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## GRAMFC - Groupe de recherches sur l'analyse multimodale de la Fonction cérébrale

Rapport Hcéres

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# HCERES

High Council for the Evaluation of Research  
and Higher Education

Department of Research evaluation

Report on research unit:

Research Group on Multimodal Analysis of Brain

Function

GRAMFC

Under the supervision of  
the following institutions  
and research bodies:

Université de Picardie Jules Verne

Institut National de la Santé et de la Recherche  
Médicale - INSERM

Evaluation Campaign 2016-2017 (Group C)

# HCERES

High Council for the Evaluation of Research  
and Higher Education

Department of Research Evaluation

*In the name of HCERES,<sup>1</sup>*

Michel Cosnard, president

*In the name of the experts committee,<sup>2</sup>*

Torsten Baldeweg, chairman of the  
committee

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Under the decree N°2014-1365 dated 14 november 2014,

<sup>1</sup> The president of HCERES "countersigns the evaluation reports set up by the experts committees and signed by their chairman." (Article 8, paragraph 5)

<sup>2</sup> The evaluation reports "are signed by the chairman of the expert committee". (Article 11, paragraph 2)

## Evaluation report

This report is the sole result of evaluation by the expert committee, the composition of which is specified below.

The assessments contained herein are the expression of an independent and collegial reviewing by the committee.

Unit name:	Research Group on Multimodal Analysis of Brain Function
Unit acronym:	GRAMFC
Label requested:	UMR
Current number:	1105
Name of Director (2016-2017):	Mr Fabrice WALLOIS
Name of Project Leader (2018-2022):	Mr Fabrice WALLOIS

## Expert committee members

Chair:	Mr Torsten BALDEWEG, University College London, United Kingdom
Experts:	Mr Jean-Francois AUBRY, Institut Langevin, École Supérieure de Physique et Chimie Industrielles (representative of the CSS Inserm)
	Ms Nathalie CHASTAN, Université de Rouen (representative of the CNU)
	Mr Raphaël DENIS, Université Paris Diderot (representative of supporting personnel)
	Ms Judit GERVAIN, Université Paris Descartes

### Scientific delegate representing the HCERES:

Mr Jacques NOËL

### Representatives of supervising institutions and bodies:

Mr Mohammed BENLAHSEN, Université Picardie Jules Verne

Mr Arnaud COLLIN, CHU Amiens

Ms Marie-Joséphine LEROY ZAMIA, INSERM

### Head of Doctoral School:

Mr Christian MASQUELIER, Doctoral school n° 585, «Sciences, Technologie, Santé»

# 1 • Introduction

## History and geographical location of the unit

The GRAMFC (Groupe de Recherches sur l'Analyse Multimodale de la Fonction Cérébrale) was established in 2004 as a research group and in 2008 as an équipe d'accueil (EA 4293) affiliated with the Université de Picardie in Amiens. Since then, neurophysiologists, neonatologists and signal processing specialists have joined the unit. In 2010, the paediatric neurology team together with the center for learning and language disabilities, the child psychiatry department and the autism center joined the EA. The GRAMFC was affiliated with the INSERM as an Unité Mixte de Recherche in 2012 (UMR 1105). Gynecologists and obstetricians of the university hospital joined the unit in 2016.

The unit is located at the shared premises of the Amiens University Hospital and the University of Picardie in the Centre Universitaire de Recherche en Santé (CURS).

## Management team

The director of the unit is Mr Fabrice WALLOIS.

## HCERES nomenclature

SVE6 Santé publique, épidémiologie, recherche clinique.

ST5 Sciences pour l'ingénieur.

SVE4 Neurologie.

## Scientific domains

The overall aim of the unit is research into human neurological health and innovation in clinical research and practice. The three main axes of the current contract are:

- 1- cross-sectional axis: development and/or optimization of acquisition and processing tools (EEG and optical imaging) and its translation into the commercial sector;
- 2- application axis 1: normal and pathological neurodevelopment;
- 3- application axis 2: epilepsy and cognitive disorders.

