PRIN: PROGETTI DI RICERCA DI RILEVANTE INTERESSE NAZIONALE – Bando 2015

Prot. 20154EHYW9

PART A

1 - Research Project Title

Combined numerical and experimental methodology for fluid structure interaction in free surface flows under impulsive loading

2 - Duration (months)

36 months

3 - Main ERC field

PE - Physical Sciences and Engineering

4 - Possible other ERC field

5 - ERC subfields

1. PE8_5 Fluid mechanics, hydraulic-, turbo-, and piston engines
2. PE8_7 Mechanical and manufacturing engineering (shaping, mounting, joining, separation)
3. PE8_3 Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

6 - Key Words

1. FREE SURFACE FLUID STRUCTURE INTERACTION
2. STRUCTURAL HEALTH MONITORING
3. WATER ENTRY PROBLEMS
4. HYDRAULIC ENGINEERING
5. ENERGY HARVESTING

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7 - Principal Investigator

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8 - List of the Research Units

nº	Associated Investigator	Category	University/Research Institution	E-mail address
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2.	FALCUCCI Giacomo	Ricercatore a t.d. - t.pieno (art. 24 c.3-a L. 240/10) (*data fine contratto: 30/05/2017*)	Università degli Studi di NAPOLI "Parthenope"	giacomo.falcucci@uniparthenope.it (adesione completata il 08/01/2016)
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9 - Research project abstract

This proposal addresses the grand challenge of the fluid-structure interaction in impulsive events with the presence of a free-surface flow. In particular, we will develop an integrated theoretical-numerical-experimental methodology merging together the experience of the partners in their areas of expertise, namely the fluid dynamics simulation techniques, the dynamic modeling of solids and structures, the experimental techniques developed within the water entry problems and the Fiber Bragg Grating (FBG) Sensor devices for strain measurements.
The numerical simulations will be conducted both through traditional Computational Fluid Dynamics (CFD), within the OpenFoam framework, and through the Lattice Boltzmann Method (LBM), given the expertise in this field of all the operating units involved. Due to its intrinsically mesoscopic nature, the LBM has several advantages as compared to other conventional CFD methods, as the conceptual and practical simplicity of the numerical scheme and the computational efficiency in simulating flows with complex geometries.
The numerical simulations, appropriately validated, will support the definition of theoretical simplified models, which could be easily applied for design purposes.
Free fall and actuated experiments will be performed on different kind of structures, and the impact dynamics will be analyzed from accelerometers, linear position sensors, and through the analysis of high speed images.
All the above is related to the design, prediction and verification phases. For the operation phase of the engineering devices, the project aims at developing a real-time monitoring system of structures interacting with free-surface flows. A FBG system will be specifically developed for this kind of applications, with the final objective of realizing a well-suited Structural Health Monitoring (SHM) technology for the live monitoring of impulsive events. This would allow to reconstruct in real-time the three-dimensional deformation of a structure, through a data analysis algorithm capable of dealing with complex morphologies and boundary conditions. This is particularly challenging due to the high interrogation frequencies needed, involving both the measuring system and the data analysis algorithm and to the high energy content often related to impulsive events that might lead to complex structural responses.
Although the study addressed in the present project is applicable to several engineering problems, we will demonstrate its applicability in three areas: ship hull slamming, interaction between breaking waves and hydraulic structures and energy harvesting.
It is worth to underline that the research units involved in the present project have already successfully collaborated in the past , as evidenced by the several publications in co-authorship reported in the CV of the scientists involved. Moreover, most of the people involved have already applied their field of expertise in the water entry problems.

10 - Total cost of the research project, per single item

Associated Investigator	item A.1	item A.2.1	item B	item C	item D	item E	item F	Total

BISCARINI Chiara	50.400 €	46.000 €	57.840 €	6.000 €	10.000 €	10.000 €	17.496 €	**197.736 €**
FALCUCCI Giacomo	0 €	58.000 €	34.800 €	7.000 €	10.000 €	15.000 €	€	**124.800 €**
FANELLI Pierluigi	30.000 €	48.000 €	46.800 €	10.000 €	10.000 €	10.000 €	€	**154.800 €**
MANCIOLA Piergiorgio	50.000 €	46.000 €	57.600 €	5.000 €	5.000 €	2.000 €	€	**165.600 €**
DI FRANCESCO Silvia	0 €	69.000 €	41.400 €	6.000 €	0 €	5.000 €	€	**121.400 €**
Total	**130.400 €**	**267.000 €**	**238.440 €**	**34.000 €**	**35.000 €**	**42.000 €**	**17.496 €**	**764.336 €**

