Research activity

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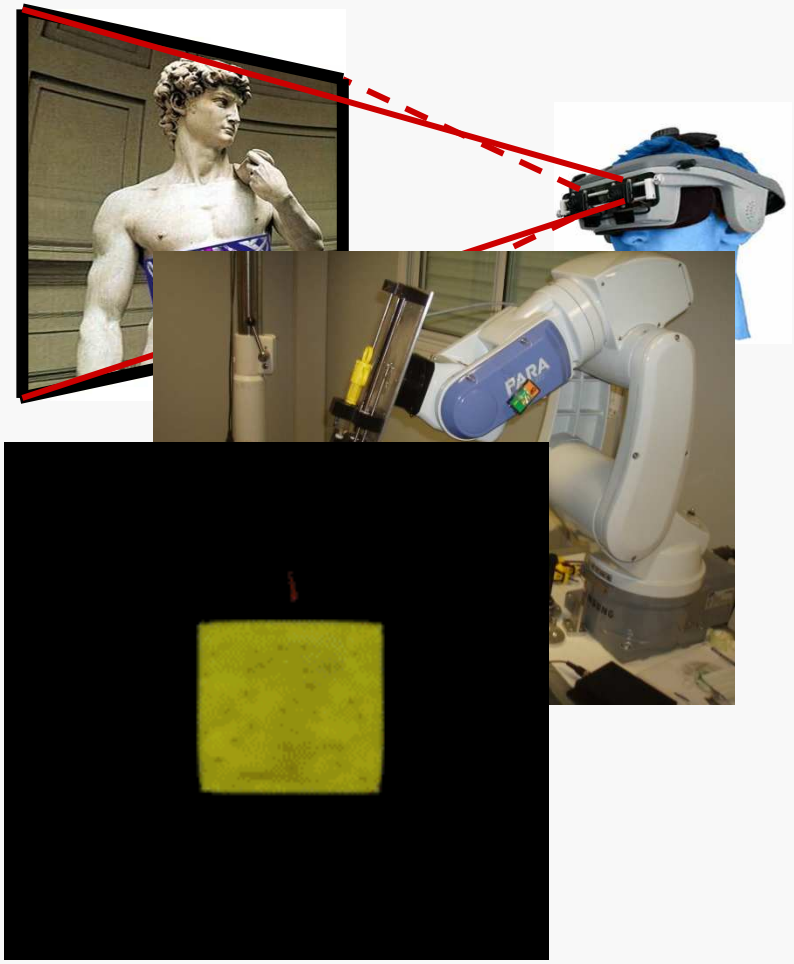
Current activities

- Surgical Navigators and Mixed Reality systems
- Robotic/mechatronic Instruments
- Simulation and Deformable Models
- Araknes project



