Innovative Training Networks (ITN)

Call: H2020-MSCA-ITN-2017

MultidisciplinarY training network for ATrial fibRillation monItoring, treAtment and progression

Project Nº: 766082

Start date of the project: 01/11/2017

Duration: 48 months

Project Coordinator: Luca Mainardi

INDIVIDUAL RESEARCH PROJECTS

This project has received funding from the European Union's Horizon 2020 research and Innovation programme under the Marie Skłodowska-Curie grant agreement No 766082.

Fellow	Host institution	PhD enrolment	Start date	Duration	Gross Salary
ESR1	Politecnico di Milano (ITALY)	Yes	May-Jul. 2018	36 months	~47000€-50000€/year

Project Title and Work Package(s) to which it is related: Bottom-Up study on the implications of interatrial block in the mechanisms of atrial fibrillation (WP2 – T2.1)

Supervisor: Luca Mainardi (luca.mainardi@polimi.it)

Co-Supervisor: Josè Felix Rodriguez (josefelix.rodriguezmatas@polimi.it)

Objectives:

- To study, in-silico, the influence that different interatrial conduction defects have on the morphology of the P-wave in patients with normal and dilated left atrium.
- To study the influence of anatomical variability of the interatrial connections on the interatrial conduction delay (IACD) associated with IAB on patients with normal and dilated left atrium.
- To study the effect of different atrial resynchronization pacing strategies on improving the IAB condition.

Expected Results:

- A comprehensive understanding of the mechanism related to IAB, helping to have both better diagnosis and better treatment of patients with AF
- A better interpretation of the ECG signal when different interatrial connections are abnormal, in the cases of normal and dilated left atrium
- A better understanding of the impact of anatomical variability on IAB and IACD helping to explain why some individuals develop interatrial conduction defects whereas others do not
- A reliable methodology for the selection of optimal pacing sites for resynchronization

Planned secondments:

- Universitat Politecnica de Valencia (M14) (3m): Experience of complementary numerical model
- Fondazione IRCCS Ca' Granda Ospedale Maggiore (M26) (1m): Experience on atrial resynchronization pacing therapies
- Medtronic BRC (M32) (2m): Feasibility on monitoring of IAB using subcutaneous implants supplied by BRC

Notes:

The candidates must comply with the Italian laws and Politecnico rules for signing the contract. In particular, they have to provide the original academic diploma or a true copy of the same made by an Italian authority.
Non-EU candidates must legally stay in Italy at the starting date of the activities. Please read carefully the file "Additional information of employment POLIMI" for further restrictions and information.
http://www.myatria.polimi.it

The hosting group: POLIMI is the largest Technical University in Italy and the Dipartimento di Elettronica, Informazione e Bioingegneria (DEIB) and the Dipartimento di Chimica, Materiali ed Ingegneria Chimica Giulio Natta (DCMC) are the departments involved in MY-ATRIA. Within the DEIB, the Biosignals-Bioimaging-Bioinformatics (BBB) Group will participate to this network. The Group has long standing expertise in the processing of vital signals, feature extraction, system modeling as well as in the implementation of these methodologies in wearable or portable devices. Within DCMC, the Laboratory of Biological Structure Mechanics (LaBS) will participate to this network. The group aims at basic and applied research in the various fields of biomechanics, through the integration of mathematical modelling and experimental testing. The research at LaBS spans from orthopaedic and spinal devices to micro-fluidic chips for cell assays, from endovascular devices to micromechanics of materials and tissues, from blood pumps to regenerative medicine technologies, and electrophysiology applications.

Fellow	Host institution	PhD enrolment	Start date	Duration	Gross Salary
ESR2	Universitat Politecnica de Valencia (SPAIN)	Yes	May-Jul. 2018	36 months	~43600€-46600€/year

Project Title and Work Package(s) to which it is related: Detailed 3-D computer models of human atria and torso for studying atrial fibrillation initiation and progression (WP2 – T2.2)

Supervisor: Javier Saiz (jsaiz@ci2b.upv.es)

Co-Supervisor: Lucia Romero (lromero@ci2b.upv.es)

Objectives:

- To develop detailed 3-D models of both normal and dilated atrial morphologies including anatomical details as well as electrophysiological heterogeneities.
- To develop electrophysiological models of the different AF types (paroxysmal, persistent, permanent), with different fibrosis degrees
- To develop models of ion channels mutations that can favour AF development and progression

Expected Results:

- Realistic computer models of atria with different anatomical, electrophysiological and structural characteristics.
- A relationship between the different AF types and biomarkers obtained from simulated surface bioelectrical signals
- Sensitivity analysis of different AF types and relation with ionic channel mutations.