- item A.1: enhancement of months/person of permanent employees
- item A.2.1: cost of contracts of non-employees, specifically to recruit
- item B: Overheads (flat rate equal to 60% of the total cost of staff, A.1 + A.2.1, for each research unit)
- item C: cost of equipment, instruments and software
- item D: cost of consulting services and similar
- item E: other operating costs
- item F: prize (to take advantage of the prize it is mandatory to attach to the project a declaration signed by the Rector of the university, according to the outline of section B2.7)

PART B

B.1

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1 - State of the art

Fluid-structure interaction problems in free surface flows has received considerable attention in the recent years, as it deals with several relevant engineering problems, as water entry problems, which is to say the impact between a body (e.g. ship or airplane hulls) and the water surface, and energy harvesting, in which the fluid is treated as a source of usable energy rather than a mere source of mechanical damping.
The interaction between water and structures are generally responsible for large impulsive loadings, with the complicating factor of the presence of the free-surface, which represents a a jump of density of approximately 3 orders of magnitude. The generated impulsive forces may induce considerable vibrations and local structural damages due to stress concentration and fatigue. Moreover, a significant amount of energy is thus lost in mechanical vibration, which is detrimental for both the structure performance and its durability. Furthermore, depending on the structural geometry, up to 80% of the impact energy is consistently transferred (thus lost) to the risen water, which accounts for the formation of the pile-up region, water jets, and spray sheets.
Therefore, the development of numerical methods and experimental techniques to characterize such impulsive loading is crucial for the design of several kind of engineering devices, as for example marine vessels and hydraulic structures. The analysis of such fluid-structure interaction events has relied for years on simplified approaches, as for example in hull slamming in which the actual dynamic load is replaced by an equivalent static pressure uniformly distributed over the panels. When the duration of the pressure pulse is considerably longer than the natural period of the structure, it is admissible to assume the pressure equal to the spatial average of the real hydrodynamic load. However, in the presence of impulsive this approach often leads to large overestimation of the impact-induced deformations. Furthermore, the response of flexible structures during slamming is affected by various fluid-structure interaction phenomena like: cavitation, air trapping, and hydro-elasticity, which is related to those phenomena introduced by the mutual interaction between fluid motion and structural deformation.
Notwithstanding the numerous works in the literature dealing the fluid-structure interaction in the presence of a free surface, such phenomena are still a great challenge to solve. As a matter of facts, reliable numerical methods and accurate and detailed experimental techniques are still missing.
The monitoring system to be developed in the project will be based on a high frequency interrogation system for fiber optic sensors with Bragg gratings (FBG), using two leading technologies, the opto-acoustic and the transmission gratings, resulting in a product more powerful than those currently marketed. FBG are one of the most promising strain sensing technologies and their applications and reliability are growing fast. They present several advantages with respect to other technologies. Multiple sensors can be installed over a single optic fiber at arbitrarily locations. Data from the whole set of sensors are synchronously acquired by a single interrogator, whereby the same accuracy is assured at each sensing location. Moreover, such sensors are light, flexible, and their size is minimal, thus not affecting the structural mass, stiffness, and strength. Another unique property of this technology with respect to conventional electric sensors is the possibility of performing measurements during the production stage, with the FBG sensors embedded into composite structures. Finally, their insensitivity to water and moisture, make them ideal candidates for measurements in water entry problems.
As for the numerical part, the Lattice Boltzmann method, based on the fundamental concepts of statistical mechanics, has proved to be an efficient tool for the simulation of complex fluid flow problems and is now ready to enter the market in the areas where traditional methods present some difficulties. The substantial difference of this method compared to traditional CFD methods, which exhibit nonlinear terms of convective and diffusive nature, it is in the representation of convection and diffusion with linear operators of extremely simple form, in favor of a greater computational simplicity. The adaptability of the method to geometries of great complexity turns out to be of crucial importance for the fluid-structure interaction, since it allows to build computing grids for real geometries in the space of a few hours, against the days, if not weeks, required by traditional methods and does not need to change the grid during the calculation in the case of mobile contours.

