Matteo Falanga

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Date of birth: 10/06/1995 **Nationality:** Italian

WORK EXPERIENCE

[01/12/2024 – Current] **Research fellow**

University of Bologna

City: Cesena | **Country:** Italy

- Deepening the study of computational fluid dynamics in the left atrium and atrial appendage for cardioembolic risk stratification in patients with atrial fibrillation through validation with 4Dflow MRI.
- Effects of fluid dynamics in the left atrium after closure of the left atrial appendage.
- Study of pulmonary vein contraction in control and atrial fibrillation patients.

[01/11/2021 – 31/10/2024] **PhD student**

University of Bologna

City: Cesena | **Country:** Italy

- Computational fluid dynamics study in the left atrium and left atrial appendage for the stratification of cardioembolic risk in patients with atrial fibrillation.
- Study of left atrial contraction in patients with atrial fibrillation.

[01/05/2023 – 31/07/2023] **Research period abroad**

Karlsruhe Institute of Technology

City: Karlsruhe | **Country:** Germany

The research activity was focused on the definition of different regions belonging to the left atrium (LA) surface in order to separately evaluate different mechanical functions with respect to the global contraction. Fluid dynamic simulations were performed to evaluate the blood flow velocity within the LA using a realistic contraction model. Additional parameters to comprehensively assess LA fluid dynamics and the risk of thrombus formation were computed.

[2022 – 2024] **Academic tutor activity**

University of Bologna, Department of Electrical Energy and Information Engineering

City: Cesena | **Country:** Italy

- Tutoring activity in “Elementi di matematica per l’informatica” course by Prof. Frattagli Cristiano, a.y. 2021/2022 e 2022/2023;
- Tutoring activity in "Ingegneria Clinica e Informatica Medica" course and support and coordination activities in the "Smart Medical Imaging" course by Prof. Cristiana Corsi, a.y. 2023/2024.

[04/2021 – 10/2021] **University research assistant**

University of Bologna, Department of Electrical Energy and Information Engineering

City: Cesena | **Country:** Italy

Implementation of the analysis workflow in a multi-platform and open source environment for atrial fluid dynamics simulation in control subjects and subjects with atrial fibrillation.

[09/2020 – 02/2021] **Internship in electrophysiology room**

A.U.S.L. Romagna

City: Ravenna | **Country:** Italy

Internship in the electrophysiology room, U.O. Cardiology Hospital Santa Maria delle Croci (Ravenna).

Assistance in the electrophysiology room during cardiac ablation procedures and study of the state of the art of the technologies used for this purpose.

EDUCATION AND TRAINING

[08/2018 – 03/2021] **Master's Degree**

Alma Mater Studiorum - University of Bologna

City: Cesena | **Country:** Italy | **Field(s) of study:** Biomedical Engineering | **Thesis:** STUDY AND SIMULATION OF ATRIAL FLUID DYNAMICS IN ATRIAL FIBRILLATION

Biomedical signal processing, computational modeling, biomedical instrumentation, bioimaging processing.

[08/2014 – 03/2018] **Bachelor Degree**

Alma Mater Studiorum - Universiy of Bologna

City: Cesena | **Country:** Italy | **Field(s) of study:** Biomedical Engineering | **Thesis:** STUDY OF THREE MINIMALLY INVASIVE METHODS FOR THE MEASUREMENT OF HEART RATE

Fundamentals of chemistry and physics, biomaterials, analogue and digital electronics, biomedical instrumentation.

