LREN
Laboratoire de Recherche en Neuro-Imagerie

2015
Annual Report

Laboratoire de Recherche en Neuro-Imagerie

Department of Clinical Neurosciences, CHUV

Faculty of Biology and Medicine, UNIL

UNIL | Université de Lausanne

CHUV Centre hospitalier universitaire vaudois

EDITORIAL

On behalf of the members of the imaging neuroscience laboratory LREN at the Department of Clinical Neurosciences - CHUV, we present the Annual Report for the year 2015.

In 2015 we continued building up on the solid base of top quality translational research oriented strategy that resulted in a number of scientific publications in high impact journals - Brain, Molecular Psychiatry, NeuroImage, Human Brain Mapping, to name a few. With a total of more than 30 peer reviewed papers, we maintained an excellent track record in the field of imaging neuroscience focused on brain health and disease.

2015 saw renewed efforts to participate in big research initiatives related to brain health in the general population. Supported by the Directorate of the CHUV (Pr PF Leyvraz) and the Department of Clinical Neurosciences (Pr Ph Ryvlin) we took the leadership in the brain imaging initiatives supported by the Swiss National Science Foundation – the longitudinal cohort CoLaus (PI Pr M Preisig) and the project NCCR Synapsy (PI Pr. P Magistretti) with more than 1000 research participants of these two projects passing an MRI exam in 2015.

The launch of the Medical Informatics Platform of the Human Brain Project in March 2016 crowned the efforts of our team towards the development of analytical strategies with immediate relevance not only for the research community, but also to health practitioners, epidemiologists, patients and their carer.

LRENs mission in teaching and sharing know-how goes beyond the supervision of young scientists at the Undergraduate, Masters and PhD level to run for a second year a Clinical Neuroscience programme for the Lemanic Neuroscience Doctoral School and organise specialized workshops with international participation.

Finally, we will soon celebrate the sixth anniversary of LREN. Providing a fruitful ground for many research fellows, clinicians and engineers, we are proud of our achievements in maintaining an exceptional mix of creative atmosphere and output-oriented research.

Professor Bogdan Draganski
Director of LREN and the MRI platform of the Department of Clinical Neurosciences, CHUV

LREN ANNUAL REPORT 2015

HISTORY & MISSION

LREN – the Laboratory for Research in Neuroimaging at the Department of Clinical Neurosciences – CHUV, Lausanne was founded in 2010.

The focus of LREN is understanding the structural and functional remodelling of the healthy and diseased brain. LREN is an established world-class research laboratory with a unique methodological expertise in imaging neuroscience. LRENs scientific vision relies on an integrative and collaborative approach to research, building on state-of-the-art infrastructure and broad scientific expertise of its members.

LRENs mission is to develop cutting-edge scientific tools and methods, conduct and support high quality neuroimaging research through collaboration at the local and international levels. The majority of our research activities are interdisciplinary, building upon the newest theoretical, methodological and hardware developments. Our goal is to produce innovative research that leads to discoveries directly impacting patient care and medical decision making. Therefore, we emphasise on translational neuroscience projects integrating observations at various levels – genes, molecules, cells, systems and their interaction with the environment.

One of the main pillars in this challenging enterprise is our educational activity at the postgraduate level with active participation in UNILs Medical Biology Master of Science programme and the Lemanic Neuroscience Doctoral School. LRENs weekly Human Brain seminars, courses and workshops attract local and international neuroscientists, creating a platform for scientific exchange that integrates different disciplines and scientific approaches.

For the last 6 years, LRENs educational activities at various levels have established a network for studying brain development and its genetic origins (Medical Genetics - CHUV, Centre for Integrative Genomics - UNIL), neurodegeneration (Neurology Service and Centre Leenaards de la Memoire, Department of Clinical Neurosciences - CHUV), mood disorders (Department of Psychiatry - CHUV) and human behaviour (Brain Mind Institute - EPFL).

In this endeavour LREN is supported by the CHUVs Directorate, the Department of Clinical Neurosciences and the Faculty of Biology and Medicine at UNIL. We are extremely grateful to the Roger de Spoelberch Foundation and the Partridge Foundation - a John and Polly Guth charitable fund, for their generous contribution for the departmental MRI platform.

RESEARCH AIMS

LREN is a neuroimaging laboratory where clinical and basic neuroscientists study human brain structure and function relevant to neurological disorders and normal cognition.

Our systems neuroscience approach on the study of the brain relies on geneticists, psychologists, MRI physicists and statisticians working side-by-side with clinicians. We develop and apply non-invasive neuroimaging methods - magnetic resonance imaging and electro-encephalography, to investigate topics including use-dependent brain plasticity, rehabilitation of lost function and neurodegeneration.

LREN took the leadership for running a state-of-the-art neuroimaging platform featuring high-end research-only Siemens Prisma 3T MRI scanner, sophisticated MRI compatible neurophysiological equipment and high-density EEG machines.

During the last 5 years, research at LREN comprised five research programmes coordinated by a scientific leader - Principal Investigator.

This includes the following:

- Prediction of coma outcome
- In vivo brain histology using MRI
- Use-dependent brain plasticity
- Prediction of recovery of lost function
- Early biomarkers of neurodegeneration

Given that world-class imaging neuroscience requires similarly advanced methodological expertise, LRENs research strategy encompasses all methodological developments needed to support the goals of clinical and pre-clinical projects.

The cornerstone of this strategy is LRENs Methods group with unique expertise in the fields of novel MRI acquisition techniques and statistical analysis that provide new ways to study the patho-physiological basis of brain disorders and to monitor novel treatment strategies.

2016

Launch of the Neuroimaging platform as separate administrative entity.
Reaching the 1000st study participant of the CoLaus neuroimaging project.
Launch of the Medical Informatics platform of the Human Brain Project.
Strategic partnerships with Department of Psychiatry, Department of Fundamental Neurosciences, Eye Hospital Jules Gonin and BMI-EPFL.

2015

The Neuroimaging platform reports more than 1200 study participants scanned.
Installation of prospective motion correction for brain imaging.
Highly successful Human Brain Project education workshop at CHUV.
Festschrift in honour of Prof. Richard Frackowiak.

2014

Launch of the CoLaus neuroimaging project.
The Neuroimaging platform reports more than 400 study participants scanned.
Researcher Marzia De Lucia joins LREN as Principal Investigator.

2013

3T Siemens Prisma MRI scanner delivered and installed succesfully.
LRENs first retreat in Rolle (VD), Switzerland.
Researcher Antoine Lutti joins LREN as Head of Physics.

2012

LREN obtains funding for research-only MRI scanner through the charitable foundations Roger de Spoelberch and Partridge.
LREN moves to dedicated lab space at Mont Paisible 16 on the CHUV campus.

