

Patient Specific Surgical Simulation

Prof. Luc Soler
IRCAD, university of Strasbourg

University of Strasbourg, France

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Current Education without patient



IRCAD: More than 3500 surgeons each year

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IRCAD: International Network



WebSurg Virtual Surgical university www.websurg.com

**1er site de formation continue aux techniques de
chirurgie mini-invasive**

Plus de 80.000 chirurgiens inscrits
Près de 100.000 visite par mois
Plus de 300.000 vidéos regardées par mois

University of Strasbourg, France

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WebSurg: Formation Continue

WebSurg World Electronic Book of Surgery

Le plus grand choix de formations en chirurgie laparoscopique

NOTES Université virtuelle Nouvelles parutions Centre CME WeBSurg Who's Who Lettre d'information Aide

WEBSURG AWARD VOTEZ POUR LA MEILLEURE VIDEO

Le top de la formation continue !

- Plus de 570 vidéos d'interventions chirurgicales
- 124 descriptions détaillées d'interventions chirurgicales
- 86 conférences en chirurgie mini-invasive via séminaires
- 1023 interviews d'experts ciblés
- 25 débats entre experts
- 38 cas cliniques

Accédez à l'Université Virtuelle Mondiale WeBSurg
une base de données unique de contenus évolutifs en chirurgie mini-invasive

iircad Centre de formation en chirurgie laparoscopique Strasbourg France

eats Association Européenne de Chirurgie Transluminale

STORZ KARL STORZ ENDOSKOPIE WebSurg est gratuit grâce à nos partenaires

COVIDIEN Validez vos connaissances en ligne avec 41 points CME

Accréditation CME

Cours de 3ème cycle universitaire en chirurgie laparoscopique

iircad / eats CENTRE DE TECHNOLOGIE DE POINTE POUR LA FORMATION EN CHIRURGIE LAPAROSCOPIQUE - Strasbourg

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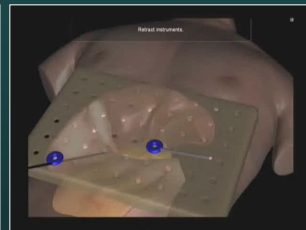
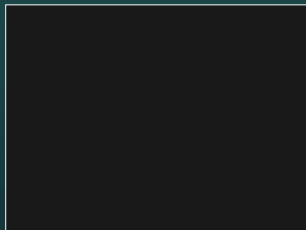
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Current Surgical Simulators

©Surgical Science

©Symbionix

©SimSurgery



- Realistic rendering
- Large set of possible training (suture, clip applying, etc...)
- Automated evaluation

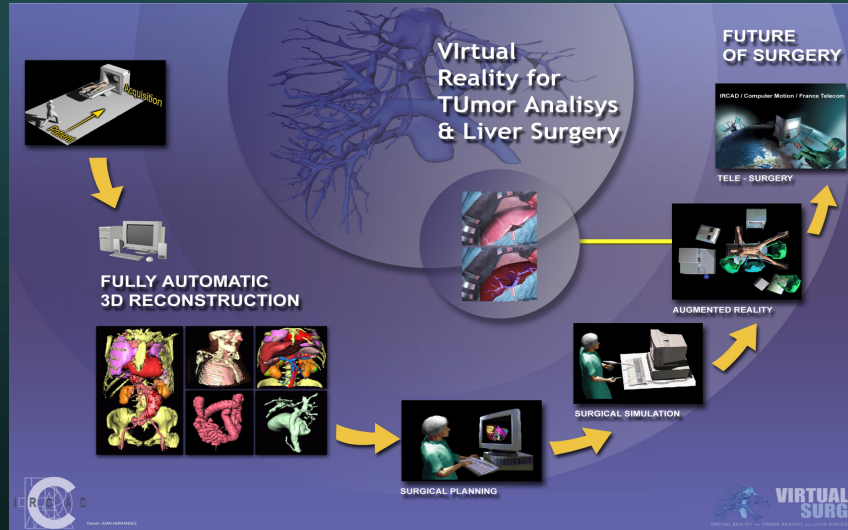
BUT : NOT PATIENT SPECIFIC and NOT PREOPERATIVE

