Patient Specific Surgical Simulation

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Current Education without patient

IRCAD: More than 3500 surgeons each year

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IRCAD: International Network

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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

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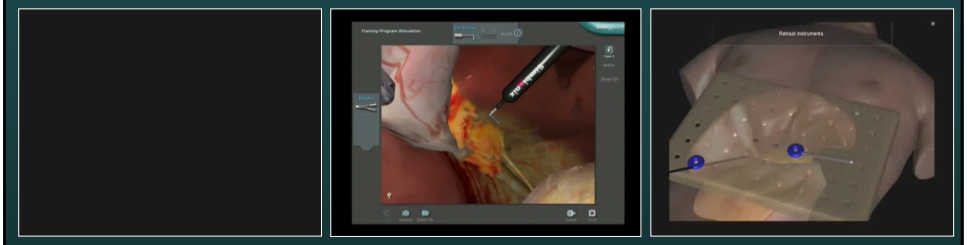
Current Surgical Simulators

©Surgical Science ©Simbionix ©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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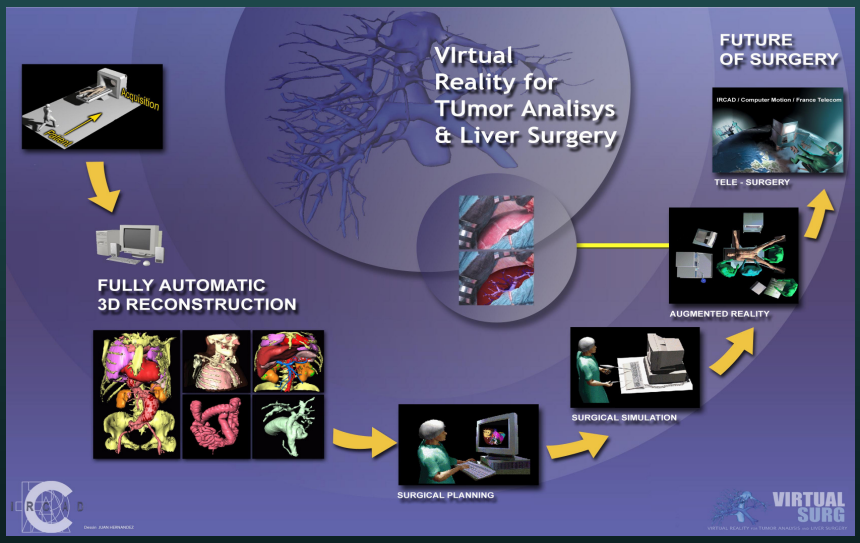
Computer Assisted Surgery



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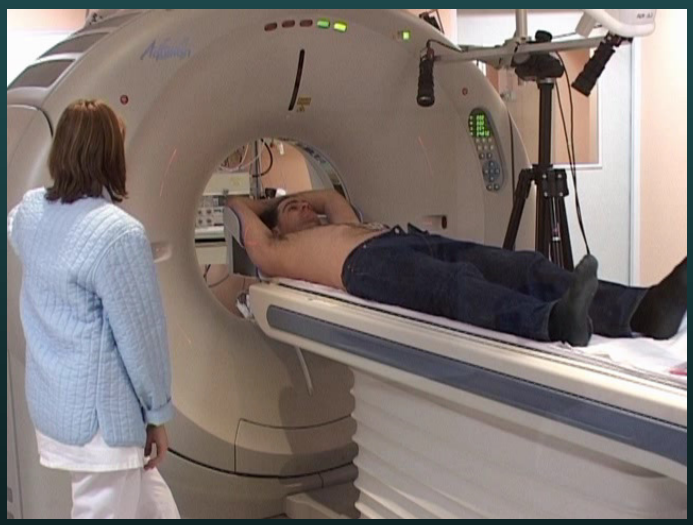
3D Modeling of Patients



