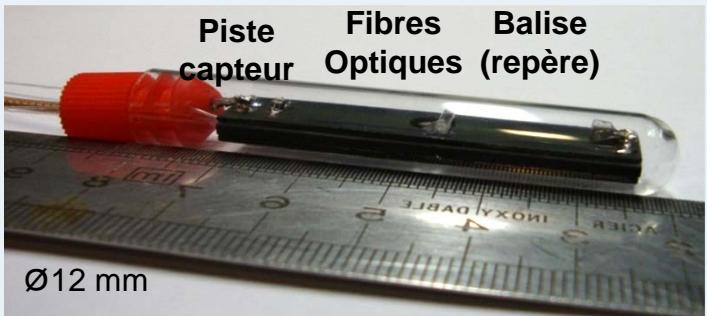
Instrumental development :
specific imaging systems
US/IRM/RX/Optics (Teams 3, 4, 5)



Bimodality imaging US/optics.
Prostate cancer diagnosis
Coll. Vermon/CEA LETI

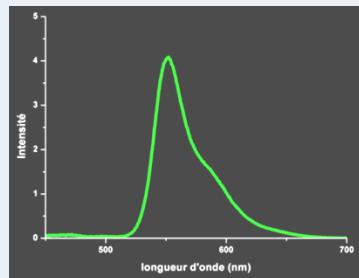


Bimodal endoluminal probe MRI/optics

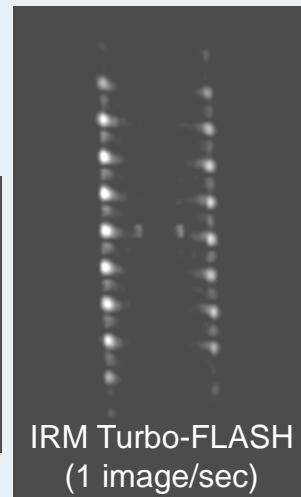


MRI/optics probe with 2 channels

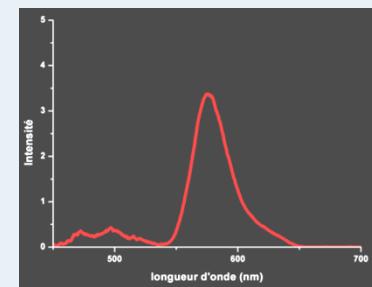
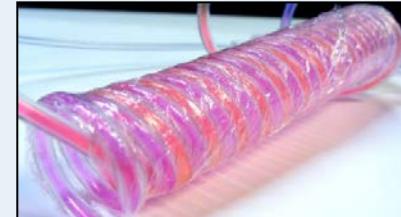
1,5T et 3T



**Eosine (0,2 g/L)
+ Gd (~2,2 mmol/L)**

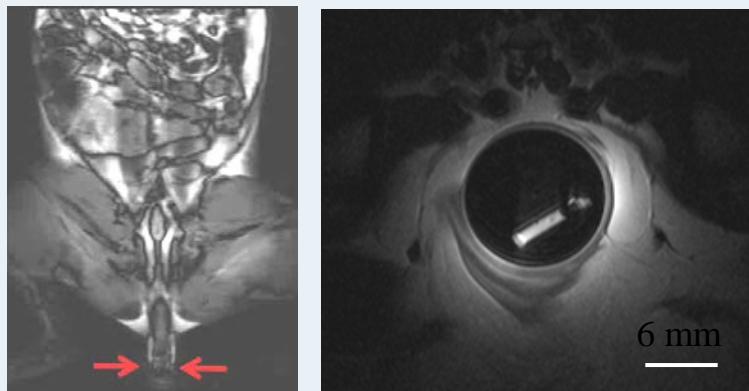


IRM Turbo-FLASH
(1 image/sec)



Rhodamine (0,01 g/L)