2011

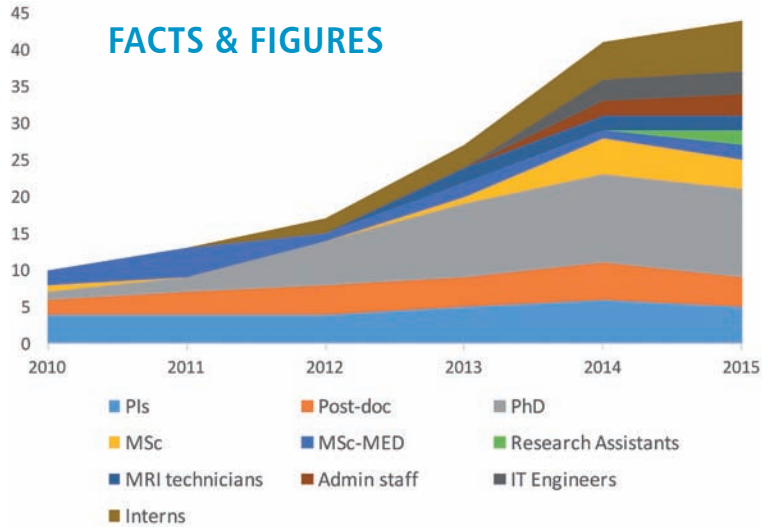
Researcher Maria Knyazeva joins LREN as Principal Investigator.
First Lausanne SPM course with more than 50 participants from all over Europe.

2010

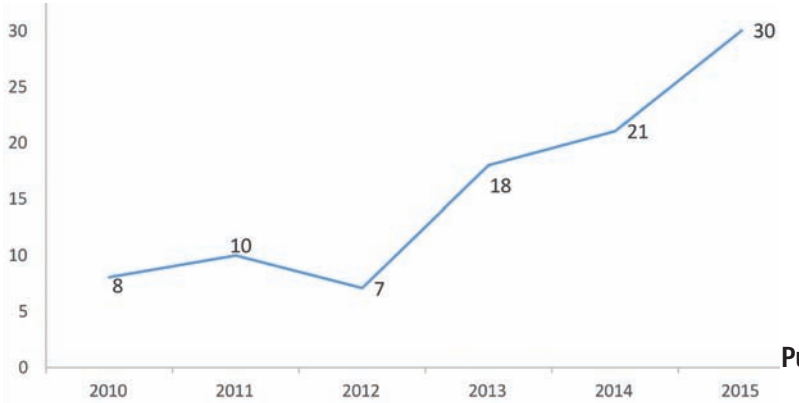
LREN is created as part of CHUV's strategic decision to develop clinical neurosciences.
Founding members Richard Frackowiak, Melissa Saenz, Ferath Kherif and Bogdan Draganski join LREN.

LREN ANNUAL REPORT 2015

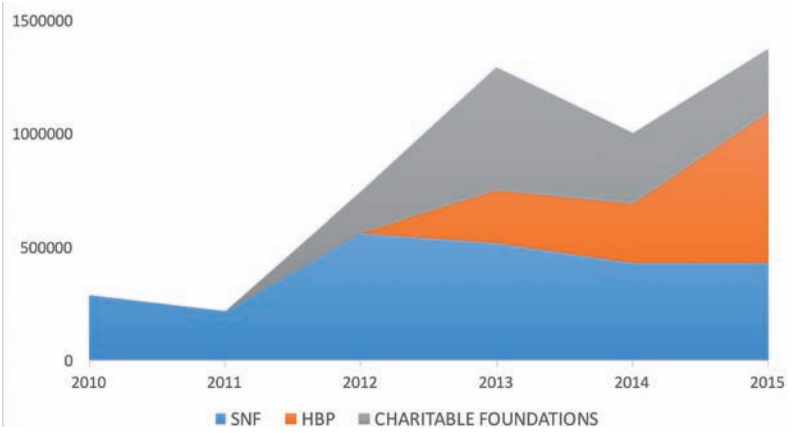
FACTS & FIGURES



LREN Growth

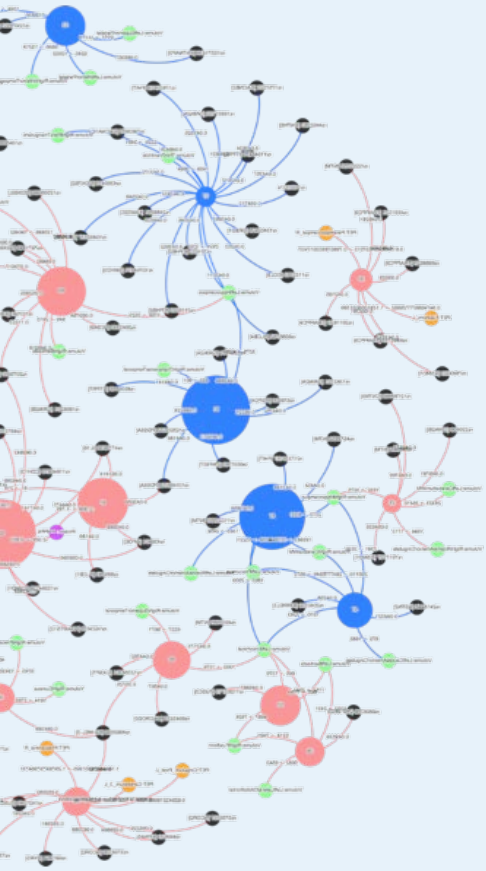


Publications



Funding

PLATFORMS

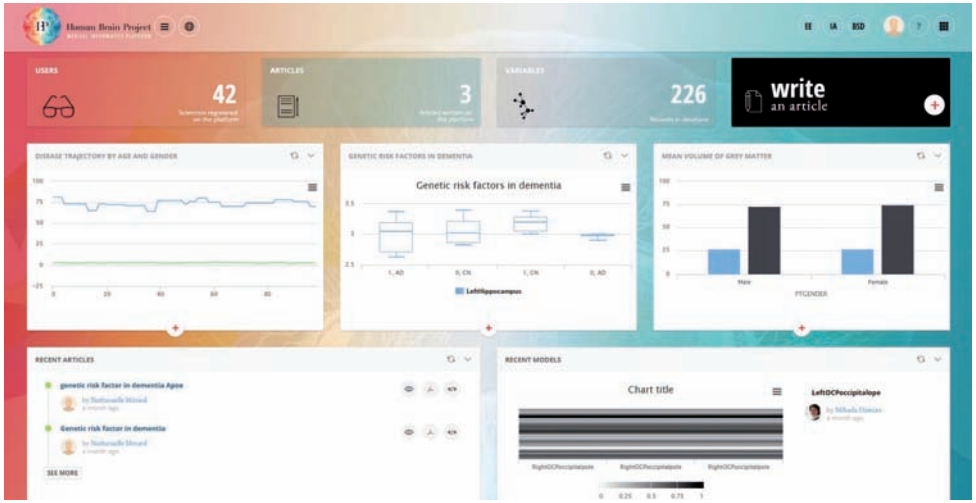


Medical Informatics - Human Brain Project

LREN is responsible for setting up the Medical Informatics Platform of the Human Brain Project under the leadership of Dr. Ferath Kherif. The platform will federate hospital and other clinical data on all brain diseases and across multiple levels of biology.