Planned secondments:

- Politecnico di Milano (M14) (2m), Karlsruhe Institute of Technology (M27) (3m): To work on the numerical modelling and patient specific models of atria respectively
- Hospital Infanta Cristina, Badajoz (M20) (4m). To work on the anatomy and physiology of the atria (fibre orientation)
- Mortara Instrument Europe (M16) (1m). To work the analysis and data collection of signals of patients with different AF types for validation purpose.

Notes:

The candidates must comply with the Spanish laws and Universitat Politècnica de València rules for signing the contract. In particular, they have to provide the original academic diploma or a true copy of the same made by a Spanish authority.

Non-EU candidates must legally stay in Spain at the starting date of the activities.

For further information visit http://www.myatria.polimi.it

The hosting group: The Universitat Politècnica de València (UPV) is one of the four public universities in the Valencian Community (Spain). More than 4,000 teachers and researchers work in this university that has about 35,000 students. One of its main interests is research and UPV belongs to the top ten Spanish Universities with the highest degree of involvement in National and European projects. Further, the UPV is one of the top Spanish universities in the creation of spin-off companies. The UPV understands that spin-off companies are the most effective and complete mechanism for transferring innovative technology to society.

The Centre for Research and Innovation in Bioengineering (Ci2B) of the UPV and was founded 23 years ago. Ci2B has developed cardiac action potential models of different tissues (atrium, ventricles, Purkinje) and species (mainly rabbit, dog, guinea-pig and human), and has proposed the formulation of new ionic currents. The members of the Ci2B are familiar with a variety of tissue structures (unicellular, one-dimensional, bi-dimensional and more recently three-dimensional). The Ci2B has strong collaborations with national and international leading experimental research groups and with medical technology and pharmacological companies.

Fellow	Host institution	PhD enrolment	Start date	Duration	
ESR3	Karlsruhe Institute of Technology (GERMANY)	Yes	May-Jul. 2018	36 months	**Gross Salary** ~44064€-47064€/year

Project Title and Work Package(s) to which it is related: Body Surface Potential Maps and ECG-signals of AF (WP2 – T2.3)

Supervisor: Olaf Doessel (olaf.doessel@kit.edu)

Co-Supervisor: Axel Loewe (axel.loewe@kit.edu)

Objectives:

- To understand the relationship between various patterns of depolarization in the atria during Sinus Rhythm, Atrial Flutter and Atrial Fibrillation and the corresponding 12-lead ECG and BSPM.
- To understand which of the atrial depolarization patterns can be detected, identified or localized reliably based on BSPMs and in a 12-lead-ECG.

Expected Results:

- Identification of depolarization patters on the atria that can be reconstructed by solving the inverse problem of ECG ("ECG-imaging").
- Sensitivity analysis to assess whether different patterns can be separated, showing up the unique features ("fingerprints") of specific patterns (like e.g. rotors)
- Identification (if possible) of ectopic centres (e.g. from the orifice of the pulmonary veins), of rotors (assessing their size and stability over time), of regions of slow conduction and of low-voltage areas from BSPM and 12-lead-ECG.

Planned secondments:

- Università degli Studi di Milano (M14) (2m), Universidad de Zaragoza (M20) (3m): To work on the advanced ECG signal analysis techniques
- Mortara Instrument Europe (M28) (2m). To work on ECG-imaging
- Karlsruhe Hospital (M17, M32) (1m+2m). To work on the acquisition of ECG and BSPM

Notes:

Candidates who do not hold a Master Degree in Electrical Engineering and Information Technology compatible to the Master degree at KIT must pass three lectures and exams in topics of Electrical Engineering and Information Technology during the first year in parallel to their doctoral research.