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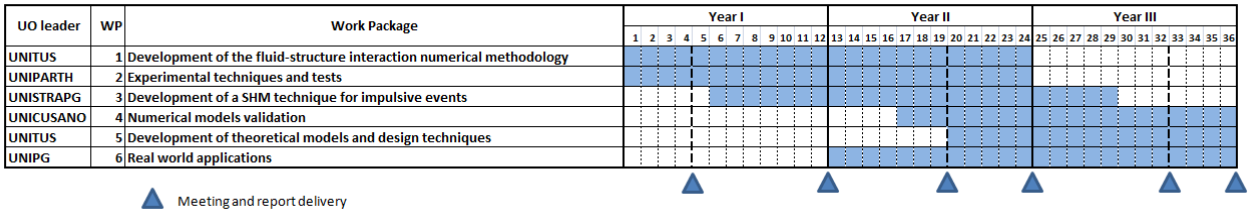
2 – Detailed description of the project: methodology, targets and results that the project aims to achieve and their significance in terms of advancement of knowledge

The main goal of the proposed research is to consolidate the technical and methodological bases on the fluid-structure interaction phenomena in the presence of free surface flows, with particular emphasis on impulsive events, typical of dynamic loading on ship and aircraft hulls, energy harvesting systems and breaking waves on hydraulic structures.
This scope will be achieved by focusing the research and development on the physics of the energy transfer processes between a free-surface flow and a structure, with the twofold aim of improving the predictive capabilities of numerical and experimental research and design tools, and of defining enhanced design criteria for structures subjected to impulsive loadings and energy harvesting devices.
The specific objectives of the project are:
a) Development of reliable numerical methods
Numerical methods are powerful tools, than can be utilized with profit, both in the area of scientific research and as engineering design instruments. In the latter field, the numerical solution of continuum mechanics equations reduces the costs and time needed for the design and realization of complex devices, by minimizing the number of prototypes required and providing the engineer a deep insight into the design process. Moreover, detailed numerical modeling of fluid-structure interaction provides a valuable amount of details, for the understanding of flow and solid physics. Thereafter, the development and validation of numerical methods for continuum mechanics is to be considered a valuable goal, characterized by a high potential in terms of scientific return and possible technological transfer.
During this project several critical aspects of numerical continuum mechanics will be faced. In particular, it is worth mentioning the presence of a multiphase (i.e. free-surface) flow, the peculiarity of impulsive events and the necessity to establish a stable and accurate procedure to solve the fluid structural coupling for light and flexible structures.
Moreover, two different approaches will be used to simulate the flow field: traditional CFD in OpenFoam, and the lattice Boltzmann method (LBM). The first has the advantage of using an open source framework. The latter is a fluid simulation technique based on a set of particles streaming and colliding in a discrete space–time universe and moving on a lattice mesh through fixed velocity vectors. Due to its intrinsically mesoscopic nature, it has several advantages as compared to other conventional CFD methods, especially in the fields of multiphase flows and fluid-structure interaction.
b) Development of innovative experimental techniques
Innovative experimental techniques and methodologies will be developed by means of the experimental test bench already available at the University of Naples "Parthenope". In particular, we intend to combine the measurements coming from FBG strain sensors, high speed camera, accelerometers and sensors positions to provide as much information as possible on the possible damage on structures undergoing impulsive interaction with a free surface. The dynamics of buoyant and sinking specimens will be investigated both for free falls from different heights, up to 2.5 m, and for actuated impacts. With our test bench, in fact, it will be possible to study, for the first time to the best of our knowledge, the dynamic response of different types of specimens performing repeated impacts on water by imposing both the impacting force or the falling velocity.