The Medical Informatics Platform (MIP) is an innovative data analysis system that provides an interface through which clinicians, neuroscientists, epidemiologists, researchers but also health managers and even the general public can access and analyse imaging and clinical data currently locked in hospital and research archives and public databases. Users can explore ontologies and variables, configure and apply statistical methods on clinical and research data, and visualize and dynamically interact with the results. The Medical Informatics Platform supports users to generate new knowledge that will help improve the understanding of the brain and the accuracy and efficiency of diagnosis of brain disorders by providing a radical new way of organising and using big data including hospital data – without the need to physically transfer data to a central data warehouse.

The Medical Informatics Platform system integrates heterogeneous data formats and federates data sources into a harmonized virtual database with a customized interface for navigation and data mining. In the long run our vision is that unlocking the wealth of information in medical and research databases will provide a credible and rapid path to precision (or personalized) medical care. Our interaction with the computing and neuroscience components of the HBP will serve to test with lesion models the functional and structural brain models and artefacts they produce.



Neuroimaging platform

Magnetic resonance imaging – MRI, is a well-established non-invasive technique for detailed characterisation of brain anatomy and function. The cornerstone of LRENs strategy for translational neuroscience with direct impact on clinical decision making and patient care is LRENs leadership in running the Neuroimaging platform of the Department of Clinical Neurosciences, CHUV.

The platform was established end 2013 thanks to the generous support from the charitable Foundation Roger de Spoelberch and the Partridge Foundation, a John and Polly Guth charitable Fund.

LREN provides assistance to all platform users, facilitates the optimal use of advanced image acquisition and analysis techniques additional to providing education and training in handling of MRI data. The MRI platform is built on two main pillars - high-performance data acquisition and advanced automated data processing.

High-performance data acquisition

Scientific instrumentation
- High-end 3T MR system offering optimal signal-to-noise ratio (SNR), speed and stability.
- A complete panel of equipment for real-time assessment of study participants' behaviour during data acquisition.
- Pioneering prospective motion correction system allowing exceptional data quality.

Expertise
- In-house developed brain imaging acquisition sequences for optimal sensitivity in cross-sectional and longitudinal studies.
- Full-range of customized protocols for assessment of brain anatomy and function

Support team
- MRI engineers for customized solutions to the most challenging demands of neuroimaging research.
- MRI physicists for tailored acquisition protocols and optimal scientific output in all neuroscience studies.
- Close monitoring of scanner performance for sustained optimal data quality.

Advanced automated data processing

Scientific instrumentation
- Advanced software solutions & High Performance Computing
- Lab management
- Data provenance
- Traceability of computing workflow process
- Partnership with CHUV IT

Expertise
- End-to-end computing workflow
- Data capture of auxiliary data (behavioral, online cognitive testing, ..)
- Large volume data storage (DICOM, CSV, ..)
- Comprehensive data base
- Data analysis and statistical tools
- Data reporting, real-time dashboard

Support team
- Experts in state-of-the-art and advanced MRI data processing within the framework of SPM, Freesurfer, FSL.
- Software engineers with profound expertise in data basing and queries.

TEAM LREN

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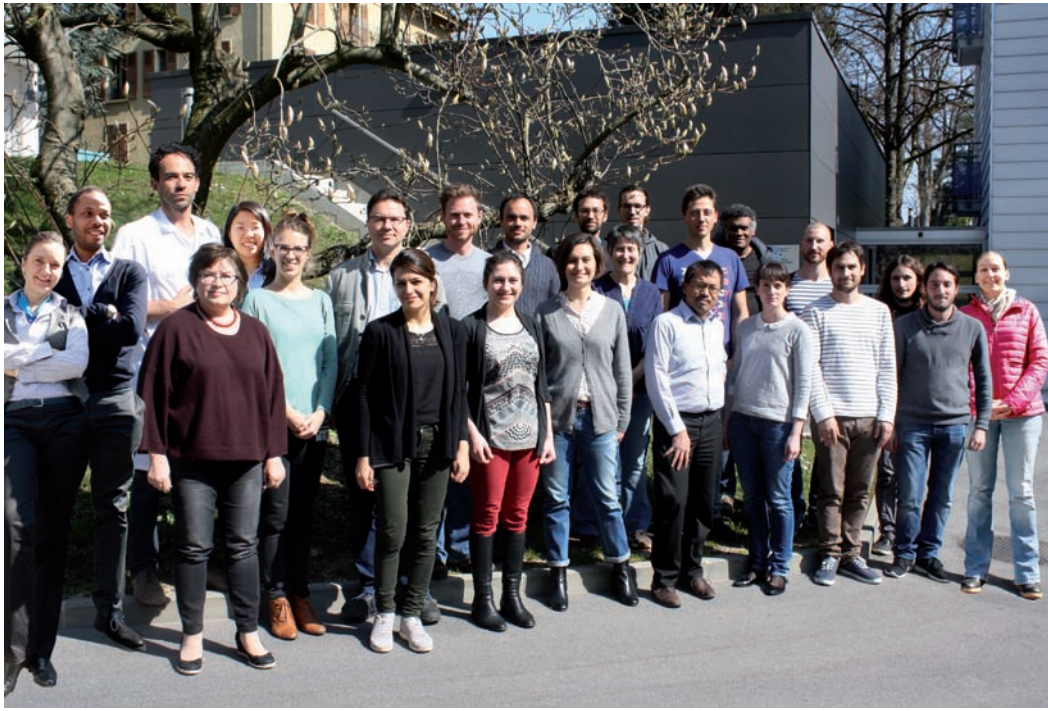


Anne Ruef
Antoine Lutti
Bogdan Draganski
Borja Rodriguez-Herreros
Christian Pfeiffer
Claudia Modenato
David Riedo
David Slater
Elham Barzegaram
Elisabeth Roggenhofer
Elsa Juan
Estelle Dupuis
Evdokia Toumpouli
Ferath Kherif
Gretel Sanabria-Diaz
Jing Cui
Jonathan Sulc
Lester Melie-Garcia
Leyla Loued-Khenissi
Lucien Gyger
Ludovic Claude
Marco Taubert
Maria Knyazeva
Marzia De Lucia
Maya Jastrzebowska
Mihaela Damian
Mirco Nasuti
Nathanaelle Minard
Phanie Bidlingmeyer
Remi Castella
Renaud Marquis
Sandra Martin
Sandrine Muller
Tea Danelutti
Thanh Luu-Tho

PRINCIPAL INVESTIGATORS

Marzia De Lucia

Marzia De Lucia received her PhD in Physics in 2004 from the University La Sapienza of Rome, Italy. She then joined as post-doc the Bioengineering and Medical Physics Department, University College London and in 2006 the Center for Biomedical Imaging Lausanne University Hospital. Since 2014 she is principal investigator at LREN and the Faculty of Biology and Medicine, University of Lausanne.

