



**Operational Program European Social Fund - Regione Liguria 2014-2020
ASSE 3 "Education and training"**



UNIVERSITÀ DEGLI STUDI
DI GENOVA

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EXCERPT OF INFORMATION SHEET SCIENCE AND TECHNOLOGY FOR ELECTRONIC AND TELECOMMUNICATION ENGINEERING	
GENERAL INFORMATION	
STRUCTURE OF THE TRAINING PROJECT	
DURATION AND ORGANIZATION OF THE COURSE	<p>The course starts officially on 1 of November 2018 and lasts three years. At the end of each year, doctoral students shall present the Teaching Body with a detailed written account of the activities carried out. The Teaching Body may ask for the account to be discussed according to procedures it has established.</p> <p>Coordinator of the course: Prof. Mario Marchese E-mail address: Mario.Marchese@unige.it Department coordinating for research: Department of Marine, Electrical, Electronic and Telecommunications Engineering (Dipartimento di Ingegneria navale, elettrica, elettronica e delle telecomunicazioni – DITEN)</p>
TRAINING PROJECT	<p>The following 3 projects/scholarships are activated:</p> <p>Curriculum: ELECTROMAGNETISM, ELECTRONICS, TELECOMMUNICATIONS (CODE 7312)</p> <p><u>Project/scholarship No. 1: Study and implementation of an innovative IoT system for rehabilitation and coaching of post-ictus patients in domestic environment.</u></p> <p><i>Months abroad: 4.</i></p> <p><i>In cooperation with:</i></p> <ul style="list-style-type: none"> • DITEN – Dipartimento di Ingegneria Navale, Elettrica, Elettronica, delle Telecomunicazioni • Dipartimento di Neuroscienze, Riabilitazione, Oftalmologia, Genetica e Scienze Materno-Infantili (DINOEMI) • A.L.I.Ce. Italia Onlus – Associazione per la Lotta all'Ictus Cerebrale • SI4Life • VAR Group SPA • VarConnect S.r.l. • Polo Ligure Scienze della Vita

Project/scholarship details:

Stroke is an acute pathological condition caused by a cerebrovascular disease that affects 6.5% of the Italian population. It is the most common cause of disability. In fact, those who survive present focal neurological deficits including, often, weakness and lack of dexterity in the lower limbs, which results in a compromise quality of life. Rehabilitation in the immediately post-acute phase requires hospitalization; however, it has been shown that home-based rehabilitation is effective. For this reason, the use of a tool that is easy to wear and linked to a platform that can be used by health personnel would allow the execution of therapeutic exercises at the patient's home with a continuous monitoring that guarantees safety and effectiveness.

The project proposes a highly innovative solution, easy to use and at low cost, for post-acute functional recovery of the lower limbs at home. In this context, the development of a prototype of a monitoring system for recovery activity based on wearable sensors, non-invasive, easily usable at home without the assistance of local health personnel, which, in the form of trousers, according to the Internet of Things paradigm, allows the specific monitoring of the patient's movements during physiotherapy activities, or also generic motor activity and provides, both to the patient (and his family) and to the health personnel, through appropriate interfaces, information related to the recovery progression.

It is important noticing that the prototype, although it is not the first example of trousers with sensors (they exist on the shelf for purposes mainly related to fun and fitness), will represent the first system of this type with specific rehabilitation purposes, which stimulates the patient (coaching) and allows automatic verification of the progression of functional recovery.

From a functional point of view, the system will be based on the processing of signals from various sensors that involves a low-level pre-processing phase (e.g., filtering, fragmentation, frequency pre-analysis) used in a classification framework and recognition of the movement based on the most modern signal and data analysis techniques such as, for example, the classification methods based on Neural Networks, Support Vectors Machines and Gaussian Mixtures.

The prototype will be tested with patients both at the Neurological Clinic of Genoa and at the rehabilitation centre of the ASL4 Chiavarese to verify the effectiveness of the prototype solution and calibrate its functions.

Project/scholarship No.2: Web-based platforms for medical imaging and surgical and rehabilitation therapy for musculoskeletal system pathologies.

Mesi all'estero: 4

In cooperation with:

- DITEN - Dipartimento di Ingegneria Navale, Elettrica, Elettronica, delle Telecomunicazioni
- Dipartimento di scienze chirurgiche e diagnostiche integrate (DISC)
- Dipartimento di Medicina Interna e specialità mediche (DIMI)
- IMATI (Istituto di Matematica Applicata e Tecnologie Informatiche "Enrico Magenes"), Consiglio Nazionale delle Ricerche (CNR)
- SOFTECO SISMAT srl
- Animareum srl (PMI)
- Polo Ligure Scienze della Vita

Project/scholarship details:

Musculoskeletal rheumatic diseases are among the most common chronic conditions affecting the European population and include numerous diseases that are differentiated by the symptomatology and by the signs by which they occur. They are inflammatory degenerative diseases for which there are no

definitive treatments but only clinical treatments that control and slow down the degenerative phenomenon, mitigating the painful symptoms. The new diagnostic imaging modalities, in particular Magnetic Resonance imaging, have shown great potential for the early diagnosis of these pathologies. At the same time, the recent development of new data analysis and multidimensional visualization techniques increases and improves the information available to the physicians during the diagnostic and follow-up process. The fusion of images and tomographic volumes allows creating a single image / volume starting from different acquisitions, synthesizing various information contents in a single integrated data.

