PhD Project

Dynamic MRI to study musculoskeletal system

Lab

Research at Telecom Bretagne involves nearly 500 people, including 160 teachers and researchers and 200 PhD students, and is on two axes: the axis of the information (from capture to restitution) and the communications infrastructure (the component system). It thus covers all disciplines (from the physical sciences to humanities and social sciences through those of information and knowledge) and covers all fields of science and information and communications technology.

The thesis will take place in the laboratory LaTIM (INSERM U1101), the Telecom Bretagne campus under the supervision of François Rousseau and Douraied Ben Salem.

Starting date: October 2016
Funding : INSERM - Télécom Bretagne, Région Bretagne

Project description

Cerebral palsy is the leading cause of child disability engine in France (2 births per 1000). This is a term for permanent developmental disorders of movement and posture, responsible of activity limitations caused by non-progressive damage occurring during brain development in the fetus or infant. Cerebral palsy movement disorders are characterized by control disorder, muscle weakness, abnormal muscle tone.

The ankle is the most common equine musculoskeletal strain in children with cerebral palsy. The muscle contractions associated with the defect bone growth impact directly on the march (on tiptoes) and therefore on the social integration of children. Despite medical and surgical therapies multiple, postoperative recurrence rate is still very high (48%). A major reason for therapy failure is the lack of knowledge of joint and muscle biomechanics, that is to say what is happening in mechanically bones, muscles and tendons in case of equine during 'a movement.

Dynamic MRI can be used to explore the musculoskeletal system during the movement in 3 dimensions of space with high precision (<1mm) [1]. Can we then improve functionality by rehabilitation or surgical correction with motor capability prediction from these new 3D information + t?

The work consists in three steps: 1) 3D+T MRI reconstruction [2,3], 2) extraction of morphological information [4,5], 3) biomechanical modeling and characterization of the disease. [6]

Profile

- Master degree in image processing or applied mathematics
- Required skills: statistics, programming (C++ & Python), medical imaging.

Net income/month : ~1500€

Contact

François Rousseau
email : francois.rousseau@telecom-bretagne.eu
www : http://perso.telecom-bretagne.eu/francoisrousseau

How to apply

Candidates are invited to email (to François Rousseau) a motivation letter and CV detailing in full your academic background, including all modules taken and grades assigned.

Bibliography

1. Clarke, E. C., Martin, J. H., d'Entremont, A. G., Pandy, M. G., Wilson, D. R., & Herbert, R. D. (2015). A non-invasive, 3D, dynamic MRI method for measuring muscle moment arms in vivo: Demonstration in the human ankle joint and Achilles tendon. *Medical Engineering and Physics*, *37*(1), 93–99. http://doi.org/10.1016/j.medengphy.2014.11.003
2. Rousseau, F., Glenn, O. A., Iordanova, B., Rodriguez-Carranza, C., Vigneron, D. B., Barkovich, A. J., & Studholme, C. (2006). Registration-Based Approach for Reconstruction of High-Resolution In Utero Fetal MR Brain Images. *Academic Radiology*, *13*(9), 1072–1081. http://doi.org/10.1016/j.acra.2006.05.003
3. Rousseau, F., Oubel, E., Pontabry, J., Schweitzer, M., Studholme, C., Koob, M., & Dietemann, J.-L. (2013). BTK: An open-source toolkit for fetal brain MR image processing. *Computer Methods and Programs in Biomedicine*, *109*(1), 65–73. http://doi.org/10.1016/j.cmpb.2012.08.007
4. Caldairou, B., Passat, N., Habas, P. A., Studholme, C., & Rousseau, F. (2011). A non-local fuzzy segmentation method Application to brain MRI. *Pattern Recognition*, *44*(9), 1916–1927. http://doi.org/10.1016/j.patcog.2010.06.006
5. Rousseau, F., Habas, P. A., & Studholme, C. (2011). A Supervised Patch-Based Approach for Human Brain Labeling. *IEEE Transactions on Medical Imaging*, *30*(10), 1852–1862. http://doi.org/10.1109/TMI.2011.2156806
6. Studholme, C., & Rousseau, F. (2014). Quantifying and modelling tissue maturation in the living human fetal brain. International Journal of Developmental Neuroscience : the Official Journal of the International Society for Developmental Neuroscience, 32, 3–10. http://doi.org/10.1016/j.ijdevneu.2013.06.006