UNIVERSITÀ DEGLI STUDI DI GENOVA
DI GENOVA

UNIVERSITÀ DEGLI STUDI DI GENOVA

EXCERPT OF INFORMATION SHEET **MECHANICAL, ENERGY AND MANAGEMENT ENGINEERING**	
GENERAL INFORMATION	
STRUCTURE OF THE TRAINING PROJECT	
DURATION AND ORGANIZATION OF THE COURSE	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. **Coordinator of the course:** Prof. Luca Antonio Tagliafico; **E-mail address:** tgl@ditec.unige.it **Department coordinating for research:** Department of Mechanical, Energetics, Management and Transport Engineering (Dipartimento di Ingegneria meccanica, energetica, gestionale e dei trasporti – DIME).
TRAINING PROJECT	The following 3 projects/scholarships are activated: **Curriculum TECHNICAL PHYSICS (CODICE 7302):** **Project/scholarship No. 1: Dynamic modeling and ICT integration for Demand Side Management (DSM) of systems for heating, cooling and related electrical loads.** *Contact*: Prof. Corrado Schenone. *Months abroad*: 6 *In cooperation with*: - IREN - INGENIA S.r.l. - ABIRK ITALIA s.r.l. - Univeristà Politecnica delle Marche (Italia) - RISE - Istituto Svedese di Ricerca (Svezia) - Technical University of Cologne (Germania) - University of Wollongong (Australia) - Polo EASS *Project/scholarship details*: The energy efficiency of heating/cooling systems, both for residential buildings and for district heating/cooling systems, is a key objective for achieving low

energy consumption urban areas and high environmental sustainability. In particular, it is fundamental in the case of existing buildings, when the constraints deriving from the structural and architectural features make the intervention on the building envelope extremely difficult. In this case, an intervention on the plants is the most effective way to achieve energy efficiency. However, this option often leads to a more complex and expensive intervention, which discourages the plant renewal if carried out according to traditional methods. An alternative solution is represented by the use of innovative systems for the control of heating and cooling systems, a "smart" approach that, using ICT technologies, makes it possible to regulate the system efficiently and, at the same time, to provide a complete thermal comfort in air-conditioned environments, allowing the reduction of the operating costs and and execution time.

The present project aims therefore to develop an ICT control system based on the following principles: dynamic modeling of the thermal system (heat pump or air conditioning system), definition of a control logic for energy efficiency, realization of a regulation system, validation of the integrated system, connection to the plant and its application. The goal of a more efficient management of heating systems is achieved in this way by means of a thorough use of electronics and intelligent management strategies, based on a dynamic model for the analysis of thermal systems able to simulate the temporal history of some key parameters and predict the behavior of the system for variable boundary conditions. The final aim is energy management for the optimization of electricity consumption (demand side management).

To achieve these objectives, a dynamic approach to the analysis of the heating system is required, since only knowledge of the transient behavior of the different elements of the plant can lead to successful energy saving actions. The added value is therefore the development of a technology in order to produce energy efficiency in the existing buildings with a heating plant, to start residential buildings with central plant, which can be applied in a simple and direct way.

The results already obtained in terms of international research and the immediate and intense economic fallout of the same are encouraging electricity suppliers to explore the management of energy demand in order to optimize the supply of electricity and therefore minimize the relative cost, with benefits for end users, for utilities and in general for energy saving.

Curriculum ROBOTICS AND MECHATRONICS (CODICE 7301):

Project/scholarship No. 2: Development, engineering, prototyping of a low-cost robotic system for postural rehabilitation with intuite interface using consumer VR-AR technology and wearable IoT sensorization of the patient.

Contact: Prof. Matteo ZOPPI
Months abroad: 12

In cooperation with:
- Swhard S.r.l.
- Singular Perception S.r.l.
- University of Birmingham (UK) - Centre of Precisione Rehabiliatation for spinal pain
- Imperial College London (UK) - Department of Bioengineering
- VUB – Vrije Universiteit Brussel (Belgium) - Unit Experimentele Anatomie
- Polo Ligure Scienze della Vita

Project/scholarship details:

The project involve three locations and two additional centers of reference, in Italy (including the DICCA biomaterial laboratory (Genoa, Opera Pia 15A)) and the laboratory for the analysis of movement and rehabilitation

of neuromusculoskeletal disorders of DINOGMI, hosted in Smart Energy Building (SEB) at the Savona pole), and three foreign research institutions (distinguished by competence and with a training plan that provides for each period a well-defined time table and training objectives).

The three years are organized according to the following timetable:

Nov 18 --> Gen 19. Tutoring of the PhD student to gain expertise and familiarize with the use of a VR platform already available for general VR use at the Italian partners in Genoa, called SP-7. This platform will be modified in the project to realize the one specific for rehabilitation. The student will learn on platform hardware and software, control and interfaces, and the interfacing of external sensors (to comprise, later on, the sensorization of the patient when applied to rehabilitation).

Feb 19 --> Mag 19. Stay of the student at Vrije Universiteit Brussel, Unit Experimentele Anatomie, prof. Erik Cattrysse, to learn methods and experimental practice in rehabilitation.

Giu 19 --> Lug 19. Stay of the student at the University of Birmigham, Centre of Precisione Rehabiliatation for spinal pain, prof. Deborah Falla, to study and learn on the relations between postural equilibrium and the physiology and diseases of the rachis and muscles; the student will also study the use of electromiograpich techniques for patient monitoring.

Ago 19 --> Giu 20. In Italy at DIME, Singular Perception s.r.l. and Swhard s.r.l. to extend and consolidate the expertise on control electronics and software; the student will work to the adaptation to the use for rehabilitation of the robotic platform derived from the SP-7 VR platform. The redesign and integration work will have been done by the rest of the team during the period of stay abroad of the student.