For further information visit http://www.myatria.polimi.it

The hosting group: KIT – Karlsruhe Institute of Technology (the former Universitaet Karlsruhe) is University of the State of Baden-Wuerttemberg and National Research Center of the Helmholtz Association with 5600 scientists and 24.000 students (www.kit.edu). The Institute of Biomedical Engineering (IBT) is the leading laboratory in this field of competence at KIT joining forces with other laboratories active in this field e.g. in the Departments of Information Sciences, Mechanical Engineering and Biology. Research topics of IBT span from cardiac modeling and simulation, biosignal analysis of intracardiac electrograms and ECG and ECG-imaging (the inverse problem of ECG). IBT is among the top 5 laboratories in Germany in Biomedical Engineering. Currently, two Professors, one Associate Professor and 14 scientists are doing research at IBT. They are supported by a technical staff of five persons.

Fellow ESR4	**Host institution** Università degli Studi di Milano (ITALY)	**PhD enrolment** Yes	**Start date** May-Jul. 2018	**Duration** 36 months	**Gross Salary** ~47000€-50000€/year

Project Title and Work Package(s) to which it is related: Atrial complex networks in endocavitary recordings during AF (WP2 – T2.4)

Supervisor: Roberto Sassi (roberto.sassi@unimi.it)

Co-supervisor: Massimo Walter Rivolta (massimo.rivolta@unimi.it)

Objectives:

- To study concurrent EGMs collected in different positions within the atria in term of complex network measures
- To quantify local circuitry and their stability

Expected Results:

- A solid background in the theory of complex network and in the electrophysiological properties of the atria
- Testing and selection of relevant metrics, using computer simulation of the electrical activity of the atria
- A validation of the metrics with the design of proper experimental protocol to be conducted, after informed consent, during routine electrophysiological interventions

Planned secondments:

- Universitat Politecnica de Valencia (M14) (3m), Universidad de Zaragoza (M24) (2m): Complementary expertise in endocardial networks and endocardial EGM signal analysis, respectively
- Medtronic BRC (M20) (1m): Signal analysis and data collection of EGM signals from available clinical studies
- Fondazione IRCCS Ca' Granda Ospedale Maggiore (M30) (1m): Complementary expertise in clinical endocardial procedures

Notes:

The candidates must comply with the Italian laws and Università degli Studi di Milano rules for signing the contract. In particular, they have to provide the original academic diploma or a legalized copy of the same made by an Italian authority. Non-EU candidates must legally stay in Italy at the starting date of the activities. Additional requirements are listed in the file "Additional information of employment UMIL".
For further information visit http://www.myatria.polimi.it

The hosting group: Università degli Studi di Milano (UMIL), member of the League of European Research Universities (LERU), is a public teaching and research university, distinguished by its wide variety of disciplinary fields and the largest university in the region (65000 students and a teaching staff of about 2200 professors). The Department of Computer Science (DCS) is the unit directly involved in MY-ATRIA. Within the DCS, the BiSP (Biomedical image and Signal Processing) group will participate to the MY-ATRIA network. The BiSP group has a significant expertise in biomedical signal processing, computer simulations, information processing technology and systems, applied mathematics, and wearable technologies. The Department of Clinical Sciences and Health Community (DCSHC) will also be involved in the education of the Ph.D. student, with specific regard to the acquisition of medical signals and definition of the medical experimental protocols. DCSHC has a long-lasting experience in the autonomic regulation of cardiovascular system.

Fellow	Host institution	PhD enrolment	Start date	Duration	Gross Salary
ESR5	Mortara Instrument Europe (ITALY)	Yes	May-Jul. 2018	36 months	~47000€-50000€/year

Project Title and Work Package(s) to which it is related: Paroxysmal atrial fibrillation: Continuous tracking of arrhythmia progression (WP3 – T3.1)

Supervisor: Johan De Bie, PhD (Johan.DeBie@mortara.com**)**

Co-Supervisor: Nicoletta Marzocchi, PhD (Nicoletta.Marzocchi@mortara.com)

Objectives:

- To develop noise-proof techniques that make it possible to continuously monitor and track the properties of paroxysmal atrial fibrillation (PAF) episodes, capable of detecting episodes as brief as 5s, where both intra- and interepisode information is taken into account.
- To study the correlation between brief PAF episodes and the risk for stroke.
- To evaluate the resulting algorithms under ambulatory circumstances to make sure that the performance remains reliable also in the presence of various types of disturbances.