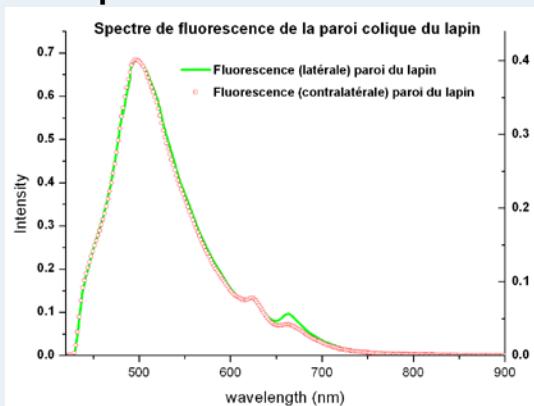
In vivo



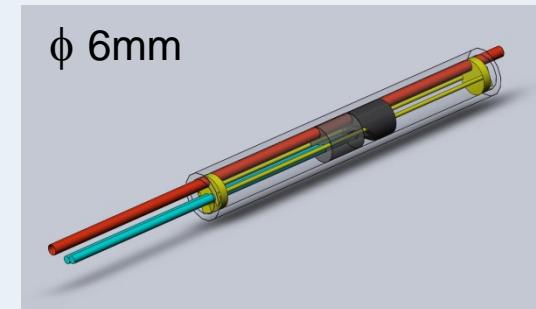
1,5T

Main results : compatible and complementary modalities

Spectrum of fluorescence



Drawing of the prototype



- Start-ups :

► 2001 : Theralys - BioClinica



► 2002 : Intellimed Consulting. **INTELLIMED CONSULTING**

► 2008 : CIRMA , MRI diagnosis for animals

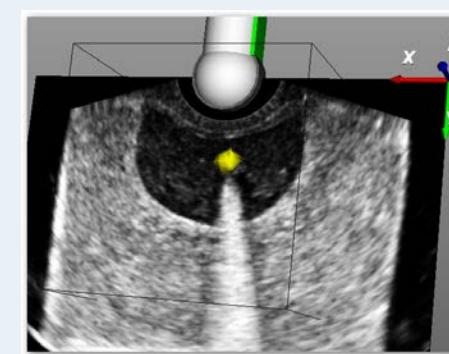


- Partnership with industry :

► Siemens, Philips, General Electric, Guerbet, Elekta, Theraclion, OBICA-3D, Lipha, DMS, Merck Health, Bracco, Novartis, Vermon , Dosisoft, IBA....

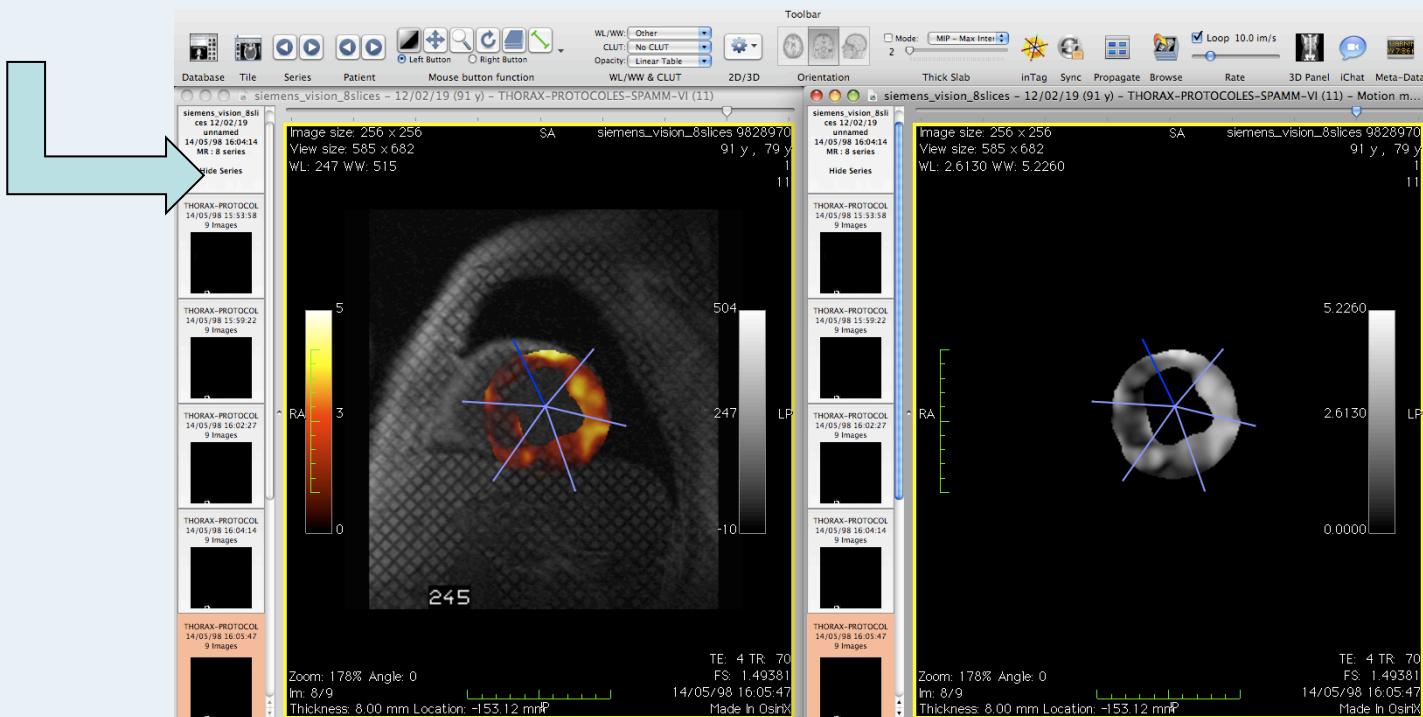
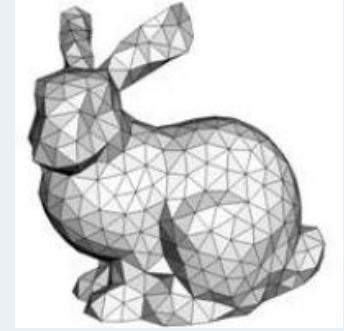
and also Michelin, SNCF, Plastic Omnium, L'Oreal...