Giu 20 --> Gen 21. Work of the student on the interfaces between the new rehabilitation platform and the environment in a broad sense. In parallel, participation of the student to the development of a low-cost IMU sensor done at Swhard s.r.l.

Feb 21 --> Lug 21. Stay of the student at the Imperial College London, Department of Bioengineering, prof. Dario Farina. The student will learn and practice on sensing and techniques for electromiographic monitoring relevant to the identification of a human posture; will also study the merging of electromiographic data with inertial data from the IMU and use of the information to control a cycle of rehabilitation.

Ago 21 --> Feb 22. Student at Genoa, working to complete the integration of the new rehabilitation system: implementation of the interfaces and strategies for the definition of the rehabilitation cycle; implementation and related testing; feedback on sensorial data for online planning and control of the rehabilitation procedure; decison of relevant logics. The activity is carried on at Swhard with testing periods at the University and at Singular Perception s.r.l.

Mar 22 --> Ott 22. Experimentation and testing of the new rehabilitation system. The work comprises systematic and extensive sessions with patients; it is carried on at the facilities UNIGE of DINOGMI, in Savona.

Curriculum TECHNOLOGIES AND PLANTS (CODICE 7303):

Project/scholarship No. 3: From the design to application of Internet of Things technologies (IoT) in the context of Industry 4.0.

Contact: Prof. Flavio Tonelli
Months abroad: 6

In cooperation with:
- ABO DATA S.r.l.
- Novigo Technology S.r.l.
- Polo SOSIA

	Project/scholarship details: The grant will cover issues of Industrial Internet of Things (IIoT) and the application of Internet of Things (IoT) technologies to the manufacturing world in full harmony with the concept of Cyber Physical Manufacturing Systems (CPMS) as a pillar of Industry 4.0 in the management of flexibility and heterogeneity of existing machines (OT) and IT systems, and in connecting new types of equipment. The connection of the machines (OT) and the interconnection of IT systems to acquire new data and identify additional patterns, however, does not in itself represent added value for the company. What represents value is the collection and conversion of data into information useful for the factory decision-making process. It is in this scenario, in fact, that the IIoT, intended not purely as connectivity but as the combination of connectivity, process knowledge and analytics (data science), has carved out an increasingly important role within I4.0. The PhD program is structured over three years, within which the PhD student will first acquire training on the main manufacturing processes and on the relevant enabling technologies used to then dedicate themselves to the realization of innovative concepts and participate in I4.0 R&D projects. During the first year the PhD student will have the task of training on the best practices of the manufacturing processes on the technological trajectories of the I4.0. Furthermore, the PhD student will have to assess the current situation of Italian manufacturing companies with respect to the standards identified or being identified. At the same time, the PhD student, accompanied by the company tutor and the Abo Data colleagues, will study the projects in which Abo Data intends to apply IIoT technologies in order to identify obtainable advantages, more suitable technologies and related effort for the realization of both instruments. for connectivity with the field (Edge) and tools for data management and analysis (Cloud). Starting from the second year, the PhD student will be able to devote himself to the design and implementation of IIoT solutions by actively participating in the definition of innovative blueprints and concepts IIoT within the Abo Data team on the issue of connectivity with the field and local data management contributing to the choices related to the implementation of models and pilots in I4.0. In this phase, an activity abroad is planned to assimilate international IIoT / CPMS approaches and technologies. In the third year, the focus will pass to the cloud part and therefore to the management of the high level data concerning both the storage of the same, and the part of data science necessary to extract value-added information. The research field related to machine-learning applied to cases emerged during the first two years that will be considered most suitable will also be part of the data science business.
PhD FUNDING	The annual gross amount of the grant, including social security expenses to be paid by the recipient, is € 16,500.00. 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. 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.
ADMISSION REQUIREMENTS	
COURSE ADMISSION	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.
REQUIRED QUALIFICATION	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.

SELECTION PROCESS	
SELECTION COMMITTEE	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.
ADMISSION TEST VENUE	Università degli studi di Genova, Department of Mechanical, Energetics, Management and Transport Engineering (Dipartimento di Ingegneria meccanica, energetica, gestionale e dei trasporti - DIME), sezione MEC, via all'Opera Pia 15 A, Genova
TYPE OF ADMISSION TEST	• 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 The tests are focused on confirming the candidates' aptitude for scientific research.
METHODS FOR INVITING THE CANDIDATES AND COMMUNICATING THE OUTCOMES OF THE TESTS	The **examination schedule** is as follows: • Evaluation of qualifications, curriculum and written test (research project): **26.7.2018, 10.00 am** • Interview: **26.7.2018, 3.00 pm,** at Dipartimento di Ingegneria meccanica, energetica, gestionale e dei trasporti (DIME), meeting room, DIME-MEC. **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.** The **list of those admitted to the interview** will be affixed at Dipartimento di Ingegneria meccanica, energetica, gestionale e dei trasporti (DIME) The **final lists** shall be announced on **10th August 2018**, and will appear solely on: • 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 No information whatsoever shall be posted to candidates' domicile.
WRITTEN TEST	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'. 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.
INTERVIEW	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 During the interview, the candidate shall also prove his/her proficiency in the following foreign language: English. Non-Italian candidates will also have to prove knowledge of the Italian language.

PERCENTAGE VALUES OF TO EACH TEST	To each candidate can be assigned a maximum of 150 points, divided as follows: - 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. 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.
ADDITIONAL CRITERIA FOR ADMISSION TO THE COURSE	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

PROJECT CO-FINANCED BY THE EUROPEAN UNION
Regional Operational Program for Liguria - European Social Fund 2014-2020