c) Development a real-time structural health monitoring (SHM)
One of the objectives of the present project is the development of an experimental methodology to measure the structural deformation of compliant bodies entering the water free surface starting from local strain measurements. Specifically, we intend to utilize fiber optic strain sensors with Bragg gratings (FBG) and we propose utilizing both a modal decomposition approach and a FEM modeling to reconstruct the structural response of the whole body in real time starting from the local strain measurements. As the proposed methodology allows for a fairly high acquisition frequency, it could be applied for real-time structural health monitoring (SHM), which is of great interest in many engineering fields. In particular, the development of live SHM techniques would allow recognizing the ability of the structure to perform its duty while screening the integrity of the system. However, it represents a very challenging task, as sensing the stress field of an entire structure is hardly feasible in practice. Therefore, SHM must rely on a finite number of measurement locations, as an example through local strain measurements. Here we propose to utilize FBG sensors, which represent one of the most promising strain sensing technologies with several advantages: i) multiple sensors can be installed over a single optic fiber at arbitrarily locations, ii) data from the whole set of sensors are synchronously acquired by a single interrogator, whereby the same accuracy is assured at each sensing location, iii) sensors are light, flexible, and their size is minimal, thus not affecting the structural mass, stiffness, and strength, iv) their insensitivity to water and moisture make them ideal candidates for measurements in water-structure interactions v) they could be embedded in the structure during the production stage.
d) Definition of similitude criteria from laboratory scale data to real world scale applications
Experimental, as well as computational fluid dynamics, has always taken advantage from the concept of similitude, both to reduce the number of numerical as well as laboratory experiments, to be performed, both to allow the usage of scaled models to reduce experimental costs and facilitate their control. Nevertheless, when multiple physical aspects are to be considered, and concur to the same final result, it is not trivial to define those non-dimensional parameters that control the whole phenomenon. Thereafter, the possibility to establish a rigorous approach to transition laboratory-scale experiments to real-world structures, is a fundamental milestone of the present research project. In fact, this approach allows to generalize scientific results, that are obtained under strict dimensional constraints.
e) Extrapolation of practical models for fluid-structure interaction problems
When it comes to designing from scratch a complex device or structure, such those under investigation, it is not practical nor effective, to begin with expensive, and time consuming procedures, like extensive experimental of computational campaigns. On the contrary, designers should resort to more practical and mathematically manageable problem formulation to orient the design process during its initial stages. Thereafter, building on the numerical and experimental results of the previous points, this project aims to develop, reliable but still manageable theoretical and simplified models to support the designers, in particular during the initial stages of their activity.