► 15 patents since 2001



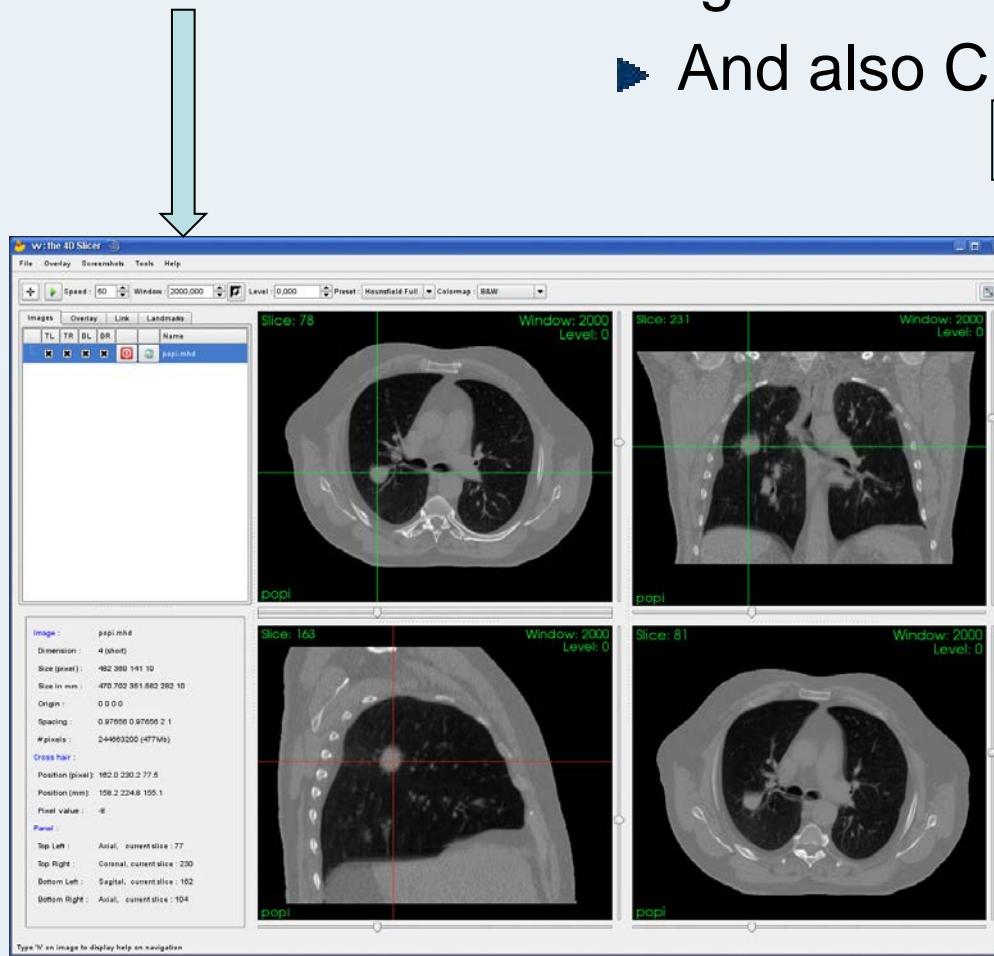
S
O
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T
W
A
R
E