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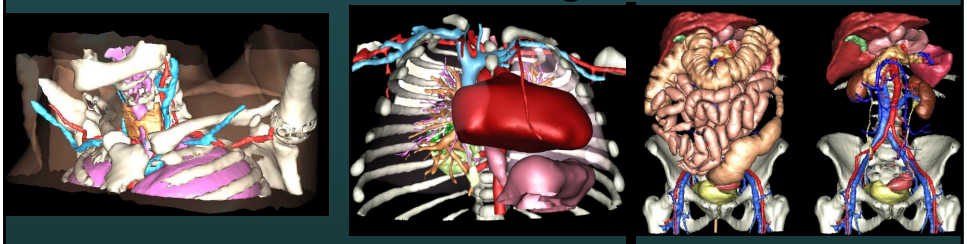
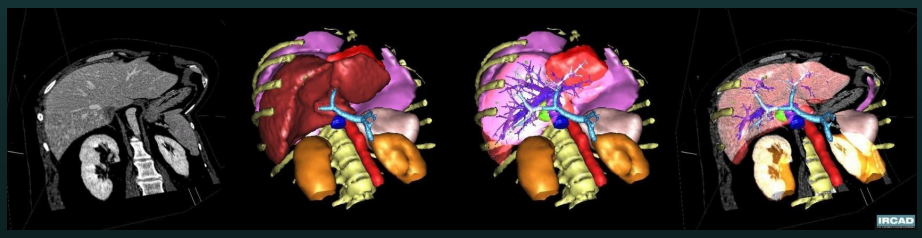
MEDIC@ : 3D Modeling online service



> 500 patients from 4 hospitals since 2005



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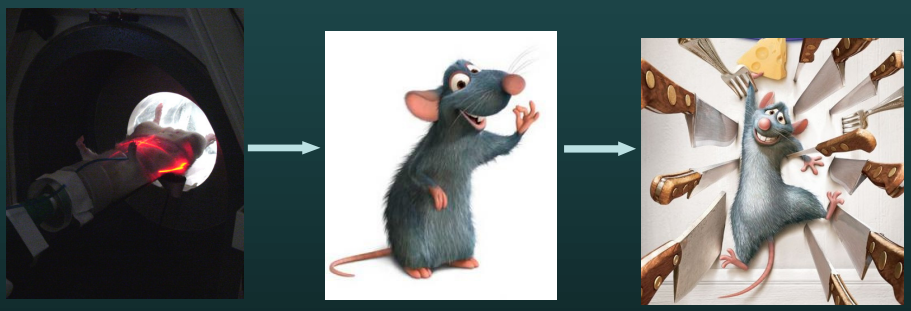
3D Modeling of Small Animals

CT-Scan → 3D Model → No Sacrifice



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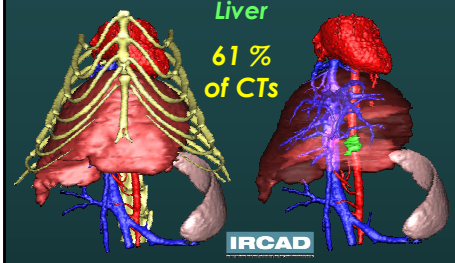
RatDiology Department