The activities of the present project are subdivided into 6 work packages, listed in following the Gantt diagram that gives also to the time related information.



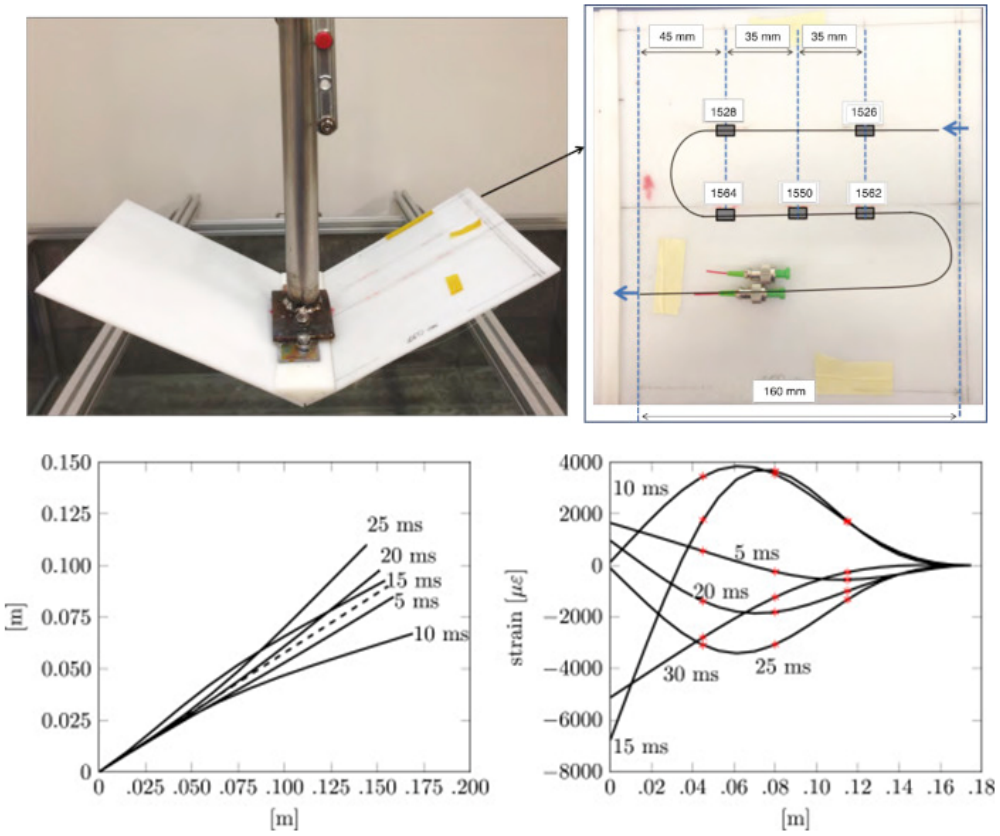
WP 1 - Development of the fluid-structure interaction numerical methodology – leader UNITUS
This WP is focused on the development of the numerical models for fluid-structure interaction, which is to say developing the fluid solvers, both the traditional and the kinetic ones, the solid solver and their coupling.
In particular, two-way FSI models attempt to describe the twofold interaction in place when the structure motion is determined by the fluid forces, and, in turn, the fluid flow is forced by the solid displacement. In this WP we will define a numerical procedure to model the two-way interaction between a moving deformable body and a free surface flow, with particular emphasis on impulsive events. In such cases, two-way FSI modeling becomes particularly challenging as the structure may be subjected to large motion or acceleration, the solid and liquid densities are comparable and the structure may be very flexible. In these cases a tight coupling between the fluid and the structure is required. Among the different coupling options, we intend to develop a partitioned approach, which is the most popular for the numerical modeling of FSI, because it is more efficient compared to monolithic methods, and it allows the utilization of existing numerical models.
Considering the complexity and the computational effort needed, the structural behavior will be defined with different models with increasing accuracy: from the Euler-Bernoulli beam model for 2D simulation of thin solids, to the implementation of finite element method for 2D and 3D solid models. The governing equations will take into account dynamic effects, large deformations and large displacements and rotations. For the implementation of the Euler-Bernoulli beam theory, we will be introduce in the fluid solver a discretized set of equations that define the behavior of elastic line using fundamentals of structural mechanics. The implementation of the FEM will make use of 4-nodes plane elements with 3 degrees of freedom per node in case of 2D simulations and 8-nodes solid elements with 3 degree of freedom per node in case of 3D simulations.
For what concern the fluid solver, we will employ both traditional fluid dynamics and the lattice Boltzmann method. For the first one, the numerical procedure will be developed in the OpenFOAM-3.0 framework. For the second one, we will test the multiphase solvers already developed by the research units (UNICUSANO, UNIPG, UNISTRAPG), with particular emphasis on a front-tracking variant of the lattice Boltzmann method (LBM), successfully tested in the past for hydraulic structures and water entry problems. An important step will be the coupling with the solid modeling,. In fact, as in the LBM the solid is free to move in a fixed lattice, we need to develop proper boundary conditions and refill procedures for fluid node initialization after solid obstacle motion.
WP 2 – Experimental techniques and tests – leader UNIPARTHENOPE
The WP 2 will be devoted to the development of innovative tests for the investigation of both for free falls and repeated impacts. Different types of specimens will be employed: from simple 2D shapes, as triangular wedges and cylinders, to complex 3D shapes realized according to actual ship hulls.
The dynamics of rigid bodies will be evaluated by means of piezo-ceramic accelerometers with the aid of a high-speed camera, capable of more than 1600 frames per second at 1280 × 800 pixel resolution. Compliant body behavior will be investigated with the same techniques, together with the ad-hoc designed FBG sensors.