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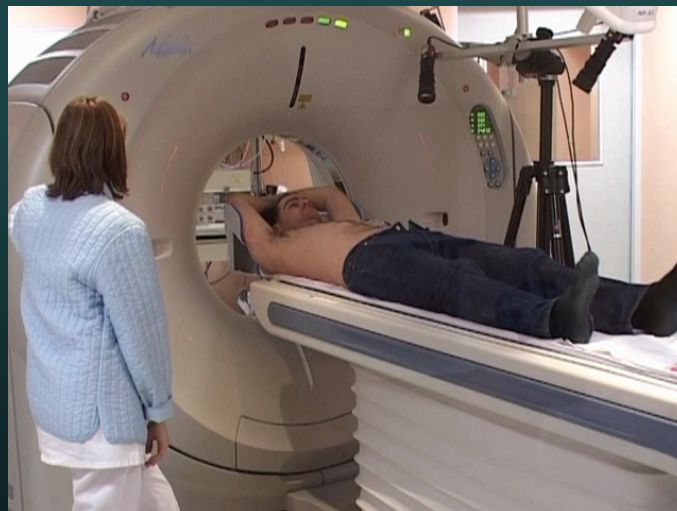
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Computer Assisted Surgery



3D Modeling of Patients

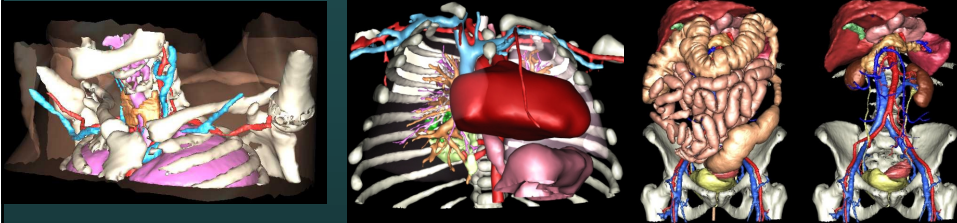


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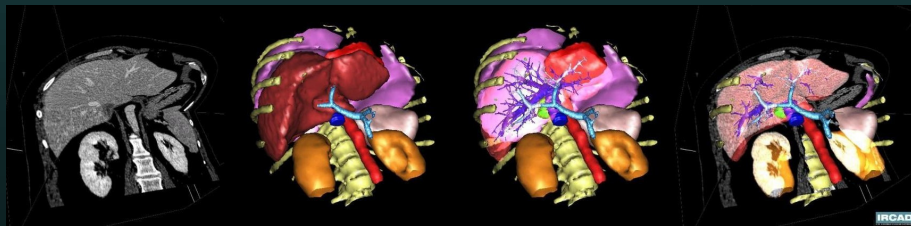
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MEDIC@ : 3D Modeling online service



> 500 patients from 4 hospitals since 2005



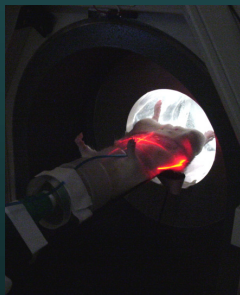
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3D Modeling of Small Animals