Expected Results:

- Novel methodology for analysing and characterizing the progression of PAF.
- Feasibility analysis of the developed methodology for the purpose of predicting risk of ischemic stroke.

Planned secondments:

- Lund University (M10, M22, M34) (2m+2m+2m): To receive training on related subjects such as medical image analysis; risk and research ethics; biomedical, optimal, adaptive signal processing; academic writing; project management; innovation and value creation.
- Skåne University Hospital (M26) (1m): To develop means and methods for describing and visualizing the density of AF episodes.
- Fondazione IRCCS Ca' Granda Ospedale Maggiore (M17, M32) (1m+1m): Acquisition of clinical data and testing of algorithms under ambulatory conditions.

Notes:

Candidates must be willing to agree not to disclose any company confidential information learned in the course of the project

Non-EU candidates must legally stay in Italy at the starting date of the activities.

This ESR will pursue the PhD program at Lund University in Sweden and must comply with its rules for enrollment. See https://www.lth.se/english/education/phd-studies/ and

https://www.lth.se/fileadmin/lth/lthhandboken/utbildningforskning/forskarutbildning/Biomedicinsk_teknik_2014-05-16_eng.pdf. The duration of the PhD program at Lund University is minimum four years.

For further information visit http://www.myatria.polimi.it

The hosting group: Mortara Instrument Europe s.r.l. is the Italian subsidiary of Mortara Instrument Inc., based in Milwaukee, USA (www.mortara.com). Mortara Instrument is a leading manufacturer of ECG-equipment, long term ambulatory monitoring equipment. The philosophy of Mortara is to continuously innovate, developing equipment and algorithms that are clinically useful and economically affordable. The company has developed a large number of innovative algorithms involving ECG processing analysis and interpretation, which are used in its products. The team in Italy consists of 11 qualified software engineers as well as the Chief Scientific Officer of the Mortara group, who is leading the algorithm development group physically located in Milwaukee. Participation in MY-ATRIA will allow us to experience new methods to measure the effectiveness of long term monitoring for atrial arrhythmias, in addition to the development of a multivariate database of long term continuous monitoring.

Fellow	**Host institution**	**PhD enrolment**	**Start date**	**Duration**	**Gross Salary**
ESR6	Lund University (SWEDEN)	Yes	May-Jul. 2018	36 months	~48876€-51876€/year

Project Title and Work Package(s) to which it is related: AF screening using everyday sensors and data fusion (WP3 – T3.2)

Supervisor: Leif Sornmo (leif.sornmo@bme.lth.se)

Co-Supervisor: Martin Stridh (martin.stridh@bme.lth.se)

Objectives:

- To develop robust techniques for detection of AF in cardiovascular signals obtained using everyday sensors (from optical sensors, e.g. mobile phone cameras, bioelectric signals, e.g. thumb ECG, mechanical measurements, e.g. ballistocardiogram and seismocardiogram).
- To study the interaction between the different signal modalities during AF.
- To study the feasibility of data fusion for improved detection of AF.
- To evaluate the resulting algorithms with respect to robustness to noise during ambulatory conditions.

Expected Results:

- Novel methodology for detecting AF, particularly well-suited for implementation in wearable devices where extremely low energy consumption is required for continuous detection during long time periods.
- Novel methodology for robust detection of AF using everyday sensors which can be used for AF screening in the general population.

Planned secondments:

- Universidad de Zaragoza (M14) (2m) and Politecnico di Milano (M20) (3m): To develop optimal fusion methods for signal information obtained using different types of everyday sensors.
- Empatica: (31) (1m): To test methods for AF detection in everyday sensors.
- Gradiant (M16) (1m): To develop noise-proof techniques for wearable devices.
- Skåne University Hospital (M19, M32) (1m+1m): Acquisition of clinical data.

Notes:

See https://www.lth.se/english/education/phd-studies/ and https://www.lth.se/fileadmin/lth/lthhandboken/utbildningforskning/forskarutbildning/Biomedicinsk_teknik_2014-05-16_eng.pdf. The duration of the PhD program at Lund University is minimum four years.

