# Flow pulsatility in brain arteries measured by magnetic resonance imaging

**Background:** Advances in magnetic resonance imaging has promoted development of fast and accurate time resolved flow measurements (4D FLOW). These measurements allow comprehensive assessments of cerebral hemodynamics in large and medium sized arteries/veins and has numerous potential applications ranging from stroke to dementia. To fully utilize the capacity of 4D FLOW it is necessary to develop algorithms for accurate vessel segmentation. Ideally, such algorithms should function automatically, with minimized user interaction. In this project, the goal is to implement and evaluate two approaches to measure flow in distal cerebral arteries. Specifically, a novel more automated method that potentially provides more noise free estimates will be tested towards a conventional manual procedure. The current project will be performed in an internationally well known multidisciplinary research environment with engineers and medical doctors highly involved in the research questions.

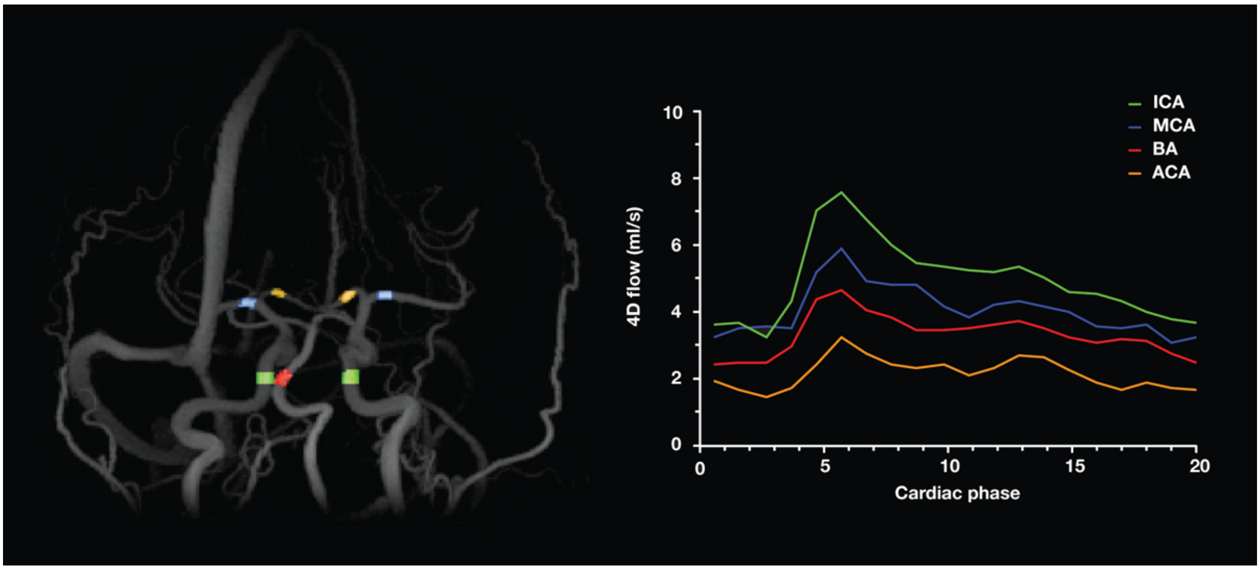

Figure. Cerebral arteries imaged by the 4D FLOW sequence.

**Purpose:** The main purpose of this project is to implement and evaluate a new method for measuring flow pulsatility in 4D FLOW magnetic resonance imaging data.
**Material and methods:** 3-Tesla scanner (GE Discovery MR 750, Waukesha, WI) 4D flow data from healthy elderly and stroke patients.
**Work description:** The present project represents a clearly described task, with an academic level and scope that suits a 30 hp master thesis. The project steps include:

- A survey of contemporary academic literature in the field.
- Data assessment
- Implementation of measurement algorithm
- Evaluation of algorithm performance
- Report writing, oral presentation.


Contact:
Anders Wåhlin, PhD in biomedical engineering. Anders.wahlin@radfys.umu.se
Anders Eklund, professor of biomedical engineering. Anders.eklund@vll.se

# Venous flow from the brain measured by magnetic resonance imaging

**Background:** Advances in magnetic resonance imaging has promoted development of fast and accurate time resolved flow measurements (4D FLOW). These measurements allow comprehensive assessments of cerebral hemodynamics in large and medium sized arteries/veins and has numerous potential applications in a range of diseases. To fully utilize the capacity of 4D FLOW it is necessary to develop algorithms for accurate vessel segmentation. Ideally, such algorithms should function automatically, with minimized user interaction. In this project, the goal is to explore the potential use of 4D FLOW to map cerebral venous drainage patterns in healthy subjects and disease. Ideally, new theoretical knowledge as well as potential automated measurement approaches should be presented. The current project will be performed in an internationally well known multidisciplinary research environment with engineers and medical doctors highly involved in the research questions.

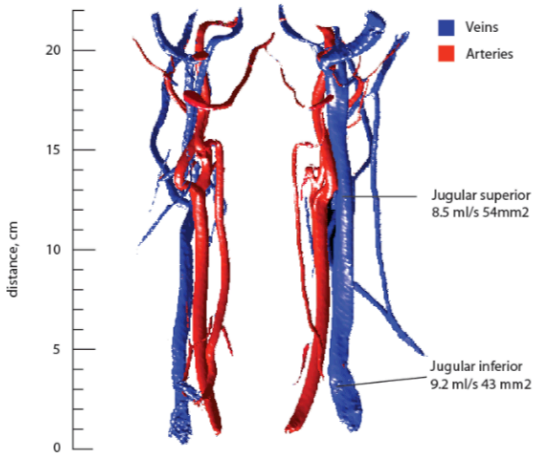


Figure. Cerebral venous drainage rendered using 4D FLOW data.