The experiments on free fall will deliver measures on the actual deformation of both the water and the (compliant) structures: these data will be used to validate the numerical results developed in the other WP's. The tests with repeated impacts will deliver important and totally new results, with details on the fatigue response of the solid structure and the onset of vibrating phenomena that can have a major influence on hull duration.
WP 3 – Development of a SHM technique for impulsive events - leader: UNISTRAPG
This WP is devoted to the development of a live SHM technique for impulsive events. In particular, we will setup the FBG interrogator (UNIPARTH) with a sufficiently high frequency and we will develop a methodology to reconstruct the whole structure deformation starting from single strain measurements in a finite number of locations. To this aim we will further develop a modal decomposition approach already in place and we will couple FEM modeling (UNITUS) to measurements. Moreover the optimal positioning of the FBG sensors will be developed by UNIPG through an entropy-decision approach.
In this phase we will also study the potential applications of the proposed methodology for: 1) impulsive load estimation; 2) real-time damage detection and structural health monitoring (SHM); 3) fatigue assessment. More in details, we propose to distinguish between monitoring sensors, used to reconstruct the shape, and control sensors, used to measure the deviation between the predicted deformation and the actual one. Given that the estimation of the deformed shape of the vessel is based on the assumption that the structure is in the undamaged healthy state, such a deviation can be regarded as a possible damage indicator.
WP 4 - Numerical models validation – leader UNICUSANO
In order to validate the numerical methodology, numerical results will be compared first with analytical and numerical data available in literature, and then with the experimental data resulting from WPs 2 and 3 (position sensor, accelerometer, high speed camera images and FBG sensors). In particular the validation will be focused on solid dynamics, structure deformation, hydrodynamic loading, and free surface dynamics.
WP 5 – Development of theoretical models and design techniques- leader: UNITUS
The theoretical analysis of the present WP will address the aspect of reduced-order modal modeling to offer an experimentally and numerically validated framework for the analysis and the design of engineering devices subjected to impulsive loading due to free-surface fluid-structure interaction. Reduced-order modeling will involve the development of both a potential flow solution for the fluid and its coupling to the structure and of simplified empirical and/or phenomenological models. Such models will be validated against controlled numerical and physical experiments performed by monitoring the impact dynamics, the structural deformation, and the hydrodynamic pressure field in the fluid. Moreover, a design methodology will be defined, taking into account the several analysis opportunities provided by the numerical and experimental techniques developed within the other WPs.
WP 6 - Real world applications – leader UNIPG
The fluid-structure interaction in the presence of free surface flows involves several engineering problems. In this phase of the project we intend to focus on three possible applications of the developed methodologies.
First we will treat the impacts between sea waves and ship hulls, that are generally responsible for large impulsive loadings, that may induce considerable vibrations and local structural damages due to stress concentration and fatigue.
Secondly we will apply the developed methodology to the study of the interaction between breaking waves and hydraulic structures commonly encountered in rivers, sea flows and flooding events.
Finally we addresses the grand challenge of extracting energy from fluid-structure interaction impulsive events through elctroactive materials.

