Project report 2020

BOSMA

Blood flOw Simulation for Medical Applications

MAIN PARTICIPANTS

			
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OVERVIEW *(keep within this page)*

Starting year: 2019 **Current researchers** (permanent/non-permanent): 3 person-month/year

Positioning *(Multiple selection allowed – total 100%)*	**Transportation**	**Energy**	**Eng. for Health**
Materials and structure design			
Surfaces and interfaces			
Simulation and modeling			100 %

Other:

Include partner from ☒ Outside ELyT ☐ Industry

Main funding source(s)
☒ Public project(s) ☐ Industrial ☐ Own resources

IFS CRP/LyC project? ☒ Yes ☐ No

For main projects: Agency / year / name of project *(up to 3, past projects in gray)*

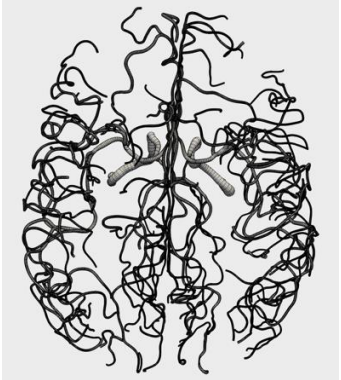
- Pack Ambition International from Région Auvergne-Rhône-Alpes, 2019-2022, SIMAVC
- INSA funding for PHD of Méghane Decroocq in the framework of ELyTMax

Estimated annual budget:10 K€

Highlights & Outstanding achievements *(3-5 bullet points)*

- We have developed a structured meshing methodology for large vascular networks
- We will soon provide a database of 60 high quality meshes of the whole cerebral arterial network, ready for CFD analysis
- Granted project from Région Auvergne-Rhône-Alpes, 2019-2022, SIMAVC

Illustration *(5x5 cm² max)*



PROJECT DESCRIPTION

Background (10 lines max; Calibri 11)

Cerebrovascular disease includes all disorders in which an area of the brain is temporarily or permanently affected by lack of blood flow. Understanding the inner workings of the cardiovascular system has been central to many studies involving clinical, interventional or computational approaches. Although the collected in-vivo measurements can be highly accurate, such interventional techniques are sometimes expensive and suffer from limitations that are not easy to address, e.g., difficulties of placing probes in cerebral arteries. These limitations motivate the use of non-invasive measurement techniques such as bio-medical imaging (Doppler ultrasound or Magnetic Resonance Imaging). However, critical variables such as the pressure cannot be directly measured by a non-invasive technique. Recent advances in clinical measurement and computational modeling techniques introduce new capabilities for monitoring the human cardiovascular dynamics.

Key scientific question (2 lines max; Calibri 11)

Make fluid dynamics simulation as realistic as possible
Analyze information provided by medical imaging to improve the accuracy of the simulations
Create fully virtual databases available for machine learning approaches

Research method (8 lines max; Calibri 11)

The objectives of BOSMA encompass medical imaging, mesh geometry, fluid dynamics and machine learning. The idea of BOSMA is to simulate medical images with a high degree of physiological realism in the context of stroke and vascular malformations, in order to create datasets large enough to allow machine learning approaches to be effective. To do this, we develop high quality meshes of the whole cerebral arterial network (ready for CFD analysis) and image simulators enabling the generation of synthetic and annotated ground truth images and associated simulated acquired images.

Research students involved *(gray color for previous years)*

Ph.D. candidates (years, institution):

- Méghane DECROOCQ (2019-present, Directors: FRINDEL, LAVOUE and OHTA)

Master/Bachelor students (years):

- Yutaro KOHATA (2019-present, Directors: OHTA, ANZAI and FRINDEL)

Visits and stays *(gray color for previous years)*

FR to JP (date, duration):

- Méghane DECROOCQ (January-December 2021, 1 year)
- Méghane DECROOCQ (November 2019, 1 month)
- Méghane DECROOCQ (Oct.2018-March 2019, 6 months)

JP to FR (date, duration):

- Yutaro KOHATA (Sept-Oct. 2019, 2 months)

COMMUNICATIONS AND VALORIZATION

Conferences *(gray color for previous years)*

	Authors	Title	Conference	Date	City	Country	DOI *(if applicable)*
1	N. Debs, M. Decroocq, T.-H. Cho, C. Frindel	Patient-Specific Hemodynamic Simulation for Stroke Lesion Prediction	International Conference of Flow Dynamics	28-30 Oct. 2020	Sendai	Japan	
2	M. Decroocq , C. Frindel, M. Ohta, G. Lavoue	Meshing Arterial Networks from Manually Extracted Centerlines	International Conference of Flow Dynamics	28-30 Oct. 2020	Sendai	Japan	
3	M. Decroocq , C. Frindel, M. Ohta, G. Lavoue	Structured meshing of large vascular networks for computational fluid dynamics	Virtual Physiological Human	24-28 Aug. 2020	Paris	France	
4	Y. Kohata, H. Anzai, M. Ohta, M. Decroocq, C. Frindel, S. RIT	A study on Optical Flow Method for Hemodynamics Estimation	2ND INTERNATIONAL SYMPOSIUM ON COMPUTATIONAL BIOFLUID 2020	16 Dec. 2020	Johor	Malaysia	

Others *(gray color for previous years)*

	People	Event	Description	Date
1	M. Decroocq, C. Frindel, M. Ohta, G. Lavoue	ELyT Workshop 2020	Oral presentation	17-19 Feb., 2020
2	Y. Kohata, H. Anzai, M. Ohta, M. Decroocq, C. Frindel, S. Rit	ELyT Workshop 2020	Poster presentation	17-19 Feb., 2020
3	M. Decroocq, C. Frindel, M. Ohta, G. Lavoue	ELyT Workshop 2019	Oral presentation	9-12 March, 2019
4	M. Decroocq, C. Frindel	ELyT Seminar	Oral presentation	6 June, 2018