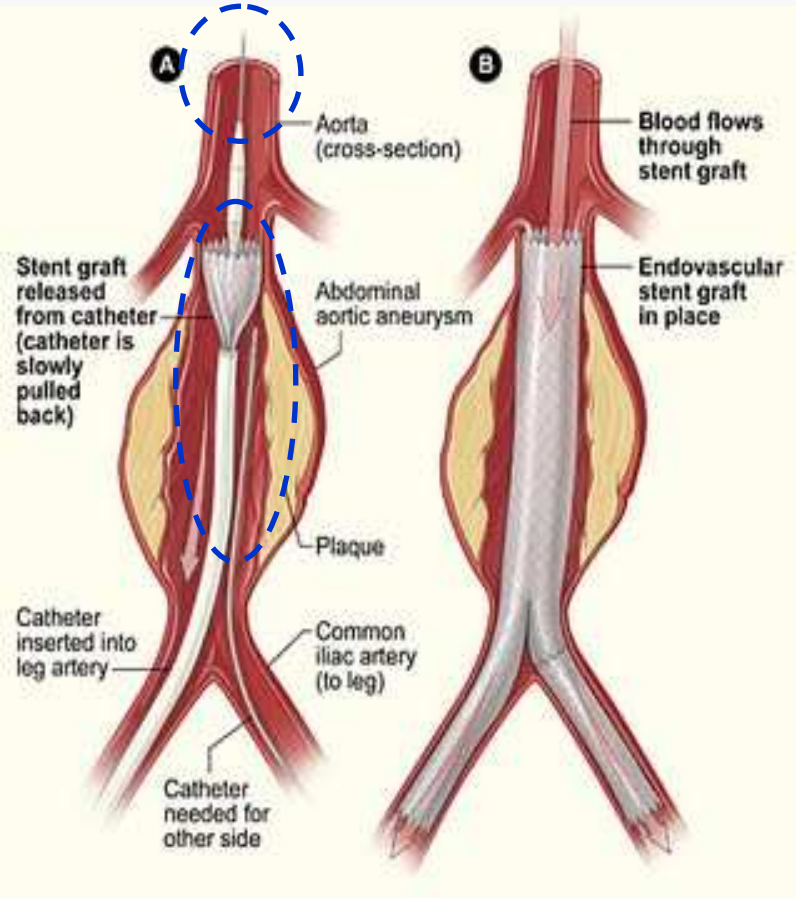
A.R.A.K.N.E.S.
Array of Robots Augmenting the KINematics of Endoluminal Surgery
Large-Scale Integrating Project (IP)-ICT-2007-2#224565
DURATION: 01.05.2008 > 30.04.2012

Endovascular Surgery

Endovascular surgery employs MIS techniques to relieve arterial obstructions or treat aneurysm using catheters under fluoroscopic guidance.

- *Advantages:*
  - Smaller incision
  - Local/regional anesthetics needed, not general anesthesia
  - Less need for blood products
  - Reduced stress on the heart
  - Reduced risks for patients with other diseases
  - Fast return of the patient to his/her normal life

- *Drawbacks:*
  - The patient and the medical staff are exposed to dangerous radiations
  - Contrast medium injection (to see the instruments) can cause adverse effects
  - Angiography offers projective images, which does not allow a 3D representation of the vascular structure



Endovascular Surgical Navigator

Aim:

- Reduce the exposure to X-rays and the injection of contrast medium
- Provide assistance in positioning and tracking of the instruments during endovascular interventions with a complete 3D visualization
- Minimize the potential human stress/error during operation

Specifications:

- Real-time tracking of surgical instruments
- Real-time visualization of the patient vasculature and surgical catethers:
  - 3D representation
  - Virtual endoscopic view
- Required precision: 2 mm (worst case)
- Intuitive and user friendly GUI

Modules of the navigation system

Preoperative Data

Patient

Image Acquisition

Segmentation

Surface extraction

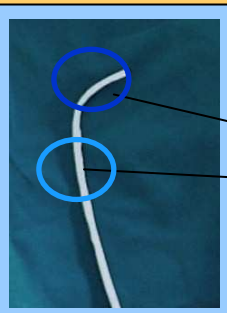
Patient specific 3D vessel model

Intraoperative Data

The electromagnetic localizer tracks the catheter.

Patient in the SR

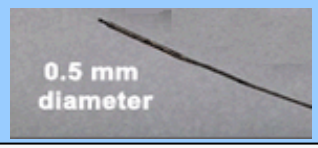
EM localizer



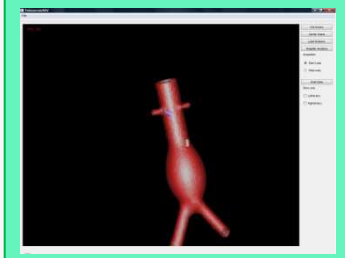
Sensorized Catheter

Position Errors	RMS
Position Accuracy	0.9 mm
Position Precision	0.6 mm
Position Trueness	0.7 mm
Orientation Errors	
Orientation Accuracy	0.3 degrees
Orientation Precision	0.1 degrees
Orientation Trueness	0.3 degrees

