PhD Proposal

Growth and prediction of the hard and soft tissue geometries and behaviors using finite element modeling coupled with modern deep learning approaches

Context

Childbirth is a complex physiological process. The risks and possible complications of childbirth relate to several factors (high blood pressure, aging of the soft tissue, complex morphology of the baby, etc.).

Purposes

This PhD project aims to use geometric deep learning coupled with finite element method to model the skeleton and soft tissue growth during the shape-function metamorphosis processes. Regression models of shape versus age will be developed and evaluated to model the growth and age-related variability processes. State-of-the-art geometric DL methods will be followed to model the 3D shape change under a target function. Then, a coupling with other deep learning models (generative adversarial networks, regression and recurrent neural network, reinforcement learning) will be investigated to deal with the multimodal data and their temporal evolution. The clinical application deals with the prediction and prevention of complex complications of childbirth process.

Details

This PhD project is divided into the following tasks:

- State of the art of the modern deep learning, tissue growth and prediction
- FE model development for learning database construction: hard and soft tissues of the baby body
- Implementation and evaluation of the deep learning process to characterize the shape-function metamorphosis pathway and network
- Evaluation of the growth and prediction outcomes with experimental observation

Keywords: Biological tissue growth, childbirth, deep learning, numerical simulation

Candidate profile: Master in Biomedical Engineering / Mechanical Engineering / Computer Science
• Knowledge in numerical methods (e.g. finite element method), geometry processing, machine learning, deep learning
• Programming skills in Python

Funding: Doctoral program of the ENGSYS Doctoral School at *Centrale Lille*
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- CV
- Master transcript of records/grades and motivation letter
- Recommendation letter(s)

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