3 - Project development, with identification of the role of each research unit and research organizations involved, with regards to expected targets, and related modalities of integration and collaboration

One of the distinguishing features of this research activity is its inter-disciplinary nature. In fact, the characterization of

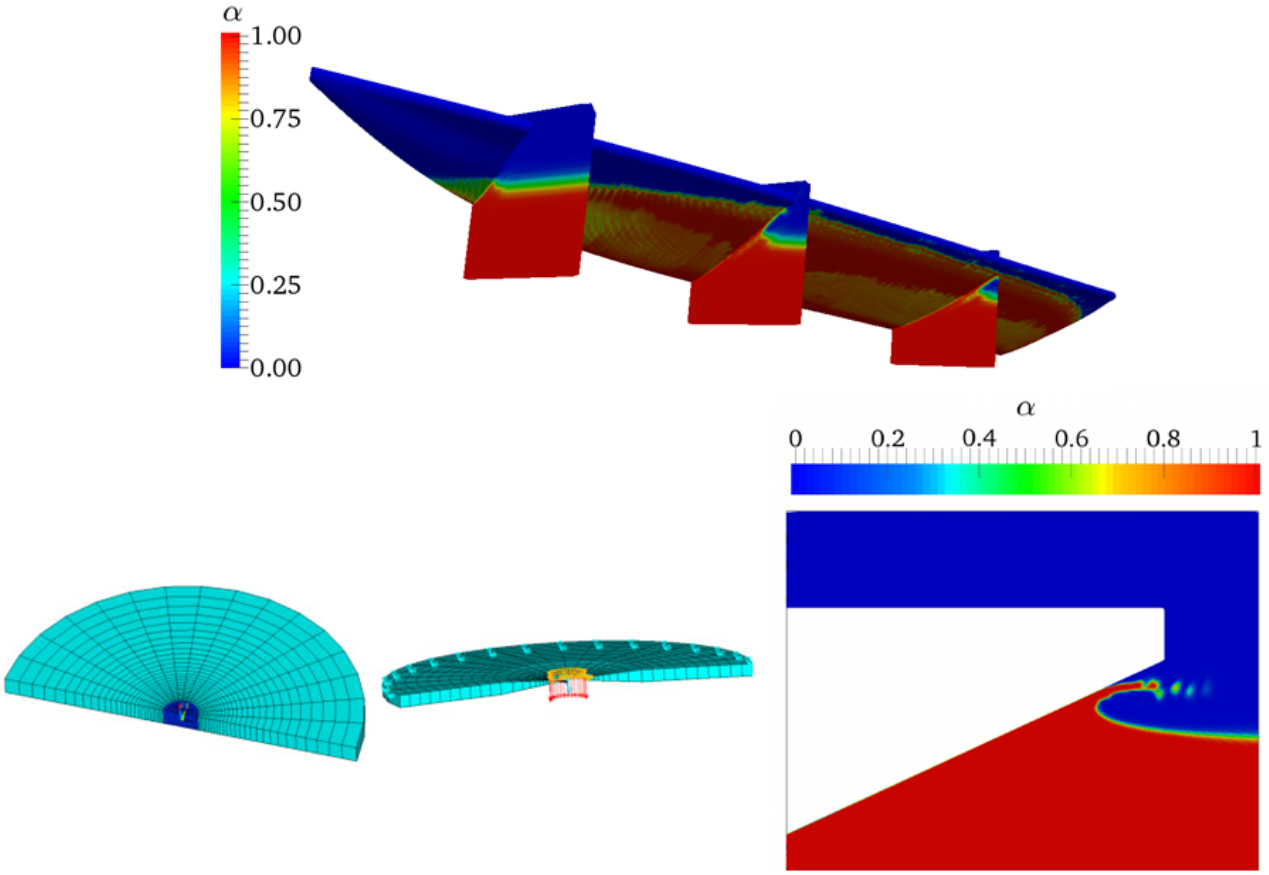
fluid-structure interaction requires a deep understanding of different physical phenomena, that pertain to many diverse fields of research (i.e. fluid mechanics, numerical analysis, solid mechanics, materials). Therefore, the research team has been identified in order to have all the required skills at the six operating units involved in the project: University for Foreigners of Perugia (UNISTRAPG), University of Tuscia (UNITUS), University of Perugia (UNIPG), University of Naples "Parthenope" (UNIPARTH), University of Rome "Niccolò Cusano". Moreover, the numerical and experimental tools available at the operating units (i.e. experimental test bench at UNIPARTH, LBM numerical codes at UNIPARTHENOPE and UNICUSANO, CFD and FEM models at UNITUS, CFD and optimization tools at UNIPG) allow to successfully perform the project with relatively low costs. The harmony and the ability to collaborate of the involved units is enforced by the fact that the people involved in the present project have already successfully cooperated in several activities as demonstrated by the shared publications.

1) UNISTRAPG
The University of Foreigners of Perugia coordinates the project activities and will make use of the experience gained in several aspects of the present project, as the development of numerical models for free surface flows, both with OpenFoam and with the front-tracking LBM, and the development of FBG measuring systems. Therefore, the UNISTRAPG will be responsible of coordinating the various activities carried out in the other operating units. Moreover, thanks to the experience gained in the FBG sensors, it will develop the structural health monitoring technique together with the unit of Naples, who is responsible of the interrogation system, and the unit of Tuscia, who is responsible for the FEM modeling.
Moreover, the UNISTRAPG unit will contribute to the real-world applications selection together with UNIPG and will take care of the ones related to hull slamming and energy harvesting.



Top: Sketch of an instrumented panel with characteristic dimensions and FBG sensors location. Bottom Left: Original (dashed line) and deformed structure (solid lines) at several impact time for the wedge impacting from 100 cm. Bottom Right: relative reconstructed strain on the upper surface of the panel (lines) and local measurements from the FBG (red marks).
From Panciroli, Biscarini, Falcucci, Jannelli, Ubertini, Journal of Fluids and Structures, 2016, 61, 60–75.