For further information visit http://www.myatria.polimi.it

The hosting group: Lund University (LU) is the largest in Scandinavia, and houses the two units participating in the current application: (1) the newly created Department of Biomedical Engineering (2014) and (2) Department of Cardiology, Clinical Sciences (Faculty of Medicine). The well-known research groups in biomedical signal processing and cardiac electrophysiology will participate in the proposed training network. A variety of research projects are currently pursued by the groups in biomedical applications, including issues in electrocardiology, dialysis, neuroengineering, and eye-tracking. Atrial fibrillation represents the main research focus, reflected by over 100 journal papers published during the last 10 years. The groups have long-standing collaboration with Swedish medical industry which to date has led to 10 patents.

Fellow	Host institution	PhD enrolment	Start date	Duration	Gross Salary
ESR7	Lund University (SWEDEN)	Yes	May-Jul. 2018	36 months	~48876€-51876€/year

Project Title and Work Package(s) to which it is related: Risk stratification and prediction of intervention outcome in AF using novel ECG-based markers of atrial remodelling (WP3 – T3.3)

Supervisor: Leif Sornmo (leif.sornmo@bme.lth.se)

Co-Supervisor: Pyotr Platanov (pyotr.platanov@med.lu.se)

Objectives:

- To study natural course and limits of applicability of novel atrial fibrillatory wave characteristics in patients with different types of AF
- To assess feasibility of non-invasive monitoring of effect of antiarrhythmic drugs during AF using real-time measurements of atrial fibrillatory rate
- To assess the implementation AFR in a single lead subcutaneous monitoring device and its clinical utility in prediction of the effects of a specific therapy and remote therapy management

Expected Results:

- Reference values for the key markers of atrial fibrillatory process detectable from surface ECG in different patient categories and subtypes of AF including patients with and without structural heart disease
- Assessment of the predictive value of atrial fibrillatory wave characteristics for prediction of the effect of interventions for AF such as administration of antiarrhythmic drugs, cardioversion or catheter ablation of AF
- Comprehensive understanding of the atrial fibrillatory rate implementation in a single lead monitoring device. A comprehensive algorithm will be created including the AF detection, atrial fibrillatory rate extraction and RR interval variability assessment.

Planned secondment(s):

- Skåne University Hospital (M13, M23, M31) (1m+1m+1m): Acquisition and treatment of clinical data
- Medtronic BRC (M15) (3m): To work on the assessment of atrial fibrillatory characteristics in long-term monitored with subcutaneous implants supplied by BRC.
- Università degli Studi di Milano (M26) (3m): To work on efficient algorithms for ECG-markers computations and risk stratification.

Notes:

See https://www.lth.se/english/education/phd-studies/ and https://www.lth.se/fileadmin/lth/lthhandboken/utbildningforskning/forskarutbildning/Biomedicinsk_teknik_2014-05-16_eng.pdf. The duration of the PhD program at Lund University is minimum four years.

For further information visit http://www.myatria.polimi.it

The hosting group: Lund University (LU) is the largest in Scandinavia, and houses the two units participating in the current application: (1) the newly created Department of Biomedical Engineering (2014) and (2) Department of Cardiology, Clinical Sciences (Faculty of Medicine). The well-known research groups in biomedical signal processing and cardiac electrophysiology will participate in the proposed training network. A variety of research projects are currently pursued by the groups in biomedical applications, including issues in electrocardiology, dialysis, neuroengineering, and eye-tracking. Atrial fibrillation represents the main research focus, reflected by over 100 journal papers published during the last 10 years. The groups have long-standing collaboration with Swedish medical industry which to date has led to 10 patents.

Fellow	Host institution	PhD enrolment	Start date	Duration	Gross Salary
ESR8	Medtronic BRC (NETHERLAND)	Yes	May-Nov. 2018	36 months	~46116€-49116€/year

Project Title and Work Package(s) to which it is related: Assessment of the AF triggers and their role in its progression (WP3 – T3.4)

Supervisor: Mirko De Melis (mirko.de.melis@medtronic.com)

Co-Supervisor: Lilian Kornet (lilian.kornet@medtronic.com)

Objectives:

- To characterize the role of premature atrial activity (PAC) in the onset of AF in combination with other ECG parameters, like atrial fibrillatory rate.
- To develop a PAC detector for a single lead continuous monitoring device, surface or subcutaneous.
- To assess in specific clinical applications, i.e. ablation, if this approach can predict AF progression

Expected Results:

- A comprehensive understanding of the PACs role as AF trigger and its combination with atrial fibrillatory rate to predict AF occurrence and to characterize its nature.
- A comprehensive algorithm suitable for implementation in a single subcutaneous or surface, monitoring device; testing and validation will be done using the datasets coming from BRC clinical studies.
- A clinical feasibility study, retrospective or prospective, where the patient status will be assessed using the aforementioned algorithm to predict AF progression.