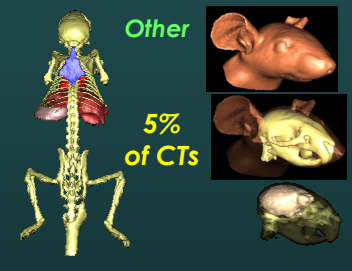
Liver

61 % of CTs



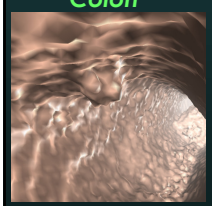
Other

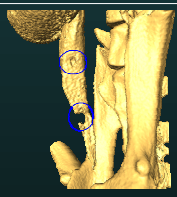
5% of CTs



More than 1500 CTs since 2005

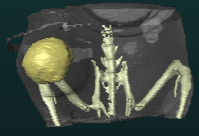
Colon



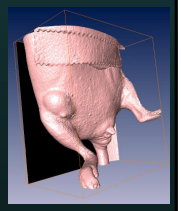


23% of CTs

Underskin



11% of CTs



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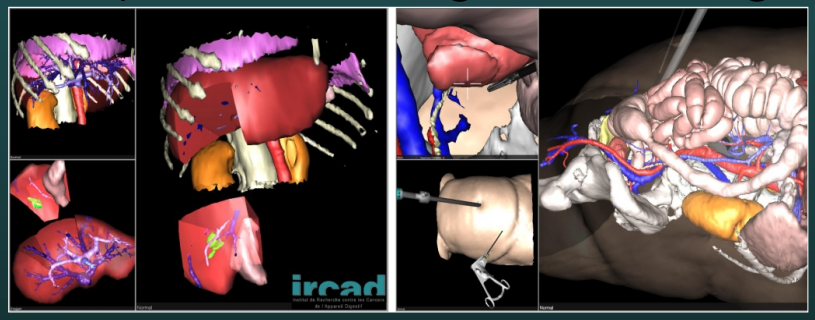
Step 2: Virtual Surgical Planning

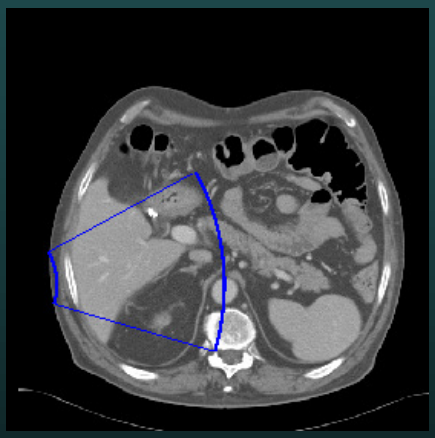


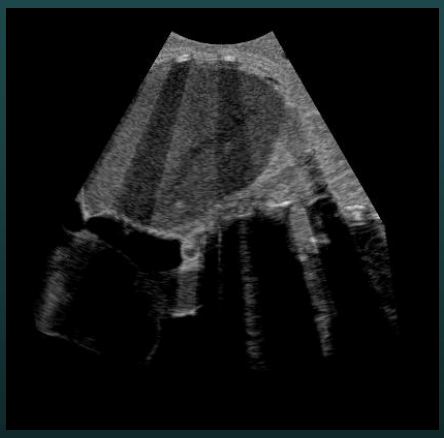
Step 3: Surgical Simulators

➔Patient Specific
➔ If possible preoperative

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

Ultrasonography Simulation

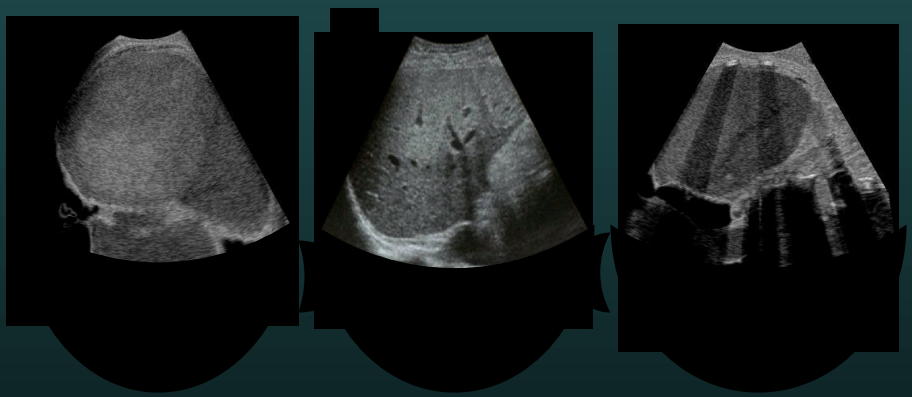




From CT-scan of the patient

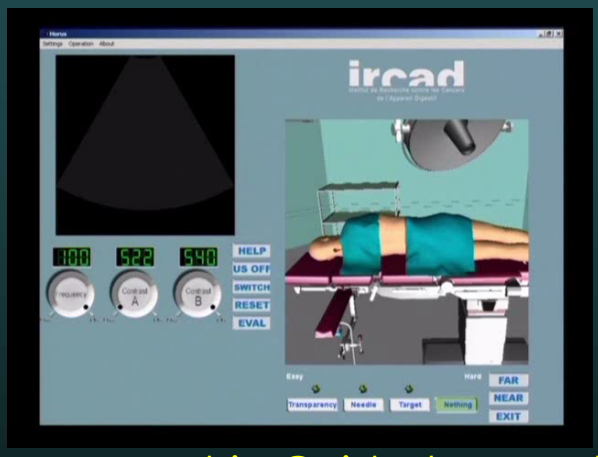
Ultrasonography Simulation

Fully Realistic Rendering



Real / Virtual ?