**Purpose:** The main purpose of this project is implement and evaluate a new method for measuring venous flow in 4D FLOW magnetic resonance imaging data.
**Material and methods:** 3-Tesla scanner (GE Discovery MR 750, Waukesha, WI) 4D flow data from healthy elderly and stroke patients.
**Work description:** The present project represents a clearly described task, with an academic level and scope that suits a 30 hp master thesis. The project steps include:

- A survey of contemporary academic litterature in the field.
- Data assment / Implementation of measurment algorithm
- Evaluation of algorithm performance.
- Report writing, oral presentation.


Contact:
Anders Wåhlin, PhD in biomedical engineering. Anders.wahlin@radfys.umu.se
Anders Eklund, professor of biomedical engineering. Anders.eklund@vll.se

# Mapping brain connectivity using magnetic resonance imaging

**Background:** Spontaneous brain activity can be observed using magnetic resonance imaging as coherent temporal fluctuations in the blood oxygenation level dependent (BOLD) MRI signal, a tool frequently used in neuroscience to examine how the brain works and how this is altered with aging and dementia. Initial observations have defined some reproducible patterns of spontaneous brain activity related to sensory, motor and higher cognitive functions. There is however much more richness in these data that require new tools that can turn BIG DATA to meaningful parameters with a clear interpretation. In the current project a neuroimaging pipeline will be developed that produces stable estimates of every potential and relevant co-activation in the brain  (i.e. the full connectome) . The pipeline will then be used to describe how and where variations between healthy subjects occur and where such variations between subjects are less pronounced.

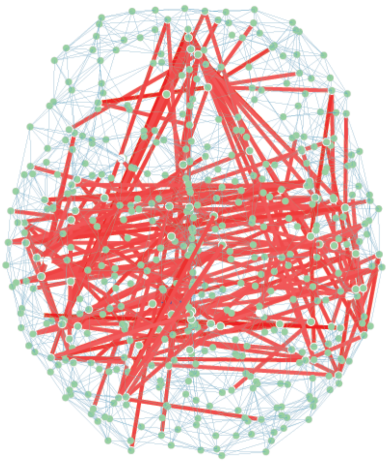

Figure. Brain connectome alteration in stroke subjects with a perceptual disorder.

**Purpose:** Develop a new neuroimaging pipeline towards connectome analyses.

**Material and methods:** Resting BOLD scans, 3-Tesla scanner (GE Discovery MR 750, Waukesha, WI).
**Work description:** The present project represents a clearly described task, with an academic level and scope that suits a 30 hp master thesis. The project steps include:

- A survey of contemporary academic literature in the field.
- Data assessment / Implementation of connecome algorithm
- Evaluation of algorithm performance, examining individual differences in the connectome
- Report writing, oral presentation.

Contact:
Anders Wåhlin, PhD in biomedical engineering. Anders.wahlin@radfys.umu.se

# Segmentation of brain ventricles using magnetic resonance imaging

**Background and aim:**
Measuring the size of cerebral ventricles, a water filled cavity in the brain, is a key diagnostic component in diagnosing Hydrocephalus, a treatable form of dementia. Simplified, one-dimensional measure have been developed as a quick tool in routine neuroimaging but now there is a need for objective methods capable of measuring the actual volume of the ventricular system. In this project, automatic ways of assessing brain structure as well as ventricular volume from magnetic resonance images will be explored. Beyond understanding the performance of such methods to quantify brain and ventricular volume, emphasis will be made on identifying key regions that seem most sensitive to deformation related to the Hydrocephalus disease.

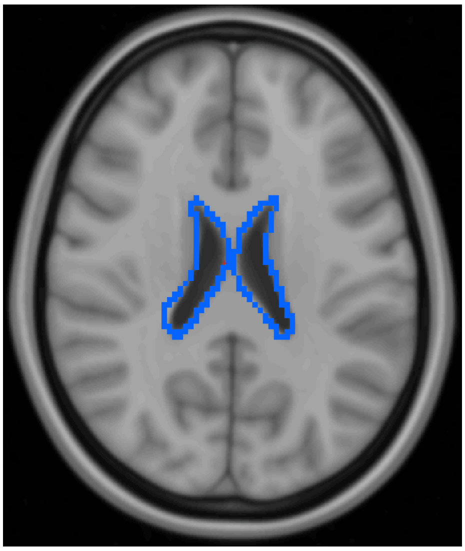

Figure. The brain ventricles outlined in a MRI scan.

**Material and methods:** Anatomical MRI data 3-Tesla scanner (GE Discovery MR 750, Waukesha, WI) from r
**Work description:** The present project represents a clearly described task, with an academic level and scope that suits a 30 hp master thesis. The project steps include:

- A survey of contemporary academic literature in the field.
- Data assessment / Implementation automatic segmentation tools (potentially including FreeSurfer, FSL and VBM).
- Evaluation of algorithm performance and describing deformation features most specific/sensitive to Hydrocephalus.
- Report writing, oral presentation.

Contact:
Anders Wåhlin, PhD in biomedical engineering. Anders.wahlin@radfys.umu.se
Anders Eklund, professor of biomedical engineering. Anders.eklund@vll.se