- ▶ **ACVD** : Simplification & remesh
- ▶ **Wavemesh** : Progressive compression
- ▶ **Gdcm library** : DICOM Lib → Kitware
- ▶ **CreaTools suite**: Image processing library open-source and multi-platforms
- ▶ **MARACAS**: vascular imaging in 3D → → HITACHI
- ▶ **inTag**: plugin OsiriX for tagged MRI cardiac data

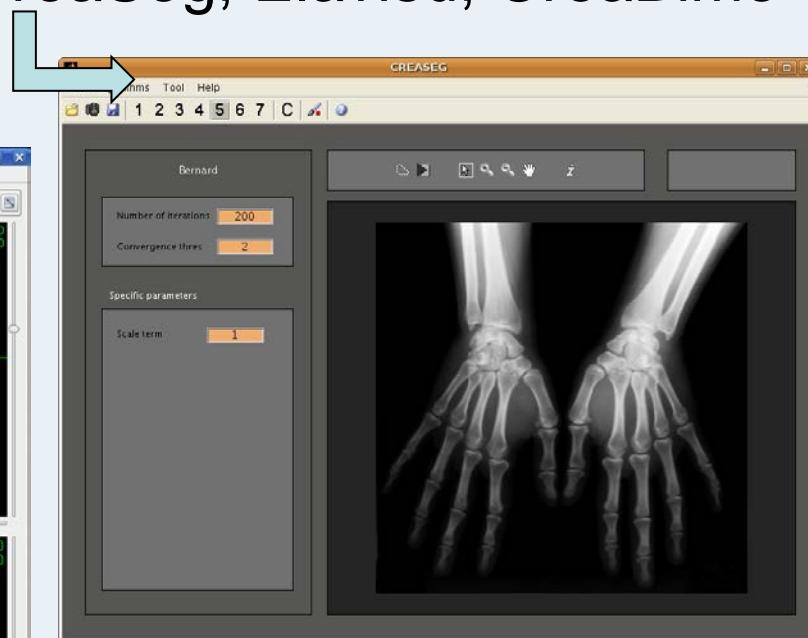


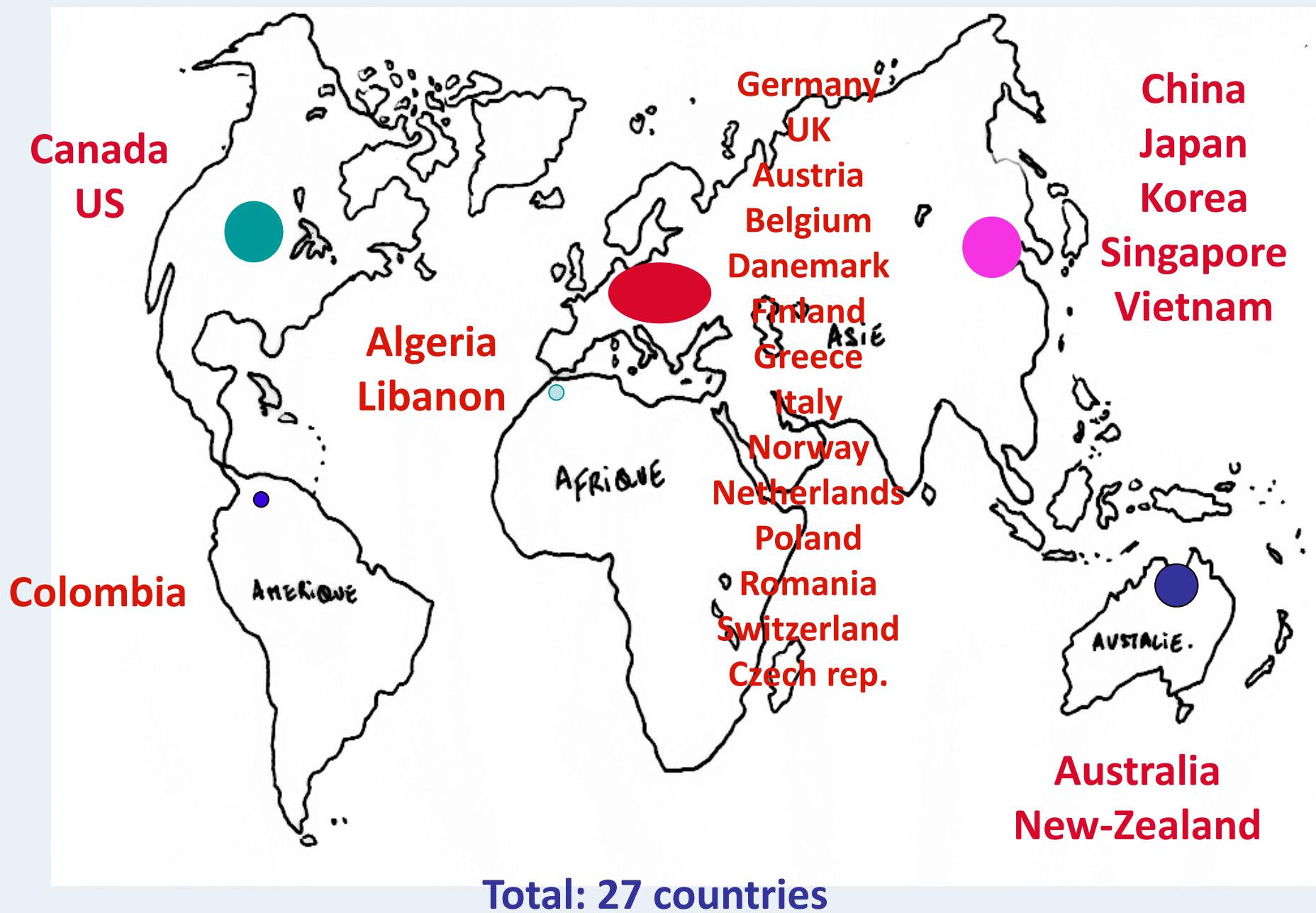
L O G I C I E L S

- ▶ **jMRUI:** MR spectroscopy, temporal analysis in vivo (spectra in 1D, 2D, 3D and 3D-MRSI)
- ▶ **SIMRI:** MRI simulation
- ▶ **Vv:** open-source, multi-platform software for visualization of multidimensional image



▶ And also CreaSeg, Elavisu, CreaBimo





Creatis Collaborations et european projects

- ▶ NoE VPH, NoE EIBIR,
- ▶ RTN Phelinet, RTN Fast, EST Warthe,
- ▶ COST P19,
- ▶ STReP EGEE (3 projects), STReP I_KNOW,
- ▶ STReP THROMBUS (leader), ITN Oiltebia



- ▶ Ecole Polytechnique Fédérale de Lausanne - (Switzerland)
- ▶ Institute of Biomedical Engineering (IBT), Zürich, (Switzerland)
- ▶ Erasmus University of Rotterdam - Thoraxcenter (Netherlands)
- ▶ University Hospital Leiden (Netherlands)
- ▶ University of Leuven - Medical Image Computing (Belgium)
- ▶ University of Firenze (Italy)
- ▶ University of Roma (Italy)
- ▶ Oxford University - Medical Vision Laboratory (UK)
- ▶ Helsinki University of Technology - LBME (Finland)
- ▶ University of Barcelona (Spain)
- ▶ Czech Technical University, Prague (Czech Republic).