2 Sensor coils with 5 DOF
(0.5 mm x 8 mm)



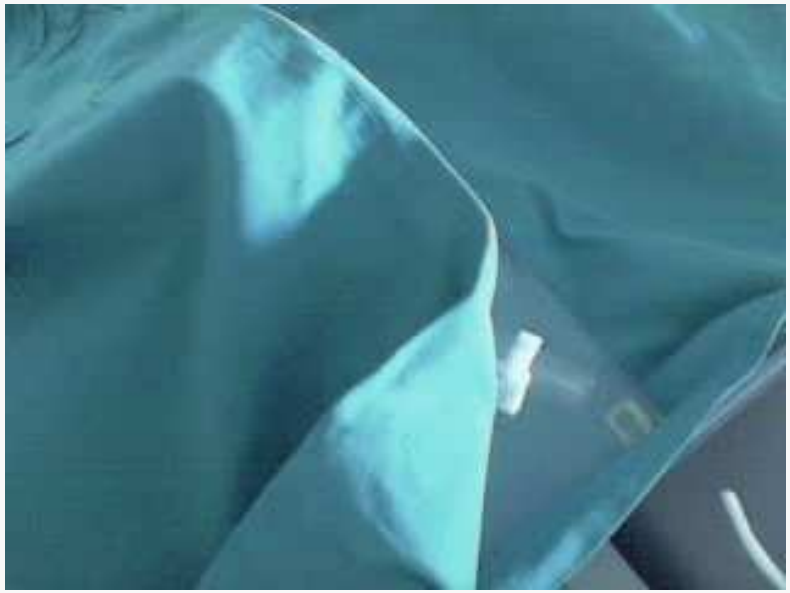
REGISTRATION MODULE:
Point based rigid registration

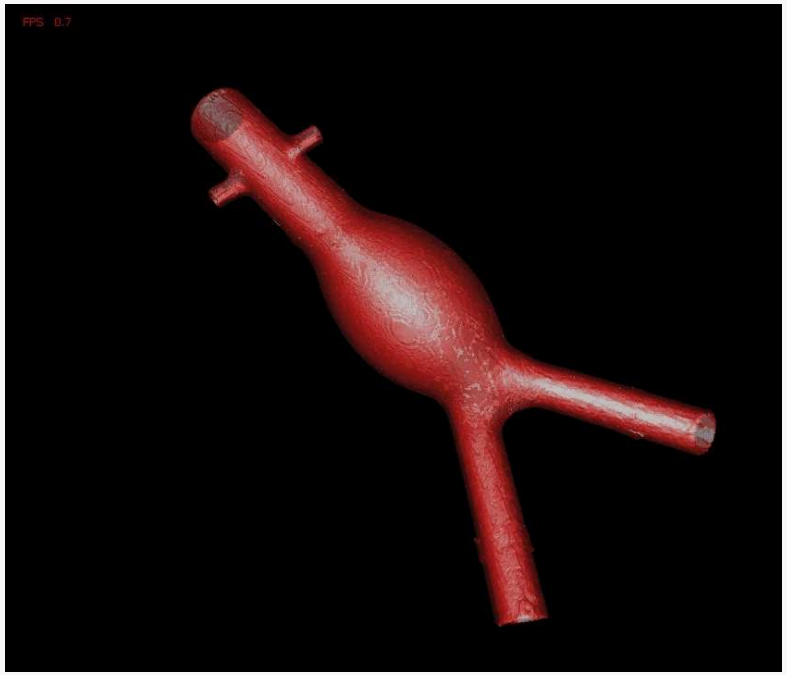


Graphical User Interface

Navigation system demonstration

Fluoroscopic image example





Future work

- In vitro and in vivo testing session of the current prototype
- Improvement of GUI functionalities adding virtual endoscopic view
- Enhancement of 3D vessel model realism through biomechanical modelling of arterial pulsation and breathing motion