ESR12 - Image guided navigation technology in endovascular interventions: advanced CAE tools and mesh morphing

Keywords: biomechanics, abdominal aortic aneurysm, Multi-Physics Simulation, Patient-specific Models, navigation, virtual fields method, CFD, RBF, mesh morphing, ultrasound, CT.

General framework: 14 Early Stage Researchers (ESRs) will be offered doctoral positions as part of the MeDiTATe project, which is funded through the H2020 program: Marie Skłodowska-Curie Actions (MSCA) Innovative Training Networks – European Industrial Doctorate. The whole MeDiTATe project aims to develop state-of-the-art image based medical Digital Twins of cardiovascular districts for a patient specific prevention and treatment of aneurysms. The individual research projects of each ESR within MeDiTATe are defined across five research tracks: (1) High fidelity CAE multi-physics simulation with RBF mesh morphing; (2) Real time interaction with the digital twin by Augmented Reality, Haptic Devices and Reduced Order Models; (3) HPC tools, including GPUs, and cloud-based paradigms for fast and automated CAE processing of clinical database; (4) Big Data management for population of patients imaging data and high fidelity CAE twins; (5) Additive Manufacturing of physical mock-up for surgical planning and training to gain a comprehensive Industry 4.0 approach in a clinical scenario.

The work of each ESR, hired for two 18 months periods (industry + research) and enrolled in a PhD programme, will be driven by the multi-disciplinary and multi-sectoral needs of a multi-disciplinary research consortium (clinical, academic and industrial) which will offer the expertise of Participants to provide scientific support, secondments and training. Recruited researchers will become active players of a strategic sector of the European medical and simulation industry and will face the industrial and research challenges daily faced by clinical experts, engineering analysts and simulation software technology developers.

During their postgraduate studies they will be trained by the whole consortium receiving a flexible and competitive skill-set designed to address a career at the cutting edge of technological innovation in healthcare. The main objective of MeDiTATe is the production of high-level scientists with a strong experience of integration across academic, industrial and clinical areas, able to apply their skills to real life scenarios and capable to introduce advanced and innovative digital twin concepts in the clinic and healthcare sectors.

Description of the ESR project: The objective of this doctoral position is to support and improve the navigation technologies implemented by ESR11 by further adding and developing supporting technological components. The physical models manufactured during the ESR11 activities will be used to generate the computational models and run detailed computational fluid dynamics (CFD) simulations (as part of the Digital Twin) with the aim to predict the flow field in function of the dynamic anatomical deformation. In particular, the latter could be caused by movements/respiration as well as to instrument manipulations (endovascular catheters), and it will be numerically also handled through radial basis functions (RBF) mesh morphing techniques. During the first period the PhD student will work will be trained on computational fluid dynamics (CFD) modelling and simulations and on the use of radial basis functions (RBF) morphing approaches to parameterize the computational grid. During one month secondment at FTGM the researcher will gain insights on experimental tests concerning the advance

medical image processing to enable the processing of clinical medical data to build up 3D models. In the last period the ESR will be working alongside SINTEF researchers in the Research Group Medical Technology, in the Ultrasound and image-guided therapy laboratory using the open access navigation research platform (software) CustusX to work on multimodal image fusion (registration) and visualization.

Additional Information:
The ESR will be enrolled in the PhD programme of University of Rome "Tor Vergata" (Italy). The PhD thesis will take place at two different places: (a) RINA Consulting (Italy – Rome), where the researcher will be trained on CFD modelling and mesh morphing (https://www.researchgate.net/profile/Emiliano_Costa3); (b) SINTEF AS (Trondheim - Norway) in the Research Group Medical Technology where ESR will be working with researchers in their Ultrasound and image-guided therapy laboratory. A one-month secondment in the Fondazione Toscana G. Monasterio (Italy) is foreseen.

Benefits, salary and duration:
The selected candidate will receive a salary in accordance with the MSCA regulations for ESR. The gross salary includes a living allowance (€3,270 per month, subject to MSCA country correction coefficient, i.e. 104.4% for Italy and 130.6% for Norway), a mobility allowance (€600 per month), and a family allowance (€500 per month, if the researcher has family by the date of recruitment, regardless of whether the family will move with the researcher or not). The guaranteed funding is for 36 months (i.e. EC funding).

Eligibility criteria:
Applicants can be of any nationality and must hold a Master of Science degree (or equivalent) in engineering. They need to fully respect both eligibility criteria (to be demonstrated in the Europass CV): (a) Early-Stage Researchers (ESRs) must, at the date of recruitment by the beneficiary, be in the first four years (full-time equivalent research experience) of their research careers and have not been awarded a doctoral degree. (b) Conditions of international mobility of researchers: Researchers are required to undertake trans-national mobility (i.e. move from one country to another) when taking up the appointment. At the time of selection by the host organization, researchers must not have resided or carried out their main activity (work, studies, etc.) in Italy for more than 12 months in the 3 years immediately prior to their recruitment. Short stays, such as holidays, are not taken into account.

Candidate profile: Candidates with strong skills in mechanics (modelling) and biomechanics are expected. Motivation and interest in bioengineering applications is recommended. Excellent knowledge of written and spoken English is required.

How to apply: Send CV, cover letter, BSc and MSc degrees, and letters of recommendation to all the following recipients: biancolini@ing.uniroma2.it, emiliano.costa@rina.org and thomas.lango@sintef.no.