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Advanced super-resolution reconstruction methods for quantitative magnetic resonance imaging of the developing fetal brain (3 open positions)

Location: This project will take place in the Center for BioMedical Imaging (CIBM) and the Department of Radiology at the Lausanne University Hospital (CHUV) and the University of Lausanne (UNIL) in Switzerland.

Start date: January 2019 (roughly)

Project description: Today, there is an increasing awareness that early brain development has an influence on health later in life. However, the study of brain maturation in vivo is challenging as it involves several complex intertwined processes. Quantitative MR imaging (qMRI) has gained a lot of attention in recent years and was shown to provide sensitive information on subtle changes in brain tissue after birth. Combining this sensitivity with super-resolution techniques adapted to prenatal imaging would allow high-resolution 3D quantitative MR imaging of the fetal brain, presenting a great opportunity to learn and understand more about the processes governing early brain maturation in utero.

The main goal of this project is to develop advanced quantitative imaging techniques for studying the maturation of the human brain in its early stages of development, when it undergoes the most significant changes. To this end, we will conceive and implement new SR reconstruction methods in conjunction with novel segmentation and MR image acquisition schemes. Specifically we will develop (i) an integrated reconstruction and segmentation framework for T2w fetal imaging, (ii) a SR framework for the reconstruction of diffusion MR images (dMRI), and (iii) new qMRI sequences for T1 and T2 mapping of the fetal brain.

This project is funded by the Swiss National Science Foundation (SNSF 205321_182602), total duration of 48 months, **three research positions are currently available**: **2 PhD students and 1 post-doc**.

Research environment: This project is hosted at Medical Image Analysis Laboratory (MIAL), lead by Dr M. Bach Cuadra, of the Radiology Department and Center for Biomedical Imaging (CIBM) of the Lausanne University and University Hospital (CHUV/UNIL). MIAL is a group of ~10 engineers with the aim at develop novel image processing methods to allow a more effective use of emerging medical images, balanced between fundamental research aspects of image processing and application-oriented projects. We have access to several state-of-the-art clinical MRI scanners, and we have active collaborations with the CHUV departments of Radiology, Neurology, Neurosurgery, and Cardiology as well as with the ACIT Siemens and EPFL.

This project will be held in collaboration with the Radiology Department at CHUV (lead by Prof. R. Meuli), the MR CHUV CIBM unit (lead by Prof. M. Stuber), Universitäts-Kinderspital Zürich (KISPI), Center for MR-Research (Dr A. Jakab) and ACIT group at Siemens Healthineers Switzerland (lead by Dr. T. Kober).

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Post-doctoral researcher in MR physics for « Quantitative MR imaging of the *in-vivo* fetal brain »

We are looking for a research and development engineer, for four years post-doctoral position (annual renew of the contract) at the Medical Image Analysis Laboratory of the Radiology Department and Center for Biomedical Imaging, **Lausanne University**. This position includes a strong collaboration with CIBM-CHUV-MR.

Description: We look for a post-doctoral researcher versatile both in MRI physics/sequence programming and image processing, dedicated to the development of MR sequences aimed at quantitative T1 and T2 mapping of the fetal brain. Moreover, the post-doc will be responsible to define and guide an adequate modification of a fetal phantom and a fetal motion simulator. The candidate will further be responsible to conduct all in vitro scanning. together with the 2 PhD students allocated to this project).

Profile:

- MSc and PhD completed in mathematics, MR physics, electrical engineering or equivalent.
- At least 3 years of research experience in the field of MR physics, sequence development and image reconstruction.
- Strong background in inverse problems and regularization as well as in MR physics.
- Knowledgeable in IDEA programming environment of the Siemens MR scanners and basic experience in sequence programming.
- Strong programming skills, good knowledge of C++, Python, Matlab and neuroimaging software will be a plus.
- Hands-on experience with in vitro and in vivo MR scanning
- Excellent verbal and written skills in English.
- Rigorous work habits, a curious and critical mind, and a good sense of initiative.
- A high-level perseverance and a strong personal commitment are expected.
- Experience in student and/or researchers supervision.

We offer:

- a multidisciplinary project between cutting-edge brain imaging and advanced image processing, MR physics, and clinical context.
- an extremely stimulating field of research within a highly specialized and qualified scientific environment.
- Access to state-of-the-art clinical MRI scanners.

Gross salary (pre-employer/employee tax): In compliance with Swiss National Science Foundation and UNIL.

Successful applications are **subject to academic approval from the UNIL.**

To apply: If you recognize yourself in this profile and want to take up a new challenge, address your complete application (CV, list of publications and 2 references) **before December 9th 2018** to: Meritxell.BachCuadra@unil.ch, with "SNF – Fetal" in the mail subject.

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2 PhD student researchers for « Quantitative MR imaging of the *in-vivo* fetal brain »

We are looking for two motivated students for a PhD candidacy positions (4 years funding with annual renewal of contract) at the Medical Image Analysis Laboratory of the Radiology Department and Center for Biomedical Imaging, **Lausanne University**.

Description: We look for two PhD student candidates that will work jointly with a post-doctoral researcher expert in MR physics and under the direction of Dr. Meritxell Bach Cuadra. The two PhD thesis projects are:

(i) the development machine learning segmentation methods for the fetal brain analysis and their integration to a joint segmentation-super-resolution reconstruction of T2-weighted and T2 quantitative images of the fetal brain.

(ii) The development of an image processing pipeline for the super-resolution reconstruction of diffusion fetal brain MRI, including the exploration of new acquisition schemes on phantom data.

Your profile:

- You should have a master's (MSc) degree in physics, computer science, or electrical engineering, or similar degree with an equivalent academic level.
- A genuine interest in signal and image processing and machine learning techniques is a must.
- Strong mathematical background.
- Good programing skills in C++, ITK and Python (knowledge of MevisLab is a plus).
- Prior exposure to medical imaging and or neuroimaging is a plus.
- Good skills in English (oral and written).
- Rigorous work habits, a curious and critical mind, and a good sense of initiative.
- A high-level perseverance and a strong personal commitment are expected.

We offer:

- a multidisciplinary project between cutting-edge brain imaging and advanced image processing, MR physics, and clinical context.
- an extremely stimulating field of research within a highly specialized and qualified scientific environment.
- Access to state-of-the-art clinical MRI scanners.

Gross salary (pre-employer/employee tax): in compliance with Swiss National Science Foundation and UNIL.

Successful applications are subject to **academic approval from the UNIL and Doctoral School**; the selected candidate will be enrolled in Life Science Doctoral School at UNIL.

To apply: If you recognize yourself in this profile and want to take up a new challenge, address your complete application (CV, list of publications and 2 references) **before December 9th 2018** to: Meritxell.BachCuadra@unil.ch, with "SNF – Fetal" in the mail subject.