Expertise
The neural basis of human auditory perception and cognition in healthy and clinical populations, brain function in coma, brain function in the absence of consciousness, decision-making.

Experimental techniques
Electroencephalography (EEG); Intracranial EEG recordings (iEEG);
functional Magnetic Resonance Imaging.

Methods
Algorithms for supervised and unsupervised learning; multivariate analyses for single-trial EEG/iEEG decoding and prediction; Event-related potential analyses

Ongoing projects
- Eureka Eurostars (E9361-ComAlert). „Consciousness Monitoring, Assessment, prediction and Life activities with EEG in Real Time“
- Swiss National Foundation grant (CR32I3_143780) “Early electrophysiological correlates of brain injury and outcome in comatose patients after cardiac arrest”

Bogdan Draganski

Bogdan Draganski qualified in Clinical Neurology in Germany followed by work on computational anatomy research at the Institute of Neurology, UCL London, UK, and at the Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig Germany. He is Academic Editor for the journals PLOS One, Frontiers in Human Neuroscience, Journal of Clinical Movement Disorders and is a member of the Dystonia Medical Research Foundation Scientific Advisory Council, USA and the Translational Brain Research Centre at the Medical University – Plovdiv, Bulgaria.

Expertise
Areas of research: modulation of brain anatomy and function after electro-convulsive therapy; identification of surrogate imaging biomarkers in the presymptomatic phase of neurodegenerative diseases; deep brain stimulation; neuropsychiatry - Gilles de la Tourette's syndrome, obsessive-compulsive disorder.

Experimental techniques
Structural and functional Magnetic Resonance Imaging; neurological assessment.

Methods
Univariate and multivariate analyses of behavioural and MRI data.

Ongoing projects
- The two faces of brain plasticity - Swiss National Science Foundation: project grant - CHF 372K
- Imaging large scale network in epilepsy - Swiss National Science Foundation - SPUM (PI Margitta Seeck, Geneva; co-applicant) - project grant - CHF 400K
- Structural and functional brain plasticity in inhibitory control: towards expertise - Swiss National Science Foundation (PI Lucas Spierer, Fribourg; co-applicant) – CHF 42K
- Neural adaptations in response to long-term balance learning in young and old: Behavioural, structural, functional and neurophysiological differences - Swiss National Science Foundation (PI Wolfgang Taube, Fribourg; co-applicant) – CHF 100K
- Cardiovascular risk factors associated with mental health in the CoLaus cohort - - Swiss National Science Foundation (PI Martin Preisig, Lausanne; co-applicant) – CHF 50K
- Development of a composite imaging/gait behaviour biomarker for early detection of cognitive impairment in ageing Synapsis Foundation - project grant - CHF 150K
- Human Brain Project as work package leader "Data collection" - CHF 250K

Ferath Kherif

Ferath Kherif obtained his PhD in neuroscience at the University Pierre et Marie Curie in Paris.
Before joining CHUV in 2010, he worked as Research Fellow at the MRC-CBU in Cambridge, UK and at the Wellcome Trust Center for Neuroimaging in London UCL, UK.
He currently coordinates and directs the Human Brain Project platforms of Medical Informatics and Future Medicine.

Expertise
Areas of research:
- models of individual differences in cognitive neuroscience in health and disease;
- mechanisms of recovery of lost function after stroke.

Experimental techniques
Structural and functional Magnetic Resonance Imaging; neuropsychology assessment.

Methods
Mathematical modelling; machine learning; univariate and multivariate analyses of behavioural and MRI data.

Ongoing projects
- Velux Grant on recovery of aphasia as principal investigator: "Comprehensive Outcome Models of Aphasia "
- Brain networks of cognition and personality in Alzheimer's disease – co-investigator, principal investigator Armin von Gunten
- Models of memory
- Human Brain Project as work package leader "Medical Informatics" – "Big data and biological signature of Alzheimer's disease" - CHF 1Mio

Maria Knyazeva

Dr. Maria G. Knyazeva obtained her PhD in neuroscience from the Institute of Developmental Physiology of Russian Academy of Sciences, Moscow, Russia. Before joining LREN in 2010, she worked as a senior researcher, then, as a Head of Research group in the Department of Cognitive Neurophysiology at the same institute. She combined her research activities with a position of a scientific editor of "Human Physiology" (Russian) journal.

Research
Formation, localization, behavior, evolution, and the structural substrate of distributed cooperative neural assemblies in normal human brain and in neurological conditions. Focus on linking these topics to spatio-temporal dynamics of high-density EEG.

Expertise
Neurophysiology of child development, Brain lateralization, Interhemispheric mechanisms, Visual perception, Neurophysiology of aging, Age-related neurodegeneration, Biomarkers of Alzheimer's disease.

Experimental techniques
Electroencephalography (EEG)

Methods
EEG technology, Ongoing EEG, Oscillations, Event-related potentials, Clinical EEG applications, Behavioral paradigms, EEG synchronization analysis, Network analysis, Dynamic Causal Modeling.

Ongoing projects
- Wearable ICT for Zero Power medical Application.
- EEG-based functional connectivity in patients with PNES
- Multimodal exploration of functional and anatomical connectivity of the brain in Alzheimer's disease.
- Connect'in age - nested CoLaus project

Antoine Lutti

Dr. Antoine Lutti is Head of Physics at the LREN-DNC-CHUV.
Dr. Lutti obtained his PhD in MRI physics at Victoria University, Wellington, New Zealand in 2007 and then joined the Wellcome Trust Center for Neuroimaging, UCL, London – UK as a post-doctoral research fellow.
He was deputy Head of Physics there from 2012. He joined the LREN in 2013 and is in charge of the development of MRI acquisition techniques, the supervision of the MRI platform and the physics support for neuroscientists.

Research
Development of quantitative relaxometry, functional and diffusion MRI acquisition techniques. Development and optimization of MRI biomarkers for the in-vivo characterization of brain tissue.

Applications
Assessment of brain microstructure with MRI, complementarity of relaxometry- and diffusion-based MRI biomarkers, relationship between brain structure and function.

Neuroimaging Platform
- Design and supervision of the construction for optimal neuroimaging research.
- Monitoring of MRI scanner performance to ensure high-end data quality for neuroscientists.
- Platform manager: access, safety, user training, supervision of staff.
- Support - Project–specific customization of MRI protocols for high-quality neuroimaging data.
- Teaching - Lausanne & London SPM course, Lemanic Neuroscience PhD course module Modern Neuroimaging Methods.