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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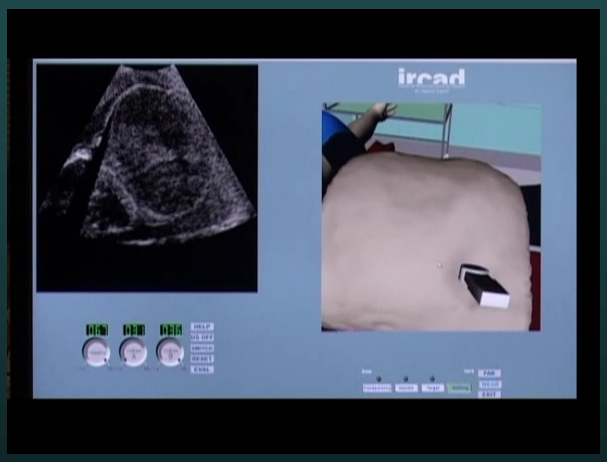
Ultrasonography Simulation



Ultrasonographic Guided procedure
from MRI of the patient

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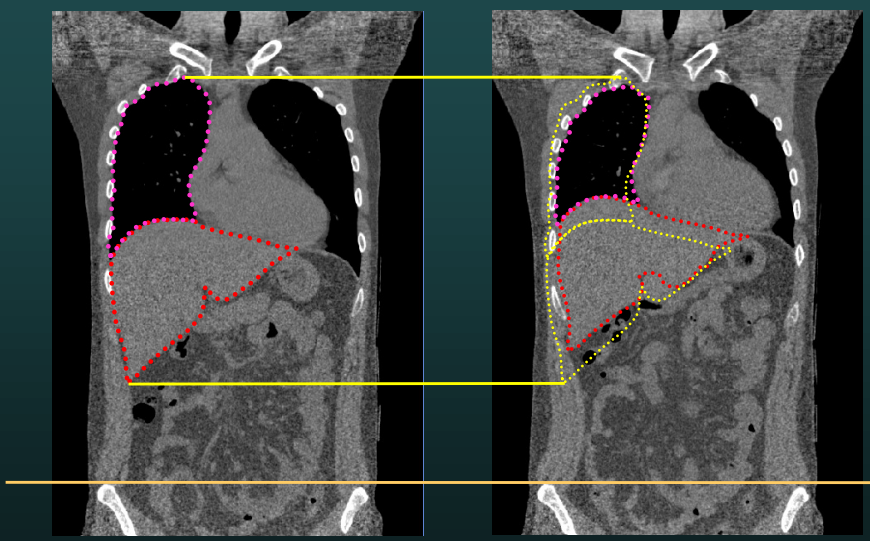
Simulation of Breath mouvements



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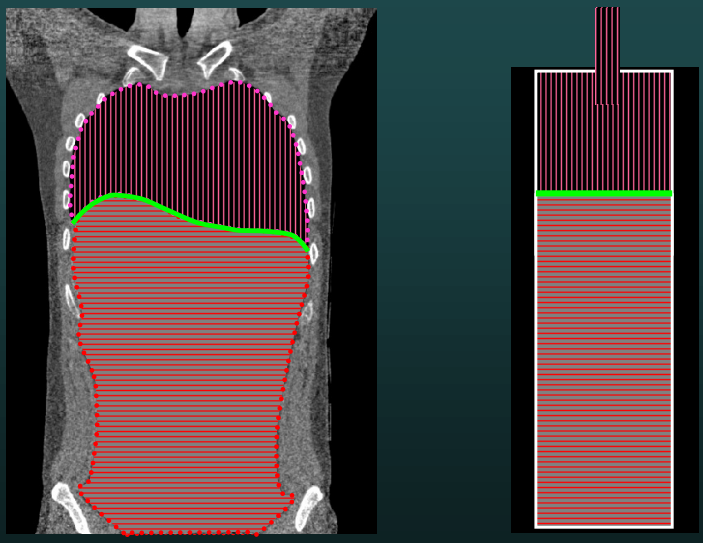
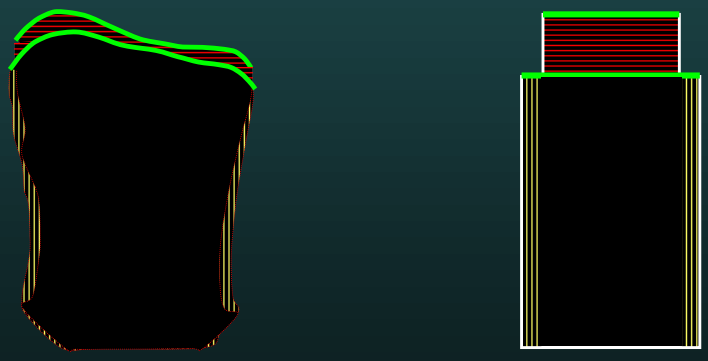
Hypothesis ➔ Non compressible area