Planned secondment(s):

- Lund University (M15) (2m), Politecnico di Milano (M20) (2m): To develop and improve atrial fibrillatory rate monitoring techniques.
- Skåne University Hospital (M27) (2m): Acquisition of clinical data of patients subjected to AF monitoring using implantable devices.

Notes:

This ESR will pursue the PhD program at Politecnico di Milano. Therefore, the candidates must comply with the Politecnico requirements for joining the PhD program. In particular, they have to provide the original academic diploma or a true copy of the same made by an Italian authority.
For further information visit http://www.myatria.polimi.it

The hosting group: Medtronic Bakken Research Center (BRC) was founded in Maastricht in 1987 as a research facility (350 employees). The BRC played a major role in the creation and realization of several world class therapies, like Deep Brain Stimulation and Cardiac Resynchronization Therapy and collaborated with Maastricht University Hospital in the definition of Atrial Fibrillation models. POLIMI is the largest Technical University in Italy and the Dipartimento di Elettronica, Informazione e Bioingegneria (DEIB) is one of the departments involved in MY-ATRIA. Within the DEIB, the Biosignals-Bioimaging-Bioinformatics (BBB) Group will participate to this network. The Group has long standing expertise in the processing of vital signals, feature extraction, system modeling as well as in the implementation of these methodologies in wearable or portable devices.

Fellow	Host institution	PhD enrolment	Start date	Duration	Gross Salary
ESR9	Politecnico di Milano (ITALY)	Yes	May-Nov. 2018	36 months	~47000€-50000€/year

Project Title and Work Package(s) to which it is related: Evaluation of the interplay mechanism between AF and AT detected by a single lead ECG (WP3 – T3.5)

Supervisor: Luca Mainardi (luca.mainardi@polimi.it)

Co-Supervisor: Valentina Corino (valentina.corino@polimi.it)

Objectives:

- To characterize the role relationship between AT and AF.
- To develop an AT detector for a single lead continuous monitoring device, surface or subcutaneous.
- To assess in specific clinical applications, i.e. anti-arrhythmic drug regimen, if it is possible to discriminate the effect of the drugs in the AT/AF interplay.

Expected Results:

- Improved characterization of AT in combination with AF, for example as its trigger, and to capture the transition from AF to AT following a specific therapy
- An AT detector, for single lead surface or subcutaneous monitoring devices, with the intent of reaching high specificity, operating in parallel to current AF detection techniques; this combined algorithm is expected to keep high predictive value of the AF detection while having good specificity of AT detection
- A clinical feasibility study, retrospective or prospective, where the AT/AF relationship before and after drugs prescription would be assessed using the aforementioned algorithm

Planned secondments:

- Lund University (M15) (4m): Experience of complementary signal processing on AF detection
- Fondazione IRCCS Ca' Granda Ospedale Maggiore (M19) (1m): Exposure to clinical procedures
- Medtronic BRC (M23) (4m): engaged in clinical studies with single lead monitoring techniques (subcutaneous and surface)
- Empatica (M32) (1m): Experience on the design and development of single lead instruments

Notes:

The candidates must comply with the Italian laws and Politecnico rules for signing the contract.
In particular, they have to provide the original academic diploma or a true copy of the same made by an Italian authority.
Non-EU candidates must legally stay in Italy at the starting date of the activities.
Please read carefully the file "Additional information of employment POLIMI" for further restrictions and information http://www.myatria.polimi.it

The hosting group: POLIMI is the largest Technical University in Italy and the Dipartimento di Elettronica, Informazione e Bioingegneria (DEIB) is the largest Department of POLIMI with 250 faculties. Within the DEIB, the Biosignals-Bioimaging-Bioinformatics (BBB) Group will participate to this network. The Group has long standing expertise in the processing of vital signals (EEG, evoked potentials, ECG, arterial pressure, respiration, etc ...), feature extraction, system modeling as well as in the implementation of these methodologies in wearable or portable devices. It has been the pioneer in the application of the parametric spectral estimators to HRV analysis and it is a leading group in the development of time-frequency methods for biological signals characterization.