RESEARCH HIGHLIGHTS

Our research strategy is to push the boundaries of clinically relevant neuroscience by combining large-scale projects with cutting-edge sophisticated imaging equipment to investigate brain anatomy and function in patients with brain disorders. This strategy provides novel insights into the mechanisms of brain diseases and their consequences that we expand to diagnosis and therapy relevant projects .

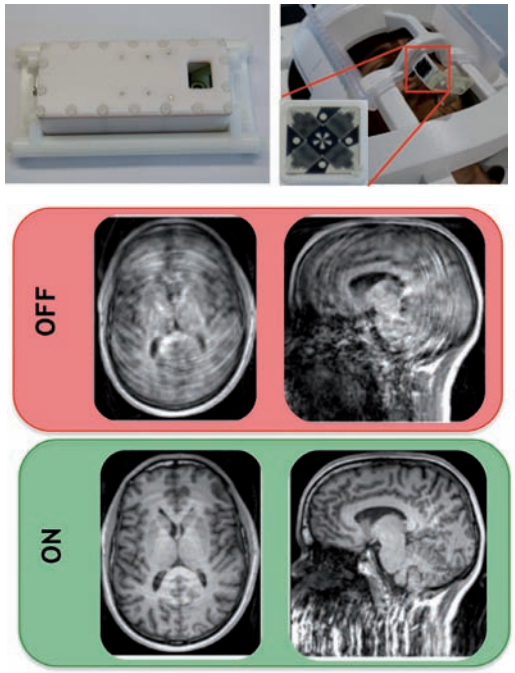
High-precision and safe behavioural assessment of study participants in the experimental setting improves the prediction of clinical outcome and the reliability of proposed theoretical disease models.

The strong involvement of clinicians - leaders in their field - ensures that the conducted research follows clinical needs.

Advanced MRI acquisition

Patient motion during a scan can lead to severe degradation of the quality of MRI images that limits the applicability of MRI for brain studies in participants with reduced compliance. In this project, patient motion is recorded by a camera during the scan and MRI acquisitions are adjusted accordingly to correct for the recorded motion. Additionally, data acquisition is put on hold when excessive motion speeds are detected to ensure optimal data quality in the MRI images.

This project aims at improving the quality of MRI images acquired on patients that cannot remain still during a scan. It is expected to facilitate the acquisition of MRI data on populations such as children and elderlies but also patients affected by Alzheimer's or Parkinson's disease and other diseases involving movement disorders.



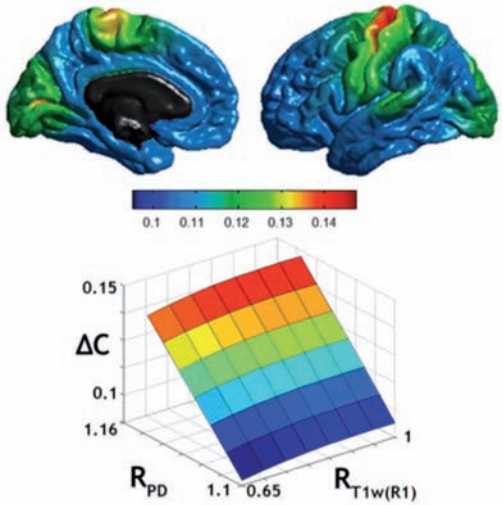
Top panel: Prospective motion correction (PMC) camera with 3D sensor
Middle panel: Movement related artifacts when PMC camera off
Bottom panel: Image quality improvement when PMC camera on

Castella R, Dupuis E., Draganski B., Lutti A., Organization for Human Brain Mapping, 2016.
Arn L, Castella R, Dupuis E., Draganski B., Lutti A., Organization for Human Brain Mapping, 2016.

Computational brain anatomy

The high grey-white matter contrast and image resolution provided by T1-weighted magnetic resonance imaging (MRI) has made it a widely used imaging protocol for computational anatomy studies of the brain. While the image intensity in T1-weighted images is predominantly driven by T1, other MRI parameters affect the image contrast, and hence brain anatomy measures derived from the data. This mixed contribution remains largely ignored in the community although it hampers the straightforward neurobiological interpretation of morphometry findings.

We created synthetic T1-weighted images from quantitative maps of brain iron, myelin and visible water to estimate local grey matter volume and cortical thickness. We observed significant variations in morphometry measures obtained from synthetic images derived from different subsets of MRI parameters. We also detected a modulation of these variations by age. Our findings highlight the impact of microstructural properties of brain tissue - myelination, iron and water content - on automated measures of brain anatomy.



Spatial distribution and prediction of grey-white matter contrast changes in T1-weighted magnetic resonance images due to proton density - visible tissue water content.

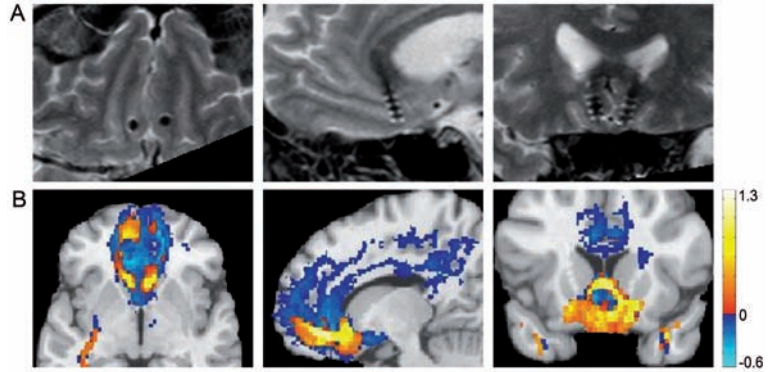
Lorio S, Kherif F, Ruef A, Melie-Garcia L, Frackowiak R, Ashburner J, Helms G, Lutti A, Draganski B. Neurobiological origin of spurious brain morphological changes: A quantitative MRI study. Hum Brain Mapp. 2016 May;37(5):1801-15

Lorio S, Fresard S, Adaszewski S, Kherif F, Chowdhury R, Frackowiak RS, Ashburner J, Helms G, Weiskopf N, Lutti A, Draganski B. New tissue priors for improved automated classification of subcortical brain structures on MRI. Neuroimage. 2016 Apr 15;130:157-66

DBS treatment for depression

Deep brain stimulation (DBS) represents an alternative symptomatic treatment for major depressive disorder in case of failure of pharmacotherapy. We implemented our own developments in computational anatomy for pre- and intra-operative DBS target optimisation and validated their utility for evaluation of clinical outcome in treatment resistant depression patients previewed for DBS of the sub-genual cingulate - Brodmann area 25 (CG-25). We observed in one out of five patients an excellent clinical response after DBS of the bilateral posterior gyrus rectus rather than the initially targeted CG-25. The remaining four patients with DBS of the CG-25 were considered as non-responders. In the case patient, we demonstrate a strong connectivity of the stimulated regions to the medial prefrontal cortex (mPFC), which contrasted to the lower mPFC connectivity in non-responders.