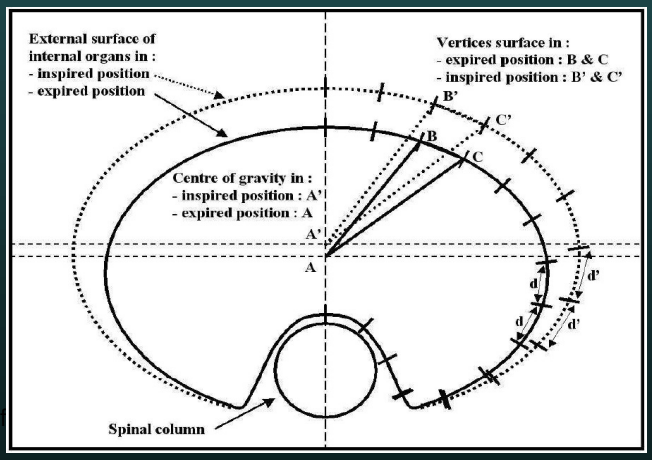
Hypothesis ➔ Non compressible area

Vol ▭ = Vol ▭



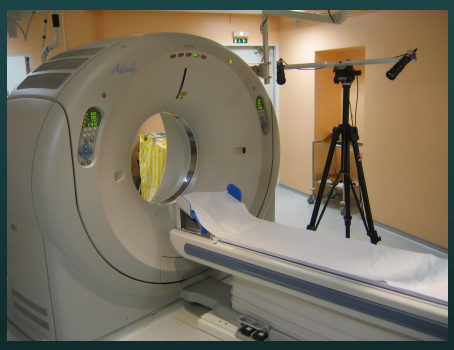
Skin mouvement ➔ Volume

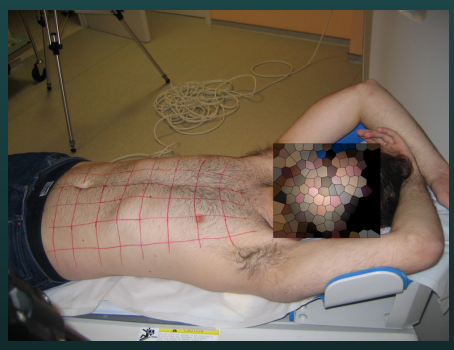
Skin mouvements allow to compute a deformation field assuming the volume stability of the abdominal area