Unit workforce

Unit workforce	Number on 30/06/2016	Number on 01/01/2018
N1: Permanent professors and similar positions	7	13
N2: Permanent researchers from Institutions and similar positions		1
N3: Other permanent staff (technicians and administrative personnel)	11	10
N4: Other researchers (Postdoctoral students, visitors, etc.)	2	
N5: Emeritus	1	
N6: Other contractual staff (technicians and administrative personnel)		
N7: PhD students	7	
<b>TOTAL N1 to N7</b>	<b>28</b>	
Qualified research supervisors (HDR) or similar positions	3	

Unit record	From 01/01/2011 to 30/06/2016
PhD theses defended	6
Postdoctoral scientists having spent at least 12 months in the unit	1
Number of Research Supervisor Qualifications (HDR) obtained during the period	

## 2 • Assessment of the unit

### Global assessment of the unit

The Research Group on Multimodal Analysis of Brain Function (GRAMFC) is a multidisciplinary unit comprising a clinical group supported by an excellent world renowned technical development team to study brain function and dysfunction in neonates and children. During the present period 2011-2016, the unit pursued the development of neuroimaging tools such as High Resolution Electro-Encephalography (HR EEG) and High-Density Near Infra-Red Spectroscopy (HD NIRS) for non-invasive acquisition and analysis of healthy and pathological brain function in children. Major progress was made in optimization of processing tools such as development of improved head models for EEG source analysis in neonates, via improved MRI tissue segmentation in neonates, and development of new technologies for multimodal analysis of brain functions (DCS, FAST). A major innovation here is the development of a multimodal wireless high-resolution acquisition system (EEG-NIRS)(Patent). Its translational approach and technical expertise give the unit a leading position in the field both nationally and internationally. Based on this cross-sectional axis, the two other axes of research are direct applications of the first. Normal and pathological neurodevelopment, comprising investigation on early EEG neuromarkers in healthy preterm infants, neural network connectivity in preterm and term neonates, functional capabilities of neural networks involved in language, coupling capabilities in preterms with patent ductus arteriosus and other related topics. Epilepsy disease in children and cognitive disorders axis was subdivided in three items: changes in hemodynamics and extracellular environment surrounding epilepsy spikes, neural network connectivity in epileptic and ADHD children, multimodal approach to interictal epileptic spikes in drug-resistant epilepsy. Research highlights here include: connectivity of interictal epileptic spikes in centro-temporal epilepsy including frontal areas likely involved in transient cognitive disorders observed in these patients and In vivo characterization of the interactions between electrical and hemodynamic networks and dynamic changes of membrane configurations occurring around interictal epileptic spikes.

This is a logical continuation of the work carried out during the previous evaluation period (report in 2011). The lab has relied on a rich network of national and international collaborations to conduct its pioneering research in developmental functional imaging.

The close collaboration between engineers, researchers and clinicians within the unit provides an opportunity to conduct cutting-edge basic and clinical research, with considerable societal impact.

The unit has continued to increase its international visibility through its publications and teaching activities as well as via an established network of national and international collaborations and appears to take a leading role in organising research in developmental neuroscience at the regional level (creation of the Institut de Neurosciences de Picardie).

The unit's research themes for the next contract and particularly the two axes dedicated to applications (language, epilepsy) are identical to the research themes during the currently expiring contract. One difference with respect to the previous contract is the absence of the animal electrophysiology research line, which will not be continued in the future contract. In the near future (next funding period) the unit is well positioned to achieve a number of important milestones: 1) the identification of sensitive and specific early biomarkers for cognitive and neurological development in neonates and children at risk of developing such deficits later in life; 2) to conduct larger scale studies on outcome prediction in those populations showing the benefit of early non-invasive neuroimaging methods developed by GRAMFC; 3) to continue the path of innovation and eventual commercialisation of those technologies.

The unit has the experience and composition, in terms of clinical and technical expertise, as well as the environment (academic and clinical networks) to achieve those important goals.