Our results confirm the variability of clinical response after CG-25 DBS in major depressive disorder patients to propose the posterior gyrus rectus region as alternative target. Our neuroimaging results suggest that the therapeutic effects of posterior gyrus rectus DBS were mediated by the modulation of circuits involving mainly the mPFC, hence through stimulation of a different than CG-25 node within the very same cortico-subcortical circuit.



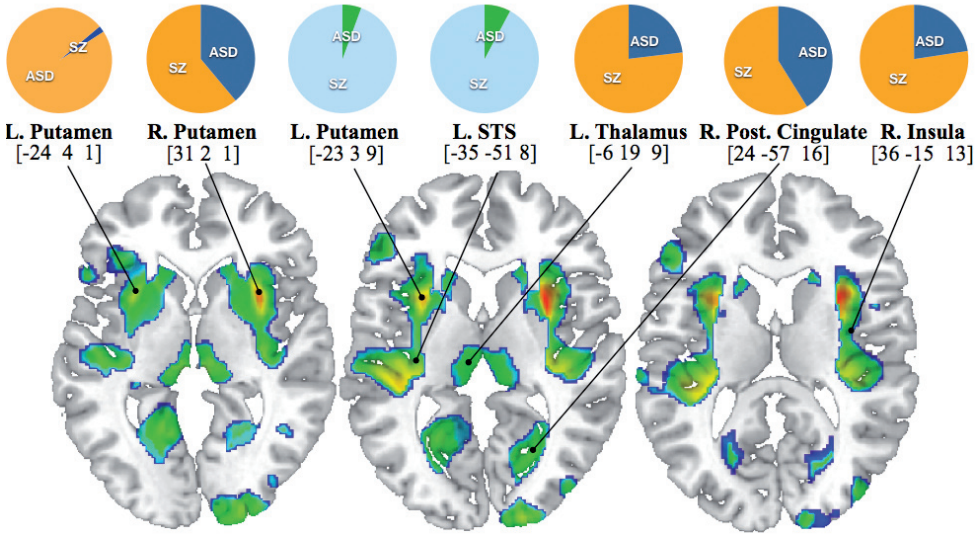
A: Postoperative MRI of DBS responder with active macro-electrode contacts within the posterior gyrus rectus.
B. Probabilistic tractography results with seeds located in the area of stimulating contacts.

Accolla EA, Aust S, Merkl A, Schneider GH, Kühn AA, Bajbouj M, **Draganski B.** Deep brain stimulation of the posterior gyrus rectus region for treatment resistant depression. J Affect Disord. 2016 Jan 13;194:33-37.

Genes, obesity and psychiatric disorders

For our studies in autism spectrum disorder (ASD) or schizophrenia (SZ) we focused on carriers with reciprocal copy number variants at the 16p11.2 BP4-BP5 locus known to carry high risk for these disorders.

We used magnetic resonance imaging data from 16p11.2 deletion and duplication carriers for computer-based analysis of the brain anatomy. Beyond gene dosage effects on global brain metrics, we show that the number of genomic copies is negatively correlated to grey matter volume and white matter tissue properties in cortico-subcortical regions implicated in reward, language and social cognition.
Despite the absence of clinical diagnosis of ASD or SZ in our 16p11.2 cohort, the pattern of brain anatomy changes in carriers spatially overlaps with the well-established structural abnormalities in ASD and SZ.

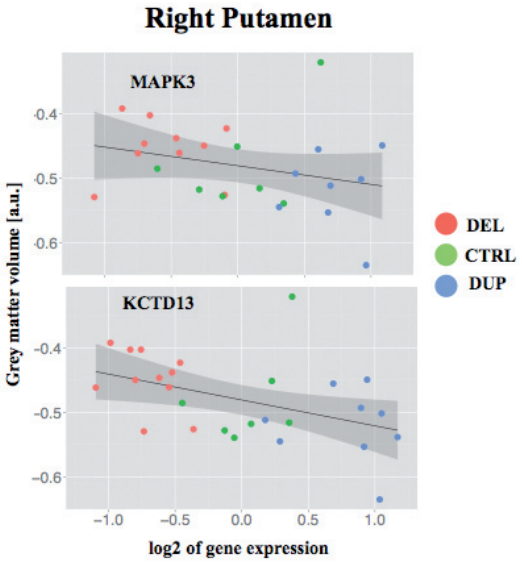


Projection of meta-analysis data in autism spectrum disorder (ASD) and schizophrenia (SZ) on a statistical map of 16p11.2 gene dosage effects on gray matter volume in deletion and duplication carriers.

Maillard AM*, Ruef A*, Pizzagalli F, Migliavacca E, Hippolyte L, Adaszewski S, Dukart J, Ferrari C, Conus P, Männik K, Zazhytska M, Siffredi V, Maeder P, Kutalik Z, Kherif F, Hadjikhani N; Beckmann JS, Reymond A**, Draganski B**, Jacquemont S**; 16p11 2 European Consortium. The 16p11.2 locus modulates brain structures common to autism, schizophrenia and obesity. Mol Psychiatry. 20(1):140-7.

Maillard, A.M., Hippolyte, L., Rodriguez-Herreros, B., Chawner, S.J.R., Dremmel, D, Agüera, Z., Fagundo, AB, Pain, A., Martin-Brevet, S., Hilbert, A., Kurz, S., Etienne, R., Draganski, B., Jimenez-Murcia, S., Männik, K., Metspalu, A., Reigo, A., Isidor, B., Le Caignec, C., David, A., Mignot, C., Keren, B., 16p11.2 European Consortium, van den Bree, M.B.M., Munsch, S., Fernandez-Aranda, F., Beckmann, J.S., Reymond, A., Jacquemont, S. (2015). 16p11.2 locus modulates response to satiety before the onset of obesity. Int J Obes (Lond). 2016 May;40(5):870-6.

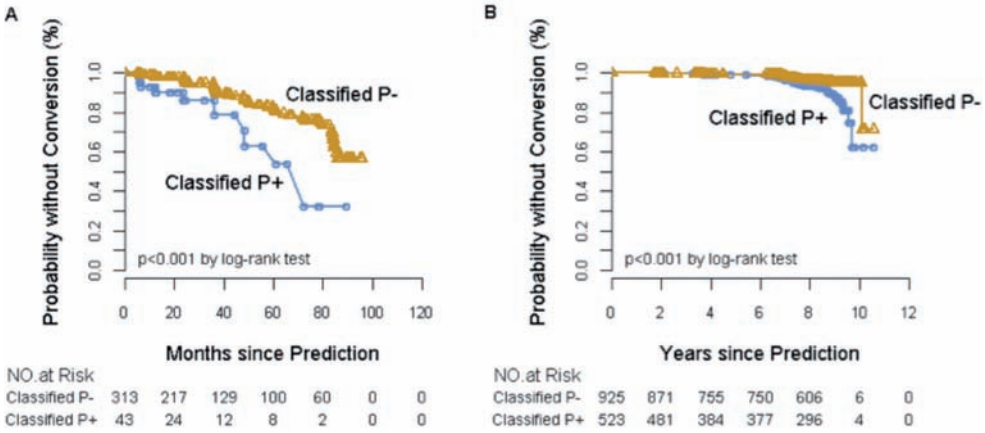
Hippolyte, L., Maillard, A.M., Rodriguez-Herreros, B., Pain, A., Martin-Brevet, S., Ferrari, C., Conus, P., Macé, A., Hadjikhani, N., Metspalu, A., Reigo, A., Kolk, A., Männik, K., Barker, M., Isidor, B., Le Caignec, C., Mignot, C., Schneider, L., Mottron, L., Keren, B., Albert, D., Doco-Fenzy, M., Gérard, M., Bernier, R., Goin-Kochel, R.P., Hanson, E., Green Snyder, L., Ramus, F., Beckmann, J.S., Draganski, B., Reymond, A., Jacquemont, S. (2015). The number of genomic copies at the 16p11.2 locus modulates language, verbal memory and inhibition. Biological Psychiatry.