Def

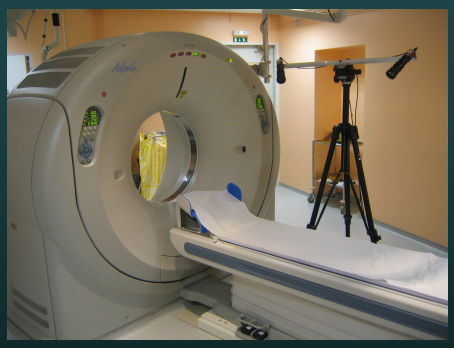
Results





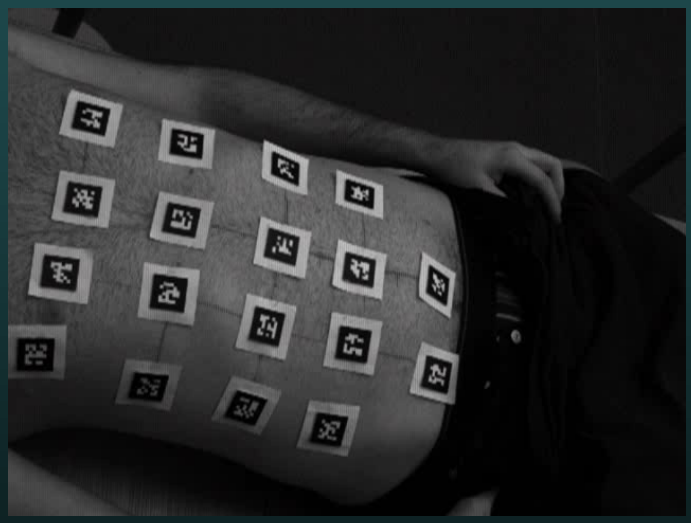
Set up for the human data acquisition

Results

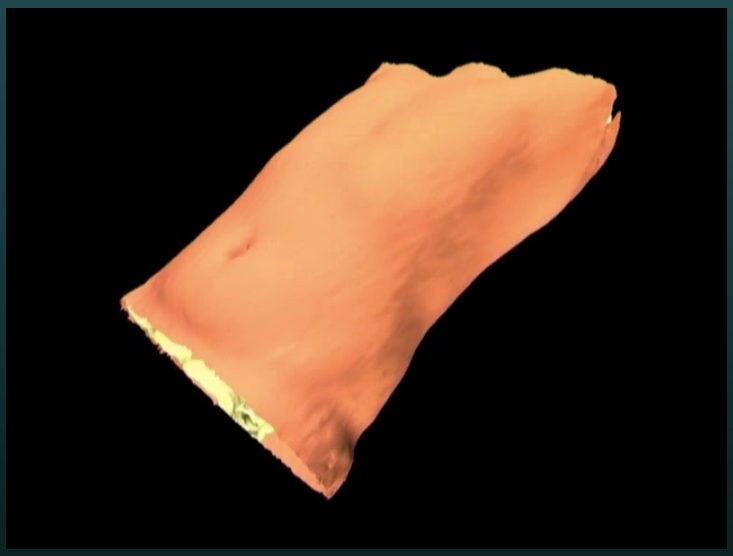


Set up for the human data acquisition

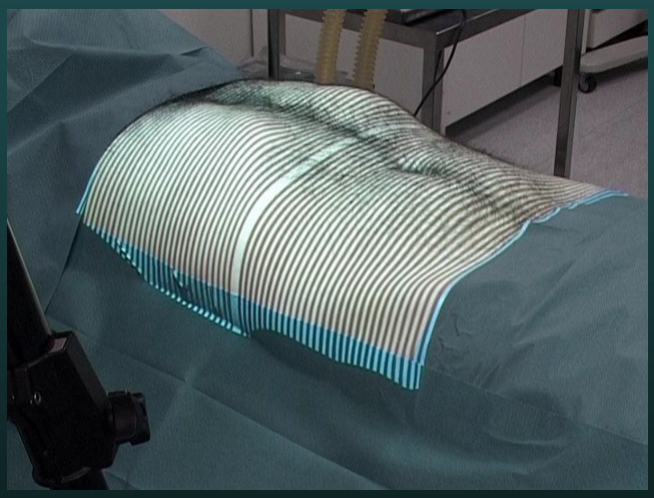
Results



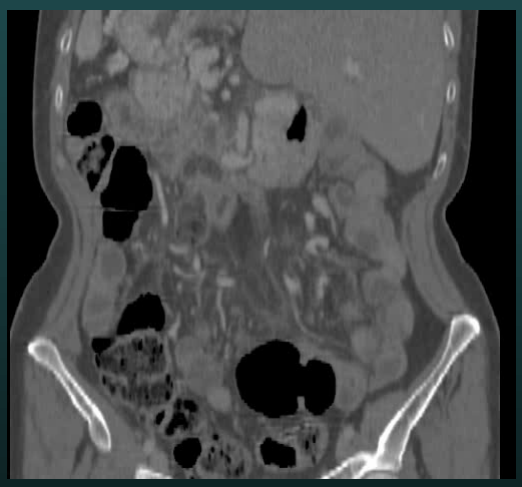
Results



Results



Results



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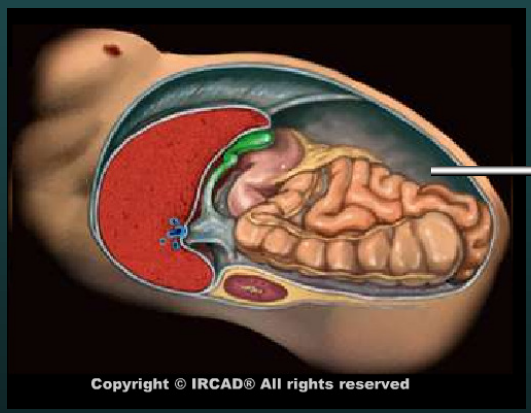
Simulation of Gaz insuflation

Gaz insuflation + table orientation



Gaz Pressure is controlled

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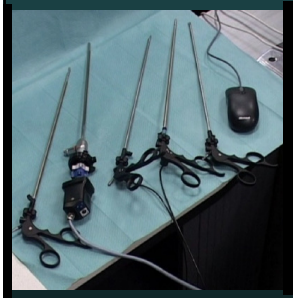
Breath + Gaz deformations

Limits ➔ ligaments linking organs & cavity