Creatis International Collaborations

Americas

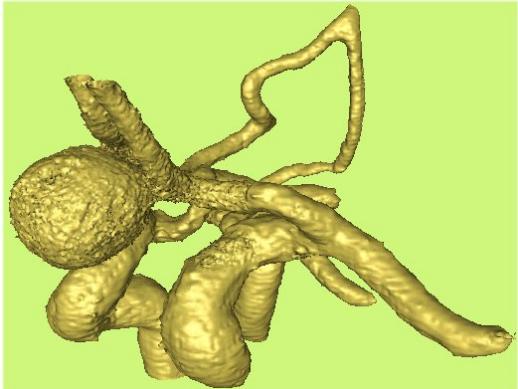
- ▶ Imagine Group, Los Andes University, Bogota (Colombia)
- ▶ Dept of Radiology, University of California San Francisco (USA)
- ▶ Image Computing Systems Lab, University of Washington, Seattle, (USA)
- ▶ Skirball Institute of Biomolecular Medicine, NYU Medical Center, (USA)
- ▶ Johns Hopkins Hospital, Baltimore, (USA)
- ▶ Harvard Medical School, Boston, (USA)
- ▶ Mayo clinic, Rochester, (USA)

Asia

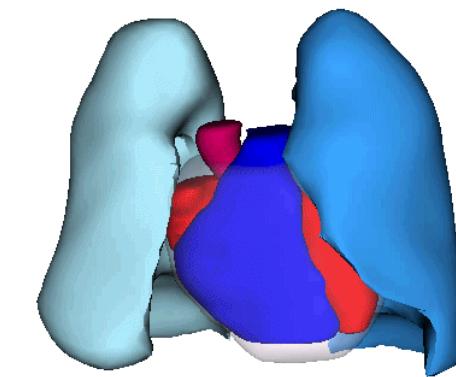
- ▶ Harbin Institute of Technology HIT (China)
 - ➔ international laboratory METISLab,
 - Collaboration INSA, Shanghai Jiaotong, University Beijing, Fuwai Hospital, LTCI-Paris, I3S-Nice, GIPSA-Lab-Grenoble
- ▶ University Shanghai JiaoTong (China)
- ▶ Yeungnam University (South Korea)
- ▶ Tokyo University, Computer Graphics Laboratory (Japan)
- ▶ SBIC, A*STAR Biopolis (*Singapore*)

Thank you

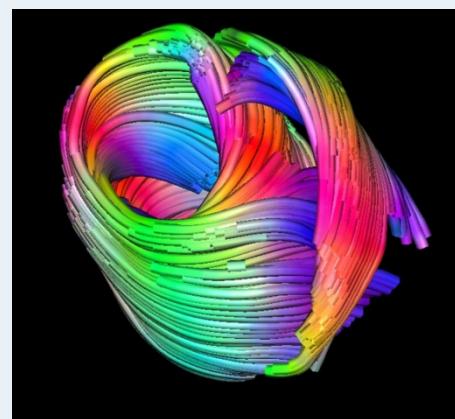
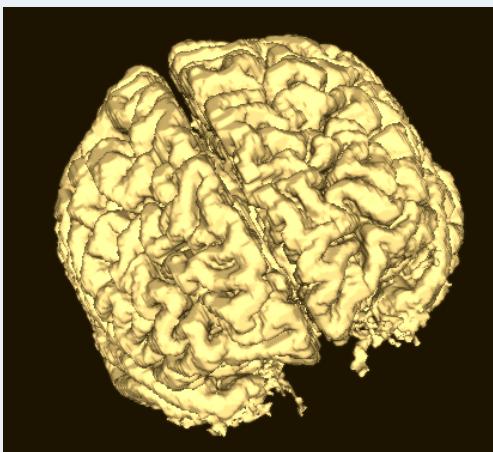
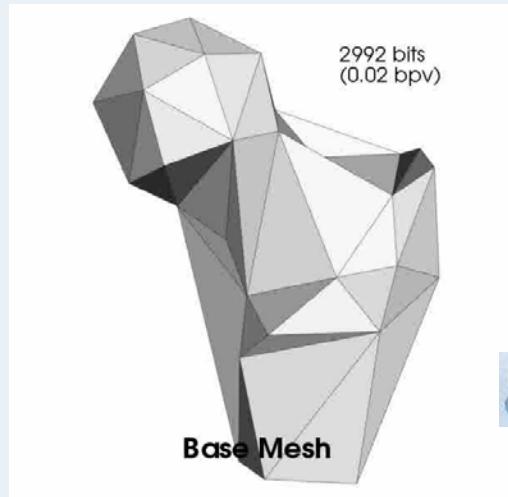
complementary images