Correlation between the log2 mRNA levels of MAPK3, KCTD13 and relative volume of the right putamen.

Prediction of dementia

We tested whether structural-MRI with pathological information can diagnose asymptomatic subjects individually at risk of AD (ASR-AD) independently of clinical symptoms.
Our goal was to predict brain pathology in general population using large data sets from two independent cohorts – a research cohort ADNI (N=639) and a population cohort three-city (3C, N=1448), consisting of demented or cognitively normal (CN) individuals. We built an automated classifier using a validated machine learning approach and grey matter volumetric features extracted from MRI of 33 pathologically confirmed AD and non-AD subjects.
This study has demonstrated two important results. Firstly, our automated classifier trained from a pathologically proven group was able to predict ASR-AD (CN_P+) among clinical cognitive normal subjects. Secondly, we detected a set of subjects among clinical AD who do not have typical AD atrophy pattern (AD_P-).



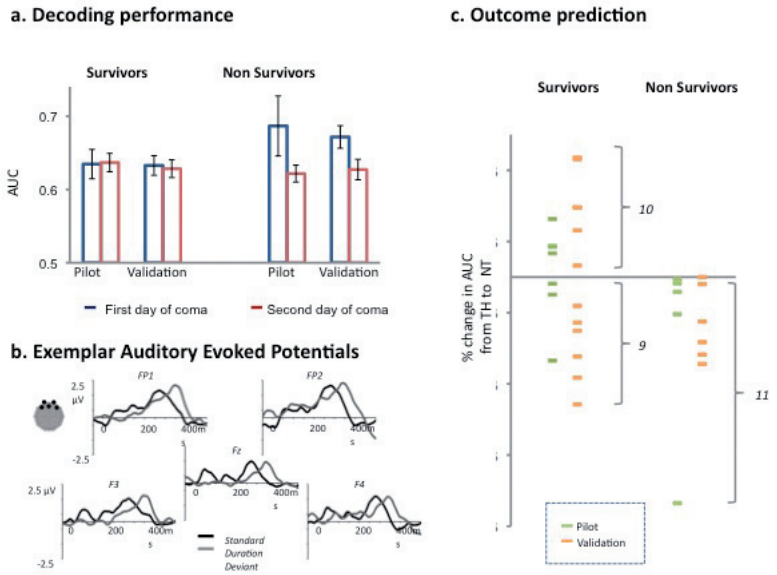
Risk for mild cognitve impairment - MCI or Alzheimer's disease – AD in the general population. Prediction based on MRI data A. from the ADNI cohort as P- (pathologically negative, n = 313) and P+ (pathologically positive, n = 43) and B. from the 3C initiative as P- (pathologically negative, n = 925) and P+ (pathologically positive, n = 523).

Cui J, **Zufferey V**, **Kherif F**. In-vivo brain neuroimaging provides a gateway for integrating biological and clinical biomarkers of Alzheimer's disease. Curr Opin Neurol. 2015 Aug;28(4):351-7

Prediction of coma outcome

Coma is the leading etiology of permanent cognitive disability in adults. During the last decade, the advancement in early clinical care has drastically improved the number of patients with good outcome. These improvements have encouraged the neuroimaging community to better understand the neural functions underlying the recovery of these patients.

Our project is based on the hypothesis that the degree of impairment of brain functions in comatose patients is particularly sensitive to the time passed after coma onset. We have strong evidence that improvement over the first days of brain functions can provide critical information about patients' condition and can lead to a new assessment of prognostication tools and consciousness detection.



Tzovara A, Simonin A, Oddo M, Rossetti AO, **De Lucia M**. Neural detection of complex sound sequences in the absence of consciousness. Brain, 138(Pt 5):1160-6.

De Lucia M, Tzovara A. Decoding auditory EEG responses in healthy and clinical populations: A comparative study. J Neurosci Methods. 2015 Jul 30;250:106-13.

ACHIEVEMENTS

The EUREKA-Eurostars grant application by LRENs PI **Marzia De Lucia** obtained the highest scores within the 89 submitted projects. It finances the partneship between Dr De Lucia's group and the industrial partner gtec, aiming at prediction of consciousness recovery in comatose patients.

The European patent office accepts to grant in Europe the patent **„Method for predicting awakening in a comatose patient and computer-implemented method thereof"**.
(Inventors Marzia De Lucia and Athina Tzovara)

Our PhD graduates for 2015 - **Valerie Zufferey** and **Sara Lorio**. Congratulations!

Valerie Zufferey:
Cognitive anatomy of the temporal lobe: Effect of personality in population with mild cognitive impairment & Functional specialization for memory systems in healthy Individuals
(thesis director - Ferath Kherif)

Sara Lorio:
Characterisation of anatomical and functional properties of the human basal ganglia using magnetic resonance imaging
(thesis director - Bogdan Draganski)

INVITED TALKS - SELECTION

Forum on Neuroscience
F. Kherif- invited speaker, Rome, Italy
December 3 2015

Web Summit Dublin – "HealthTech"
F. Kherif - invited speaker, Dublin, Ireland
November 2015

Presentation to Neuroscience and medicine working group
F. Kherif - invited speaker, Lausanne, Switzerland
October 2015

„Big Data and Data Analytics in Precision Medicine"
F. Kherif - invited speaker, conference
October 26-27 2015

Presented solution to Brain/MINDS Project
F. Kherif - invited speaker Tokyo and Kyoto Universities, Japan
July 2015

SFARI foundation
B. Draganski - invited speaker SFARI workshop, New York, USA
June 12-13

"The mysteries of brain imaging"
B. Draganski - invited speaker Clinical Neurosciences Colloquium, DNC, CHUV
June 17 2015

"Computational anatomy to study ECT effects on the brain"
B. Draganski - invited speaker MedViz conference – workshop on ECT, Bergen, Norway
June 14-15 2015