Patient Specific Laparoscopy Simulation

Force Feed-Back System from Karl Storz

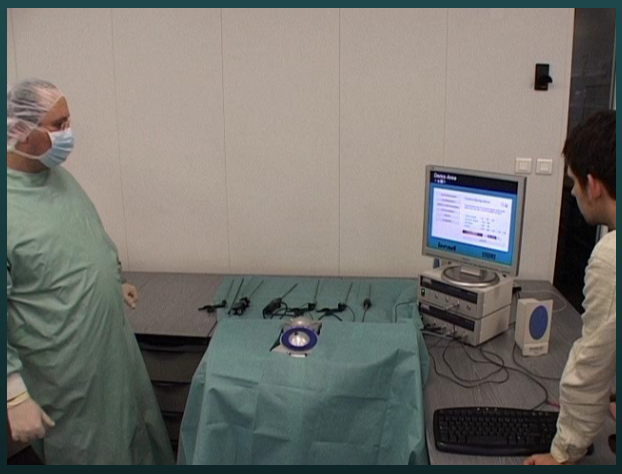


STORZ
KARL STORZ — ENDOSKOPE

Patient Specific Laparoscopy Simulation

Photo-realistic laparoscopic simulator

Patient Specific Laparoscopy Simulation



Basic Skill ULIS: **DIGITAL TRAINERS**

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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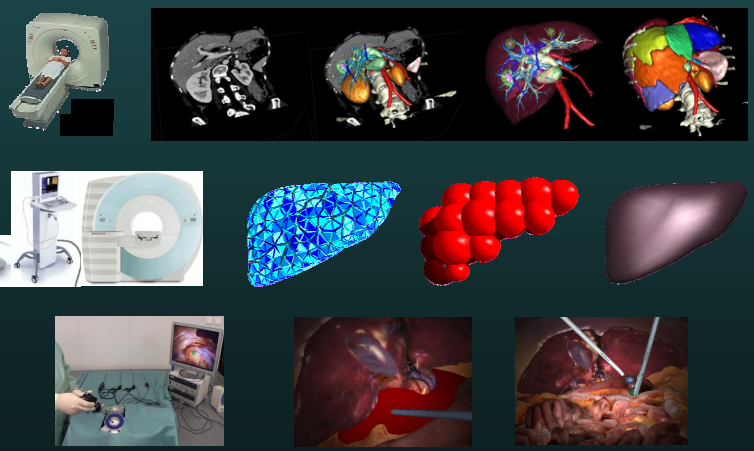
PASSPORT of Liver Surgery: 2008-2011

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
- Leipzich 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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