Fellow	Host institution	PhD enrolment	Start date	Duration	
ESR10	Karlsruhe Institute of Technology (GERMANY)	Yes	May-Nov. 2018	36 months	**Gross Salary** ~44064€-47064€/year

Project Title and Work Package(s) to which it is related: Integrated and personalized computational model of atria with AF for an efficient ablation therapy (WP4 – T4.1)

Supervisor: Olaf Doessel (olaf.doessel@kit.edu)

Co-Supervisor: Axel Loewe (axel.loewe@kit.edu)

Objectives:

- To develop computational models of the atria (with substrate modifications like fibrosis, slow conduction, lines of block) of patients suffering from AF including lines of ablation from a first (unsuccessful) ablation procedure.
- To compare in-silico arrhythmic depolarization patterns with the patterns observed in electrophysiological investigations during ablation procedures (EP-lab) on the patients using multi-electrode catheters and to develop an FEM forward calculation framework to adapt the model of the atria iteratively to fit to the measured signals.
- To compare various methods to determine AF vulnerability of atrial computer models (e.g. induce AF with a rapid pacing protocol or with a large number of S1-S2 stimuli) and to find the most robust and reliable.
- To implement a tool that enables the cardiologist to create ablation points and lines in the personalized atrial model and test AF vulnerability afterwards. The ablation pattern that is able to prevent the onset and continuation of AF will be determined.

Expected Results:

- A method for personalization of the atrial model, by iterative comparison the patterns of depolarization of a specific patient (measured in the EP-lab) with the patterns of the computational model.
- A method to test AF vulnerability of an atrial model.
- A first estimate of the inter-individual variability of patients related to the ablation outcome.
- A tool helping the cardiologist to predict the ablation outcome.

Planned secondment(s):

- Universitat Politecnica de Valencia (M15) (3m): To work on patient specific models of atria
- Medtronic BRC (M32) (2m). To work on AF-monitoring
- Karlsruhe Hospital (M25) (3m). To work on the acquisition of clinical data.

Notes:

Candidates who do not hold a Master Degree in Electrical Engineering and Information Technology compatible to the Master degree at KIT must pass three lectures and exams in topics of Electrical Engineering and Information Technology during the first year in parallel to their doctoral research.

For further information visit http://www.myatria.polimi.it

The hosting group: KIT – Karlsruhe Institute of Technology (the former Universitaet Karlsruhe) is University of the State of Baden-Wuerttemberg and National Research Center of the Helmholtz Association with 5600 scientists and 24.000 students (www.kit.edu). The Institute of Biomedical Engineering (IBT) is the leading laboratory in this field of competence at KIT joining forces with other laboratories active in this field e.g. in the Departments of Information Sciences, Mechanical Engineering and Biology. Research topics of IBT span from cardiac modeling and simulation, biosignal analysis of intracardiac electrograms and ECG and ECG-imaging (the inverse problem of ECG). IBT is among the top 5 laboratories in Germany in Biomedical Engineering. Currently, two Professors, one Associate Professor and 14 scientists are doing research at IBT. They are supported by a technical staff of five persons.

Fellow	Host institution	PhD enrolment	Start date	Duration	Gross Salary
ESR11	Universidad de Zaragoza (SPAIN)	Yes	May-Nov. 2018	36 months	~43600€-46600€/year

Project Title and Work Package(s) to which it is related: Assessment of AF therapies targeting ion channels and neural components (WP4 – T4.2)

Supervisor: Pablo Laguna (laguna@unizar.es)

Co-Supervisor: Esther Pueyo (epueyo@uniza.es)

Objectives:

- To assess the effect of anti-AF drugs modulating conductance and kinetics of the main ionic currents on personalized atrial models.
- To identify autonomic interventions that, on its own or in combination with anti-arrhythmic drugs, have the capacity to stop AF.