"Studying brain plasticity of motor networks"
B. Draganski - invited speaker EPNS International Symposium, Vienna, Austria
May 25-26 2015

"Neuroimaging in psychiatry – the case of Deep Brain Stimulation"
B. Draganski - invited speaker ESSFN workshop, Lausanne, Switzerland
May 12 2015

"Novel concepts in computational anatomy"
B. Draganski - invited speaker Guest lecture Max-Planck Institute, Leipzig, Germany
May 11 2015

"Computational anatomy - novel insights into brain tissue properties"
B. Draganski - invited speaker Images of the Mind, Milano, Italy
April 9-10 2015

"Medical intelligence for brain diseases"
F. Kherif - invited speaker Second HBP Education Workshop: Future Medicine,
CHUV Lausanne, Switzerland
March 15-18 2015

"Microscopic characterisation of brain tissue with MRI"
A. Lutti - invited speaker keynote lecture
Second HBP Education Workshop: Future Medicine - CHUV, Lausanne
March 15-18 2015

"In vivo histology"
B. Draganski - invited speaker Swiss-Japanese workshop on Ageing, Tokyo, Japan
March 18 2015

"What can we see and what do we want to see when using in vivo MRI"
B. Draganski - invited speaker Joint ETHZ-UCL workshop, Ittingen, Switzerland
March 3 2015

Annual presentation to representatives of the IT at CHUV
F. Kherif- invited speaker Lausanne, Switzerland
February 2015

Presentation to the IMI initiatives
F. Kherif- invited speaker Lausanne, Switzerland
January 2015

EDUCATION

LREN offers a wide range of ex cathedra and hands-on teaching courses with the main aim to close the gap between basic and clinical neuroscience. We are actively involved in the Master of Sciences programmes of the Faculty of Biology and Medicine - UNIL, University Geneva and the Life Sciences Department of the EPFL. Already for a third year in a row LREN hosts foreign students from the Summer Undergraduate Programme of UNIL. LRENs mission is to provide an open platform for high quality scientifique exchange for the benefit of the scientifique community of the Lemanic region and beyond.

Project presentation
Our weekly Project presentations offer an excellent opportunity for a researcher to present a planned neuroimaging study and get feedback from the specialised audience. The goal is to maximize the chance that the proposed project will answer the specified research question.

Human Brain seminar
The weekly seminar series has already a 5 years history attracting both young and established neuroscientists to present their most recent achievements in the field. Already an institution, the Human Brain seminar's hot debates and witty presentations are followed by more in-depth discussion in our laboratory's premisses over a cup of tea.

Methods meeting
LRENs Methods meetings are held every moday morning to offer imaging neuroscientists a platform for solving methodological issues centered on study planning, data processing and statistical analysis. Our experts in the field are addressing open questions and provide solutions for trivial and complex problems.

Annual SPM course
With the 7th Lausanne SPM course ahead, LREN attracts young scientists from all over Europe to provide beginners and advanced users an unique hands-on workshop. At all instances LRENs faculty are supported by our friends and collegues fro the Wellcome Trust Centre for Neuroimaging, UCL London, aka "the FIL".

Clinical Neuroscience programme
LRENs Clinical Neuroscience course is a joint effort of LREN, clinicians from the Neurology service, DNC - CHUV and our colleagues from the Centre for Sllep Investigation to introduce the topic to the students enrolled in the Lemanic Doctoral School.

SCIENTIFIC EVENTS

2nd Human Brain Project
Education Workshop
Lausanne, Switzerland
15-18 march 2015

Scientific Symposium in honour of Prof. Richard Frackowiak
(Festschrift)
Lausanne. Switzerland
12th of June 2015

LREN PUBLICATIONS

Chavan C, Mouthon M, Simonet M, Hoogewoud HM, **Draganski B**, van der Zwaag W, Spierer L. Sustained enhancements in inhibitory control depend primarily on the reinforcement of fronto-basal anatomical connectivity. Brain Struct Funct. 2015 Dec 12.

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Book chapters:

Draganski B. Insights into Gilles de la Tourette Syndrome from the Neuroimaging Perspective. In: Arthur W. Toga, editor. Brain Mapping: An Encyclopedic Reference, vol. 3, pp. 737-741. Academic Press: Elsevier. 2015

Kherif F, Muller S Early prognosis Models in Aphasia. In: Arthur W. Toga, editor. Brain Mapping: An Encyclopedic Reference, vol 3, pp-807-811. Academic Press: Elsevier 2015

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CHUV Centre hospitalier universitaire vaudois

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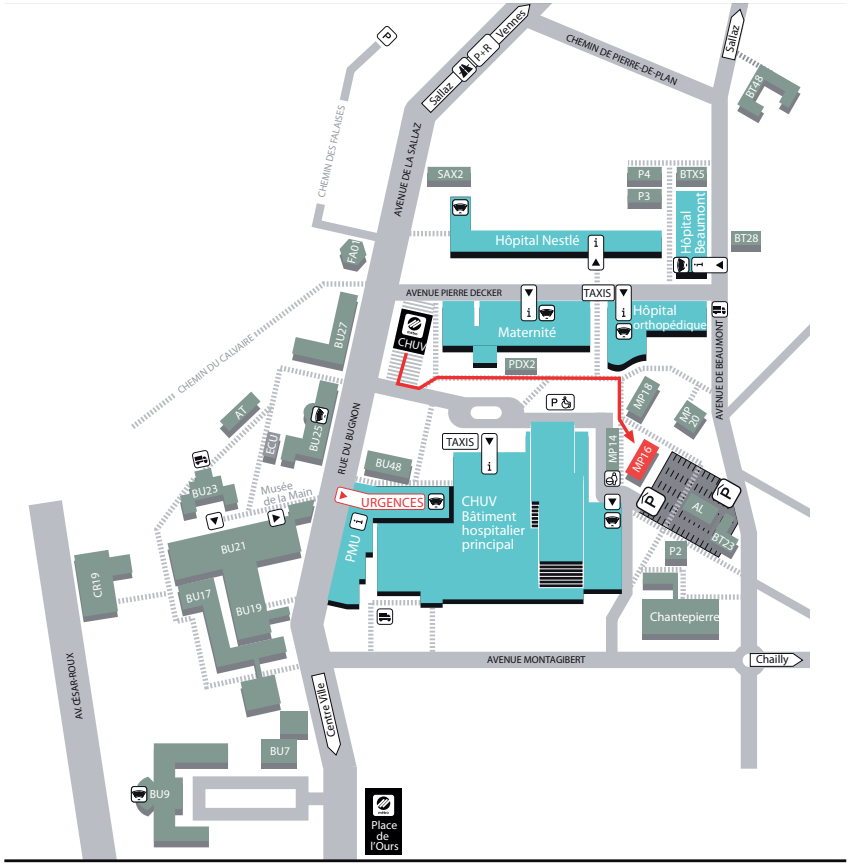

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