The disability caused by musculoskeletal diseases is a dynamic, modifiable process, and includes the effects due to an erroneous gesture that aims to protect the diseased joint. In this context, the role played by rehabilitative activities is fundamental and integral part of medical therapy, for the basic function that they can play in order to improve the quality of life of the person. In the cases of advanced pathology, a minimally invasive surgical technique is used or, possibly, the natural joint is replaced with an artificial prosthesis. Even in these cases the rehabilitation plays a fundamental role in order for the patient to reacquire his / her functionalities.

Technological innovation in the rehabilitation field makes possible to meet the main requirements universally recognized by experts in the field:

- personalization of the rehabilitation treatment;
- gradual and relaxing treatment;
- clarity of procedures and related motivations;
- absence of pain and inflammatory manifestations at the end of the treatment;
- treatment of a different anatomical district compared to the one in which pain is felt.

With these objectives, web-based rehabilitation systems provide the definition of personalized treatment plans and remote monitoring also for the activities performed at home, in a continuous and regular way, through low-cost instruments and technologies that allow a diffusion at large scale.

The present PhD project regards a translational approach whose objective is to integrate studies and experiences of the Polytechnic School and of the School of Medicine to improve the management of the patient in the rheumatic diseases of the musculoskeletal system, through the use of ICT technologies for diagnostics and rehabilitation.

Project/scholarship No.3: Development of an artificial tactile sensing and cutaneous electrostimulation system for the restoration of the sense of touch in patients with sensory deficit.

Mesi all'estero: 12

In cooperation with:

- DITEN – Dipartimento di Ingegneria Navale, Elettrica, Elettronica, delle Telecomunicazioni
- Dipartimento di Neuroscienze, Riabilitazione, Oftalmologia, Genetica e Scienze Materno-Infantili (DINOGMI)
- Department of Bioengineering, Imperial College, Londra (UK)
- Department of Health Science and Technology Center for Sensory-Motor Interaction, Faculty of Medicine, Università di Aalborg (DK)
- Camelot Biomedical Systems srl (PMI)
- Polo Ligure Scienze della Vita

Project/scholarship details:

The project aims at developing a system that can reliably model the sense of touch; it is expected to find application in a broad category of disorders characterized by injuries to the motor system associated with sensory deficits. The system will consist of (i) an artificial skin prototype installed on a robotic limb, prosthesis, or directly on the patient's areas with reduced sensitivity to touch (or no sensitivity at all); (ii) an electronic system designed to process signals received by the sensors and to control electrostimulation; (iii) one or

	<p>more arrays of electrodes for electrostimulation. This system will be able both to sense the external tactile stimuli on parts of the body with sensory deficit or upper limbs prosthesis and to communicate the tactile information on other parts of the subject body.</p> <p>The tactile stimulus will be measured and processed by an artificial skin that can provide highly innovative features and performance. Such skin is made by using printing techniques that 1) make it flexible, 2) ensure high spatial resolution and 3) can guarantee low costs on large-scale production. The reference system of the artificial skin will only include sensors that measure pressure. Nonetheless, by processing such information one can actually model the entire distribution of forces, including tangential components. The different versions of the skin will cover different applications: a stand-alone system that can be placed on a table, a skin that can be installed on robotic limb prostheses or even directly on patients with reduced or null sensitivity to touch.</p> <p>Data collected by the artificial skin will be sent via USB or via "low energy" bluetooth protocol to a laptop, which is designed to store and process the data received from sensors and also to control the electrostimulation framework. The system will be managed remotely by a laptop, to the purpose of limiting the invasiveness of the clinical trial. The stimulus will be transmitted by exploiting an electrostimulation system that lies on the skin; thus, one can avoid invasive devices. The future goal is to attain an integration of the system on small devices, which can be positioned in any region of the body. The device generates electrostimulations that are transmitted to the subject through a matrix of electrodes applied on the arm of the subject itself. Electrostimulation is actually an electrical pulse locally driven through the (human) skin surface. The stimulation device includes a single unit that can generate stimulation pulses controlled in current; the device can control the time length of such pulses and can also drive independently the single elements of the array of electrodes to which it is connected. The device can indeed be programmed.</p> <p>Main Tasks:</p> <ol style="list-style-type: none"> 1. Development of the tactile data processing methods 2. Development of encoding algorithms for cutaneous electrostimulation 3. Design and characterization of artificial skin prototypes 4. System integration and experimental tests
PhD FUNDING	<p>The annual gross amount of the grant, including social security expenses to be paid by the recipient, is € 16,500.00.</p> <p>The amount of the doctoral grant shall be increased by 50% for an overall period of not more than 18 months, if the graduate student is authorized to by the teaching body to carry out research abroad.</p> <p>Starting from the first year, each graduate student will have, besides the grant, a budget for research activities in Italy and abroad which will not be less than 10% of the grant.</p>
ADMISSION REQUIREMENTS	
COURSE ADMISSION	<p>Admission is subject to the passing of the selection tests and is conditioned by the positive outcome of the medical examinations, where required, that are carried out in health facilities and aimed at ascertaining the suitability for the specific task in accordance with D. Lgs. No. 81/08.</p>
REQUIRED QUALIFICATION	<p>Degree which has been conferred according to the rules and regulations in force prior to the reform of didactic freedom in universities, or a specialist/II level degree or an equivalent foreign academic qualification.</p>
SELECTION PROCESS	
SELECTION COMMITTEE	<p>The committees are made up of at least 3 university professors for each course; they may be integrated by not more than 2 experts, who may also be foreign nationals, from public and private research institutions and structures.</p>