Expected Results:

- Realistic computer models of human atria with description of sympathetic and parasympathetic modulation of atrial electrical activity
- Determination of how sympathetic and parasympathetic stimuli act to modulate initiation and maintenance of AF.
- Description of anti-arrhythmic drug effects on personalized human atrial models.
- Characterization of the effects of autonomic interventions on stopping AF, both on its own and combined with modelled anti-arrhythmic drugs.

Planned secondments:

- Politecnico di Milano (M14) (2m), Karlsruhe Institute of Technology (M25) (3m): To work on the numerical modelling and patient specific models of atria, respectively, with incorporation of autonomic modulation of atrial activity.
- Karlsruhe Hospital (M24) (1m). To acquire clinical data relevant to drug therapy for treatment of AT and AF.
- Mortara Instrument Europe (M16) (1m). To work on the analysis and data collection of signals of patients with AF under drug therapy.

Notes:

The candidates must have a university degree in engineering, mathematics or physics plus master of science degree in related disciplines. Experience in signal processing, statistical data analysis and numerical simulations is advantageous. The candidates must comply with the Spanish laws and Zaragoza university rules for signing the contract. In particular, they have to provide the original academic diploma or a legalized copy of the same made by a Spanish authority.

For further information visit http://www.myatria.polimi.it

The hosting group: The Aragon Institute of Engineering Research (I3A), within the University of Zaragoza, comprises more than 500 researchers and a vibrant environment for multidisciplinary research. I3A has gained notable national and international recognition. Every year I3A participates in more than 300 research projects funded with over 10 M€ and more than 200 contracts with industry with 5 M€ turnover. Around 50 PhD theses supervised by I3A members are defended and nearly 300 papers are published in JCR journals every year. The Biomedical Signal Interpretation and Computational Simulation group at I3A, University of Zaragoza is a leading expert in the development of signal processing tools to aid in the diagnosis, prognosis and treatment of cardiovascular diseases and conditions. The expertise in processing of invasive and non-invasive signals is combined with modeling and simulation of cardiac electrophysiology to provide insight into the mechanisms underlying phenomena observed from the processed signals.

Fellow	Host institution	PhD enrolment	Start date	Duration	Gross Salary
ESR12	Universidad de Zaragoza (SPAIN)	Yes	May-Nov. 2018	36 months	~43600€-46600€/year

Project Title and Work Package(s) to which it is related: Effect of atrial fibrillation dynamics on the efficacy of ablation therapies (WP4 – T4.3)

Supervisor: Pablo Laguna (laguna@unizar.es)

Co-Supervisor: Juan Pablo Martínez (jpmart@unizar.es)

Objectives:

- To identify features from single-site EGM and simultaneous multisite EGM, whose mapping can be used to guide the ablation in the Electrophysiological Lab and to predict its efficacy.
- To simulate different AF rhythms to study the effect of different EGM-based ablation strategies, using computer models with different pathological and anatomical conditions.
- To characterize spatially sampled intra-atrial signal patterns (acquired either sequentially or simultaneously) and establish their relationship to the entire atrial activation pattern.

Expected Results:

- A tool to study the relationship between AF rhythms, EGM signals and the efficacy of ablation strategies.
- EGM signatures for different types of atrial activity (characterized by its different propensity to recur after different ablation strategies).
- Assessment of the ability of different features mapped from sequentially or simultaneously acquired intracardiac EGM to identify atrial activity type and the ablation sites that would most likely terminate AF.
- Determination of the requirement for spatially sampled intra-atrial analysis in terms of density of sites and type of acquisition required (is it possible to get similar information just from sequentially acquired sites?).
- Characterization of the activation patterns observed after the application of ablation and their correlation with the efficacy of ablation strategies.

Planned secondments:

- Universitat Politecnica de Valencia (M14) (2m) and Karlsruhe Institute of Technology (M25) (2m): To work with signals from patient-specific atrial models and modelling of ablation therapies treatment.
- Hospital Infanta Cristina, Badajoz (M12) (1m) and Karlsruhe Hospital (M24) (1m): To work in the database acquisition of surgical interventions.
- Gradiant (M16) (1m): To develop noise-proof techniques for monopolar signals.

Notes:

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