CT-Scan → **3D Model** → **No Sacrifice**



Idear → Save the soldat Rat

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RatDiology Department

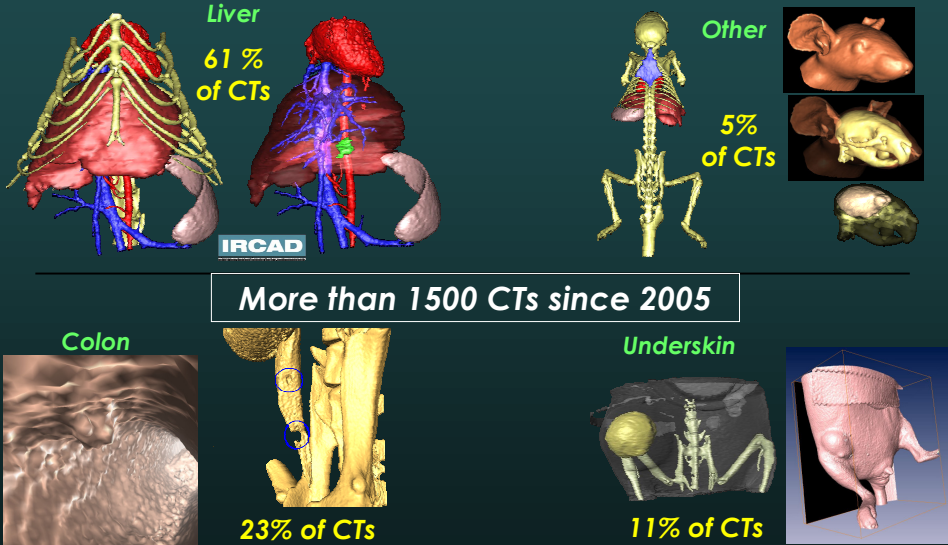


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RatDiology Department



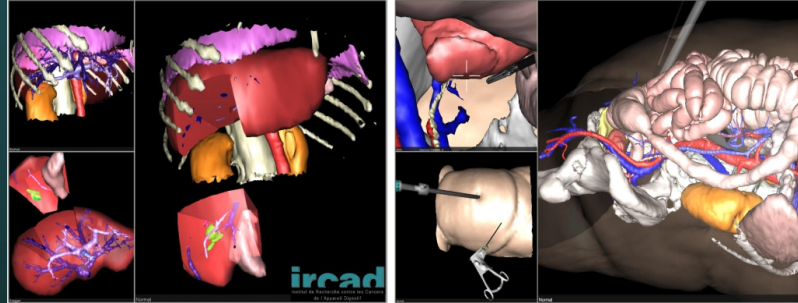
More than 1500 CTs since 2005

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Step 2: Virtual Surgical Planning



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Step 3: Surgical Simulators

- Patient Specific
- If possible preoperative

1. Ultrasonographic Guided procedure
2. Breath movements
3. Laparoscopic simulation

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Ultrasonography Simulation



From CT-scan of the patient

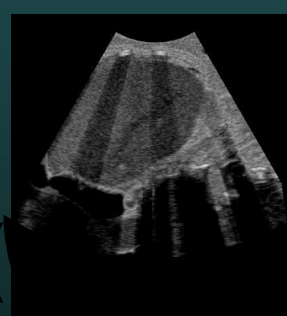
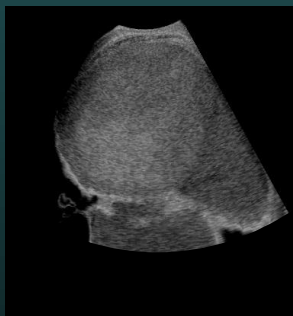
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Ultrasonography Simulation

Fully Realistic Rendering



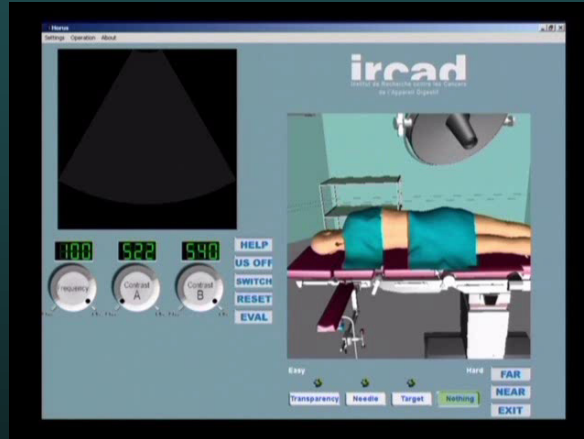
Real / Virtual ?

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Ultrasonography Simulation



Ultrasonographic Guided procedure
from CT-scan of the patient

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Ultrasonography Simulation



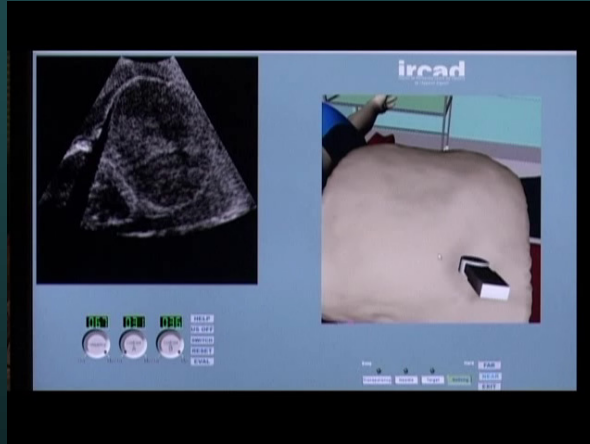
Sample of preoperative use in Strasbourg