[08/2009 – 07/2014] **Expert in electronics and telecommunications**

I.T.T. Blaise Pascal

City: Cesena | **Country:** Italy |

LANGUAGE SKILLS

Mother tongue(s): Italian

Other language(s):

English

LISTENING B2 **READING** B2 **WRITING** B2

SPOKEN PRODUCTION B2 **SPOKEN INTERACTION** B2

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

DIGITAL SKILLS

My Digital Skills

Padronanza del Pacchetto Office (Word Excel PowerPoint ecc) | sistemi operativi noti: Windows, linux e MacOS. | conoscenza dell'ambiente di sviluppo Matlab, anche con l'ausilio del tool Simulink. | Competenze decisionali ■ Competenze di occupabilità ■ Competenze personali | Scientific software for 3D analysis and visualzation (Paraview) | 3D CAD Software (3D Slicer, Meshmixer, Solid Edge) | CFD (Computational Fluid Dynamics)

PUBLICATIONS

[2024] **A Digital Twin Approach for Stroke Risk Assessment in Atrial Fibrillation Patients**

Reference: Matteo Falanga, Camilla Cortesi, Antonio Chiaravalloti, Alessandro Dal Monte, Corrado Tomasi, Cristiana Corsi, Helyion, Volume 10, Issue 20

Stroke prevention is typically guided by the CHA_2DS_2-VASc score, which lacks precision for individual risk. This study introduces a digital twin model of the left atrium (LA) with computational fluid dynamics (CFD) simulations to improve personalized assessment. In the left atrial appendage (LAA), slower, oscillatory blood flow and stagnation were linked to increased thrombosis risk in atrial fibrillation (AF) patients. This method could enhance stroke risk stratification by integrating blood flow velocity parameters.

[2023] **Preliminary findings on left atrial appendage occlusion simulations applying different endocardial devices**

Reference: Nadia D'Alessandro*, Matteo Falanga*, Alessandro Masci, Stefano Severi, Cristiana Corsi, Front. Cardiovasc. Med., Sec. Cardiac Rhythmology

Atrial fibrillation (AF) is one of the most investigated arrhythmias since it is associated with a five-fold increase in the risk of strokes. In this context, the left atrial appendage (LAA) is the site of the highest clot formation, increasing the incidence of stroke in the AF population. The aim of this study was to simulate the fluid dynamics effects of LAA occlusion in AF patients to predict hemodynamic changes: two different types of closure devices were considered based on the plug and the pacifier principles on 3D LA anatomical models derived from real clinical data in five AF patients. CFD simulations were performed on the left atrium model before and after the occlusion with each device.

[2024] **Patient-specific left atrium contraction quantification associated with atrial fibrillation: A region-based approach**

Reference: Sachal Hussain, Matteo Falanga, Antonio Chiaravalloti, Corrado Tomasi, Cristiana Corsi, Computer Methods and Programs in Biomedicine

Atrial fibrillation (AF) disrupts atrial mechanical contraction, leading to irregular, uncoordinated, and slow blood flow which favors the formation of clots, primarily within the left atrium (LA). A standardized region-based analysis of the LA is missing, and there is not even any consensus about how to define the LA regions. In this study, we propose an automatic approach for regionalizing the LA into segments to provide a comprehensive 3D region-based LA contraction assessment. LA global and regional contraction were quantified in control subjects and in AF patients to describe mechanical abnormalities associated with AF.

[2024] **Computational Fluid Dynamics Simulations to Deepen Understanding of the Hemodynamic Underlying Atrial Fibrillation and Improve Therapeutic Approaches**

Reference: Camilla Cortesi, Matteo Falanga, Sachal Hussain, Nadia D'Alessandro, Corrado Tomasi, Alessandro Masci, Cristiana Corsi, Computational Fluid Dynamics - Analysis, Simulations, and Applications book chapter, 18 December 2024

This chapter explores various applications of patient-specific computational fluid dynamics (CFD) simulations to enhance understanding of the fluid dynamics underlying the onset and progression of atrial fibrillation (AF), optimize treatment strategies, and manage disease progression. CFD serves as a powerful, non-invasive tool for analyzing key parameters within the complex fluid dynamics of the left atrium in AF. Applications of our CFD model are discussed, focusing on parameters such as left atrial appendage ostium velocity, wall shear stress, and endothelial cell activation potential. These parameters are evaluated as potential indicators for quantitative prognostic assessment of AF, with an emphasis on their role in stroke risk prediction within the framework of precision medicine.