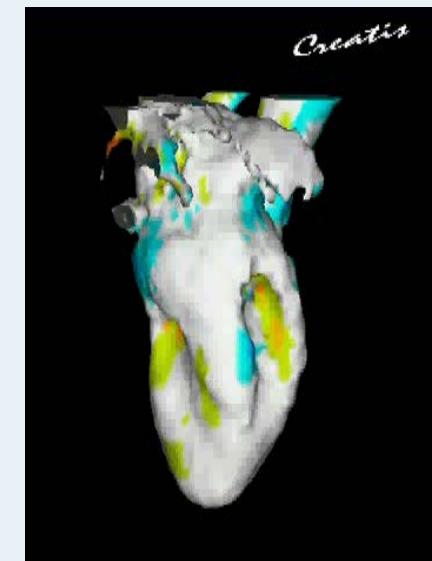
Non-separable wavelet-based cone-beam 3D reconstruction of cerebral aneurism



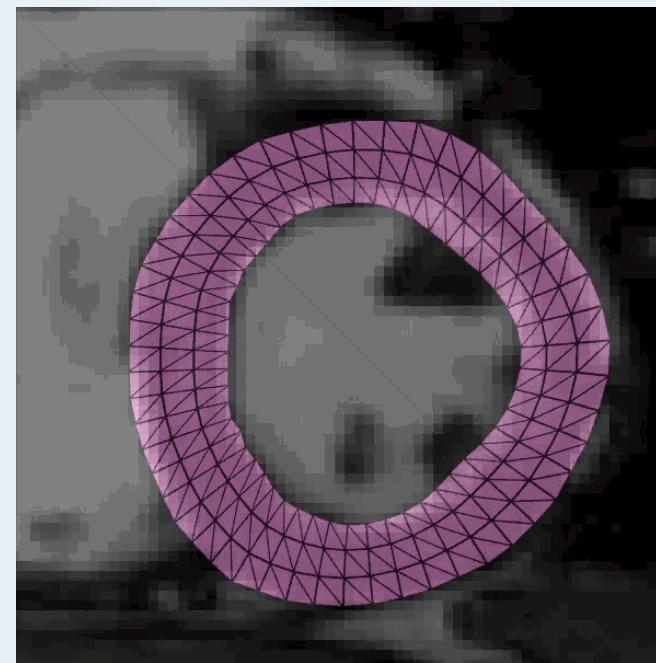
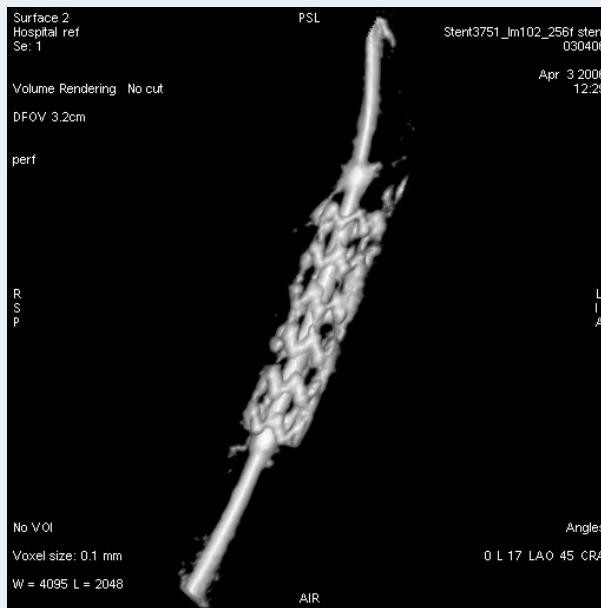
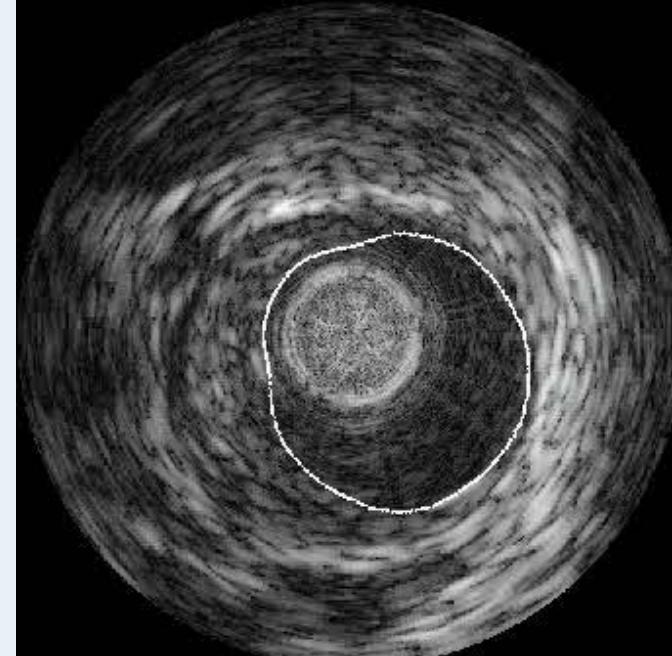
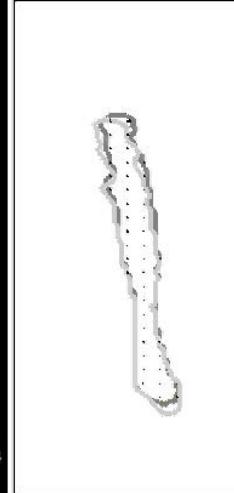
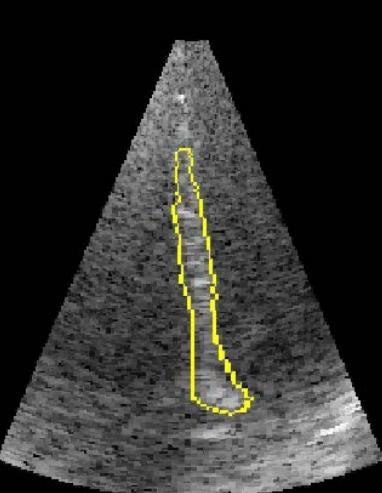
Breathing thorax and beating heart numerical model

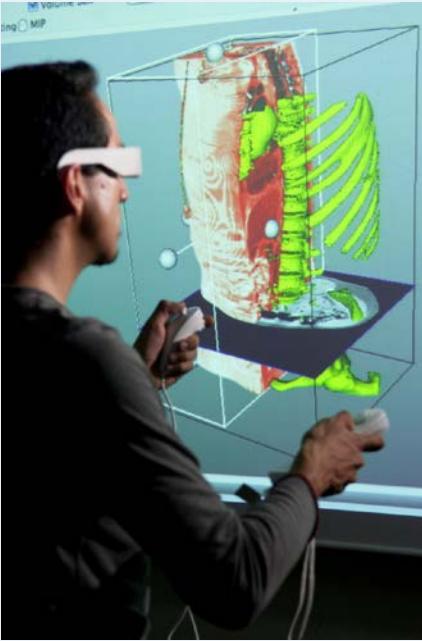


Cardiac fiber architecture from diffusion-tensor MRI



Creatis





Augmented reality for interactive 3D medical imaging visualisation



Automatic extraction of axis and contours of the carotid artery



3D X-ray CT Philips



Control of dose in radiotherapy