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Ultrasonography Simulation



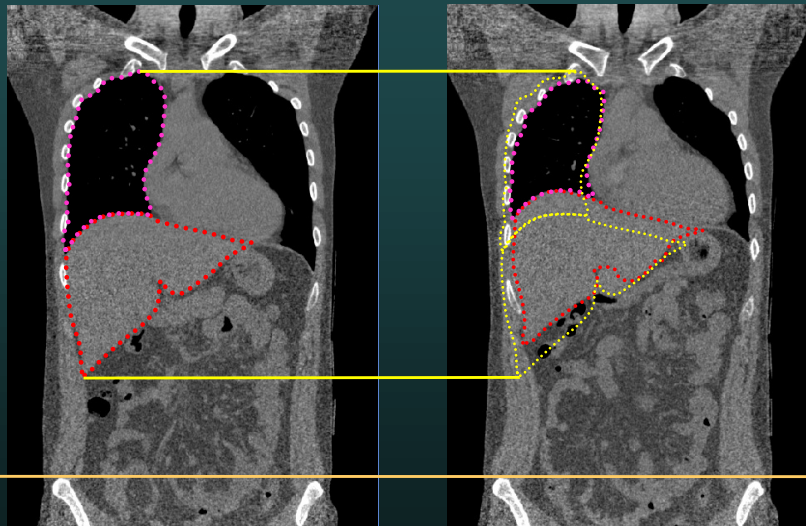
Ultrasonographic Guided procedure
from MRI of the patient

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Simulation of Breath movements

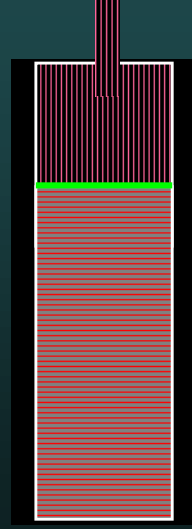
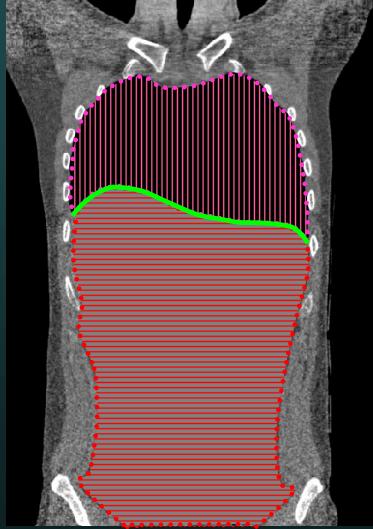


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Hypothesis → Non compressible area



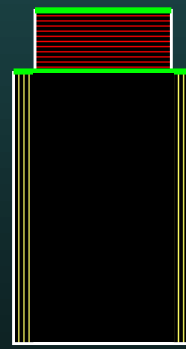
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Hypothesis → Non compressible area

$$\text{Vol } \text{■} = \text{Vol } \text{|||}$$



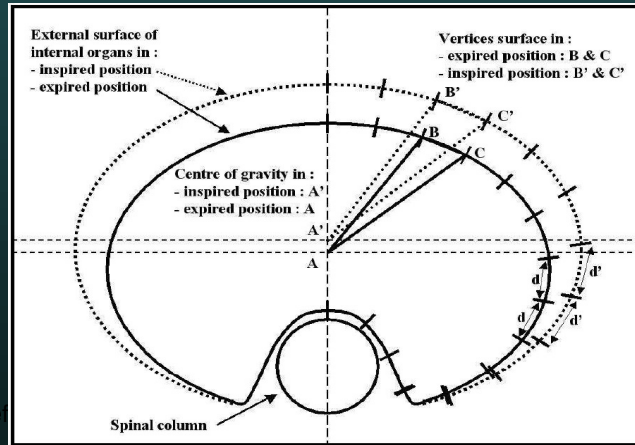
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Skin movement → Volume

Skin movements allow to compute a deformation field assuming the volume stability of the abdominal area