ADMISSION TEST VENUE	Università degli studi di Genova, Department of Marine, Electrical, Electronic and Telecommunications Engineering (Dipartimento di Ingegneria navale, elettrica, elettronica e delle telecomunicazioni – DITEN), Polo Navale, via Montallegro 1, Genova.
TYPE OF ADMISSION TEST	<ul style="list-style-type: none"> • Comparative assessment of the qualifications/publications. • Written test (research project). • The interview consists in the discussion of the written test (research project) and the description of the candidate’s research area of interest, also on the basis of previous activities stated in his/her scientific-professional curriculum <p>The tests are focused on confirming the candidates' aptitude for scientific research.</p>
METHODS FOR INVITING THE CANDIDATES AND COMMUNICATING THE OUTCOMES OF THE TESTS	<p>The examination schedule is as follows:</p> <ul style="list-style-type: none"> • Evaluation of qualifications, curriculum and written test (research project): 19.7.2018, 9.00 am • Interview: 19.7.2018, 3.30 pm, at Dipartimento di Ingegneria Navale, Elettrica, Elettronica e delle Telecomunicazioni (DITEN), Meeting room, ground floor , Via Opera Pia 11A <p>Candidates can use video conference mode; and, for identification purposes, the candidate must show the original document of which he has deposited a certified copy at the time of application.</p> <p>The list of those admitted to the interview will be affixed at the Department of Marine, Electrical, Electronic and Telecommunications Engineering (Dipartimento di Ingegneria navale, elettrica, elettronica e delle telecomunicazioni – DITEN)</p> <p>The final lists shall be announced on 10th August 2018, and will appear solely on:</p> <ul style="list-style-type: none"> • the noticeboard of the relevant research Departments/facilities for the research courses; • the noticeboard of the University; • on the Internet address https://unige.it/usg/it/dottorati-di-ricerca <p>No information whatsoever shall be posted to candidates’ domicile.</p>
WRITTEN TEST	<p>The research project (10 pages maximum) has to be attached to the online application form, and it must concern one or more research Projects/grants highlighted in the section 'TRAINING PROJECT'.</p> <p>The research project will be evaluated as practical test for the selection, together with the evaluation of the qualifications and the scientific-professional curriculum, in order to identify the candidate's aptitude for scientific research in terms of originality, feasibility, clarity in the definition of objectives, methods and expected results.</p>
INTERVIEW	<p>The interview consists in the discussion of the written test (research project) and the description of the candidate’s research area of interest, also on the basis of previous activities stated in his/her scientific-professional curriculum</p> <p>During the interview, the candidate shall also prove his/her proficiency in the following foreign language: English.</p> <p>Non-Italian candidates will also have to prove knowledge of the Italian language.</p>
PERCENTAGE VALUES OF TO EACH TEST	<p>To each candidate can be assigned a maximum of 150 points, divided as follows:</p> <ul style="list-style-type: none"> - comparative assessment of the qualifications/publications: max score 30/30, pass mark 20/30. - Written test (research project):max score 60/60, pass mark 40/60. - Interview: max score 60/60, pass mark 40/60.

	<p>The final ranking will be drawn up by adding the scores assigned in comparative assessment, written test and interview. Candidates will be selected in compliance with the principles of equal opportunities.</p>
<p>ADDITIONAL CRITERIA FOR ADMISSION TO THE COURSE</p>	<p>In the case of equal grades, the evaluation of candidates' incomes prevails for the assignation of grants, as per D.P.C.M. 9 April 2001</p>
<p align="center">PROJECT CO-FINANCED BY THE EUROPEAN UNION Regional Operational Program for Liguria - European Social Fund 2014-2020</p>	