Information Processing and Communications Laboratory (LTCI*)
Télécom Paris - SU & Necker

Replico (IMAG2-Endométriose)

#Anomatical3DModel #MRI #DeepLearning

TELECOM Paris

INSTITUT POLYTECHNIQUE DE PARIS

THE PROBLEM ADRESSED

Extending automatic segmentation algorithms developed on children's pelvic area to adult females suffering from endometriosis.

Anatomical 3D model combined with pelvic nerves modeling provides important information to understand the origin of the pain felt by the patients. It also improves high precision surgery planning, giving better results while avoiding damage on highly sensitive areas.

Close collaboration with surgeons and radiologists since 2015, to create the most precise patient specific 3D anatomical models of the pelvic area, including the nerves going through this region. This experience gives us a serious advantage compared to competitors.

TECHNOLOGY

- Two MRI sequences needed as input: a cube T2-weighted sequence for anatomical segmentation and a diffusion weighted MRI sequence for nerve modeling.
- State-of-the-art deep learning models for 3D segmentation and model creation of all anatomical structures and organs (bones, bladder, artery, etc.).
- Use of tractography algorithms on Diffusion MR Imaging to extract large sets of fibers.

- Tract nerve modeling, segmentation and recognition from these sets using our symbolic IA method based on fuzzy modeling and spatial reasoning.

COMPETITIVE ADVANTAGES

- Our automatic and deep-learning based segmentation methods are faster and more accurate than the ones of competitors.
- Nerves modeling and segmentation: key and original feature of our project. Nerves hold precious information for surgical planning to avoid any after-effect on patient's motricity.

APPLICATIONS

- Surgical planning: 3D models are helpful to define a surgical strategy (new visualization method, better understanding of the relations between organs and nerves, sparing surgery).
- Communication to patients: 3D models help the understanding of the surgical approach decided by the surgeons.
- Teaching: 3D anatomical models to train young surgeons.

PUBLICATIONS

- CO. Muller et al. J Ped Surg Case Reports 2019.
- G. La Barbera et al., Medical Image Anaysis 2023.
- I. Bloch et al. LFA 2024.

DEVELOPMENT STATUS

- Successful adaptation of the method to adults.
- Definition of regions of interest for nerves segmentation.
- Refinement of the nerves descriptions.
- First tests on data from different hospitals.
- Startup *Replico* created in 2025

INTELLECTUAL PROPERTY

- Patent "Automatic generation of 3D anatomical models" (EP 22307002.0). Expanding its use to adults and other anatomical regions.
- APP registered software (February 19th 2020) + ongoing update

INVENTORS & CONTACTS

- Sabine Sarnacki, Necker hospital
- Isabelle Bloch, Sorbonne Université
- Pietro Gori, Télécom Paris
- Giammarco La Barbera, Institut Imagine
- Enzo Bonnot, Télécom Paris, dedicated to this project
- Louis Marcellin, Cochin hospital
- Laure Fournier, HEGP hospital

LOOKING FOR

- Investors
- Expanding to new use cases
- Co-dev. and industrial partners