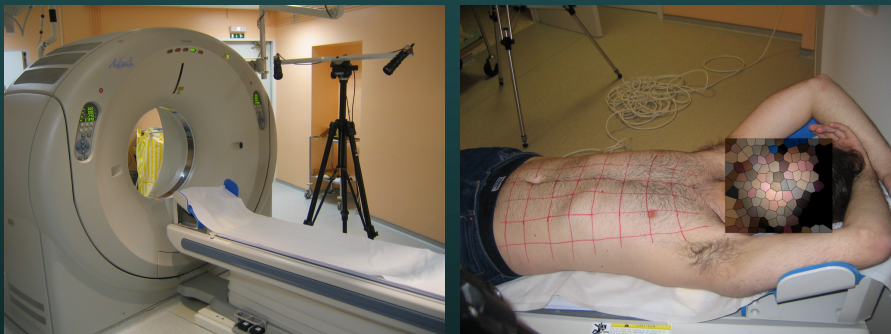


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Results



Set up for the human data acquisition

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Results



Set up for the human data acquisition



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Results

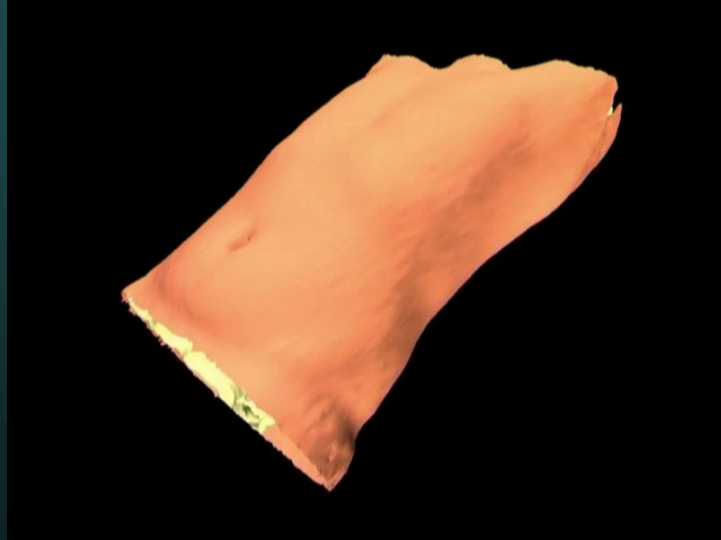


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Results

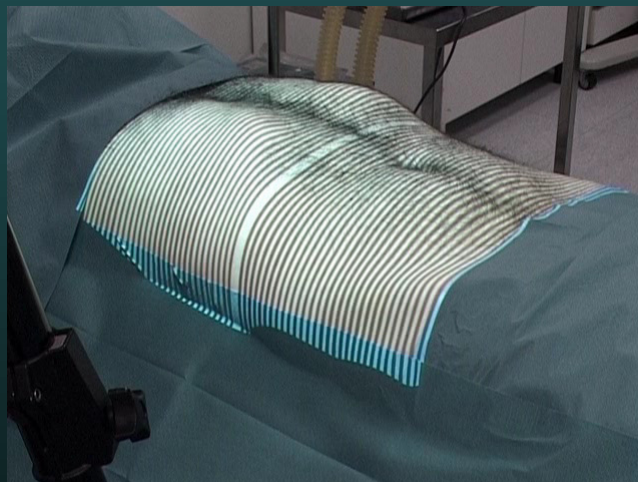


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Results

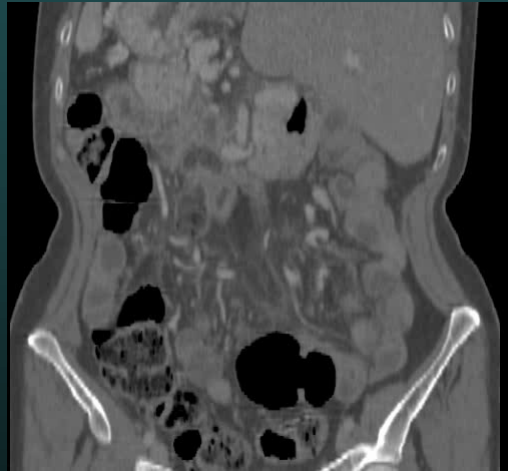


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Results



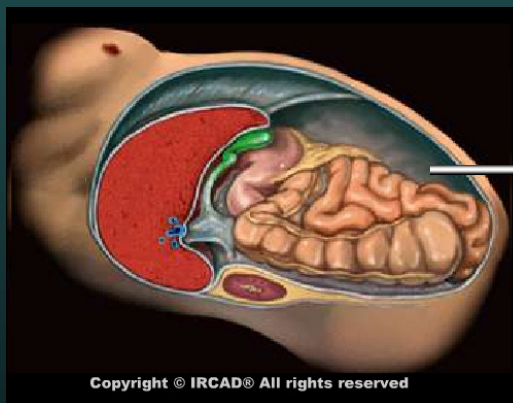
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Simulation of Gaz insuflation

Gaz insuflation + table orientation



Gaz Pressure is controlled

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Breath + Gaz deformations



Limits → ligaments linking organs & cavity

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Patient Specific Laparoscopy Simulation

Force Feed-Back System from Karl Storz



STORZ
KARL STORZ—ENDOSKOPE

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Patient Specific Laparoscopy Simulation



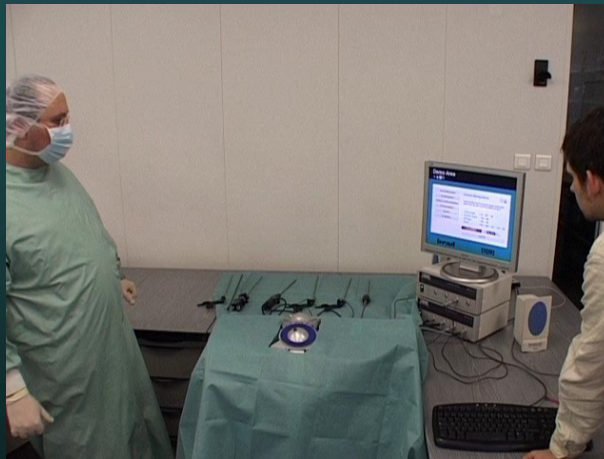
Photo-realistic laparoscopic simulator

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Patient Specific Laparoscopy Simulation



Basic Skill ULIS: **DIGITAL TRAINERS**

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Perspectives

More than realistic : Predictive simulation

Preoperative simulation

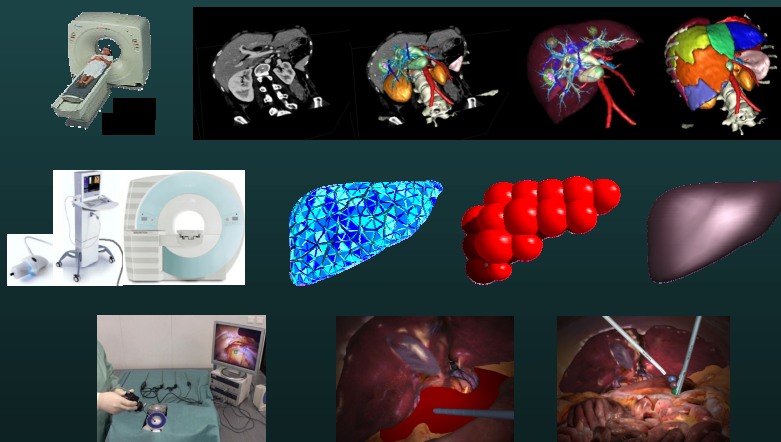
- High speed texture mapping
- Patient specific rheological data
- Connective tissue simulation
- Gravity simulation
- Real-time cutting and deformation
- Information merging in SOFA

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PASSPORT of Liver Surgery: 2008-2011 Patient Specific Simulation for Pre-Operative Realistic Training of Liver Surgery



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PASSPORT of Liver Surgery

France :

- IRCAD : coordinator
- INRIA : 4 teams
- ULP (IRMC)
- Digital Trainers

Germany :

- Karl Storz : Big company
- Leipzig university
- Munich University : CAMPAR

Belgium :

- UCL : DRU

England :

- Imperial college of London : VIP
- University College London : VIS

Switzerland :

- ETHZ : CVLab

Hospital pool :

- Strasbourg, Paris, Munich, London, Zurich, Lausanne, Brussels

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Thanks for your attention



R&D Team of IRCAD
in Computer Assisted Surgery

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