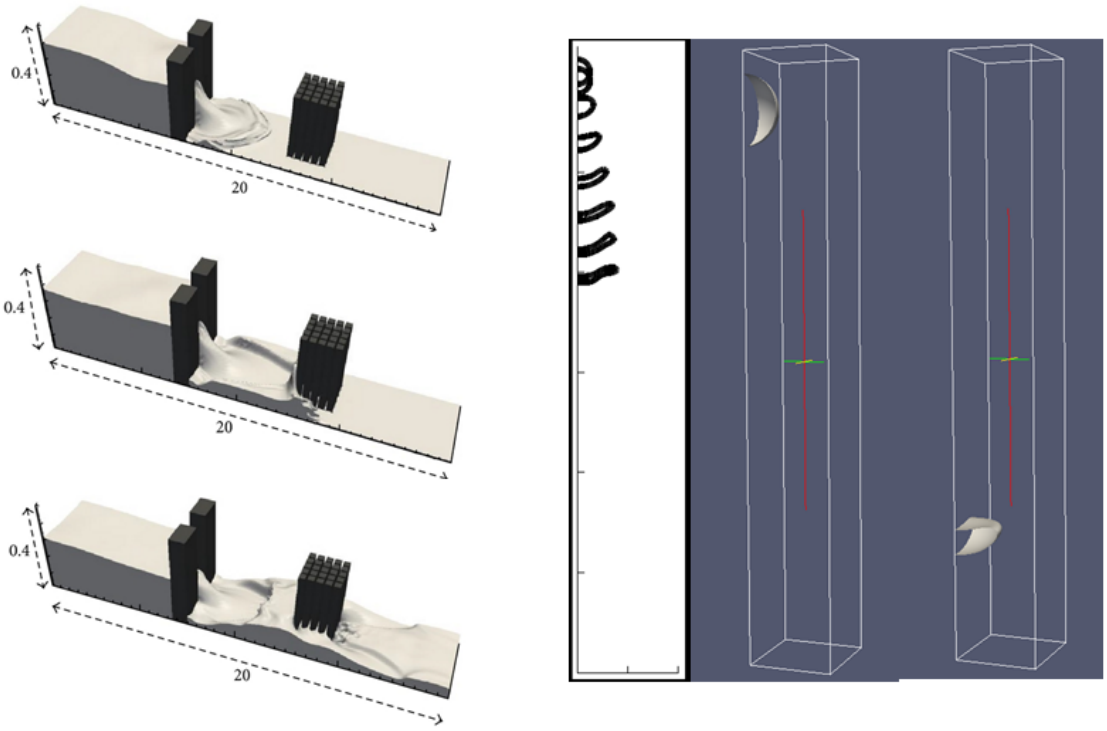
2) UNITUS
UNITUS will be responsible for the implementation of the structural behavior of deformable solids in fluid-structure interaction for both simulation and monitoring purposes. The structure dynamics will be described by the Newton's second law, while the solid deformation will be considered first using simplified theoretical models and then implementing the finite element method. The structural models will consider large strains and displacements, typical of these applications. Different types of constraints, including rigid and elastic joints will be considered and the dynamic response of the solid interacting with the water will be calculated as a coupled function of the fluid-dynamic external field by testing different coupling procedures. The structural mechanics will be considered through the use of governing equations to be implemented in both the Open-FOAM and the LBM frameworks, to be coupled with the fluid ones. The activity of this Unit consists also in the definition of FEM models for the reconstruction of the structural behavior of the whole structure starting from the local strain measurements obtained with fiber optic strain sensors with Bragg gratings (FBG).
UNITUS will also be responsible of setting up the theoretical and simplified models for design purposes (WP 5)



Free-surface fluid-structure interaction in the OpenFoam environment 3D hull slamming (top), 2D hull slamming (bottom right). FE models (bottom left): sections of equivalent plate FE model (with variable thickness) and actual plate FE model (with constant thickness).

3) UNICUSANO

The unit of the University Niccolò Cusano will be in charge of developing the fluid-structure interaction solver employing the lattice Boltzmann method (LBM) as the fluid solver, taking advantage of the previous experience in this field. To this aim, we will further develop a front-tracking variant of the lattice Boltzmann method (LBM), where the dynamics of the free surface is treated through the mass and momentum fluxes across the interface cells. The displacement of the interface is modeled through a dedicated mass fraction variable, which is updated by recording the inflow and outflow of mass via distribution functions. Thus, the scheme allows for an unconstrained treatment of the free surface motion during water entry, which, in turn, enables a thorough description of the water pile-up and its effects on the hydrodynamic loading. Given the expertise of the researchers involved in this unit, we will also explore the possibility of employing other multiphase LBM solvers.



Unsteady free surface flow through an ideal city due to the istantaneous collaps of a dam modelled through a front-tracking variant of the Lattice Boltzmann Method (left). Secondary Break Up of a Liquid Droplet (2D and 3D simulation) immersed in a continuous air domain simulated through a multiphase LBM. Simulations have been carried out with a Free Energy multiphase approach for an Eotovos number equal to 96 (right).

4) UNIPARTH

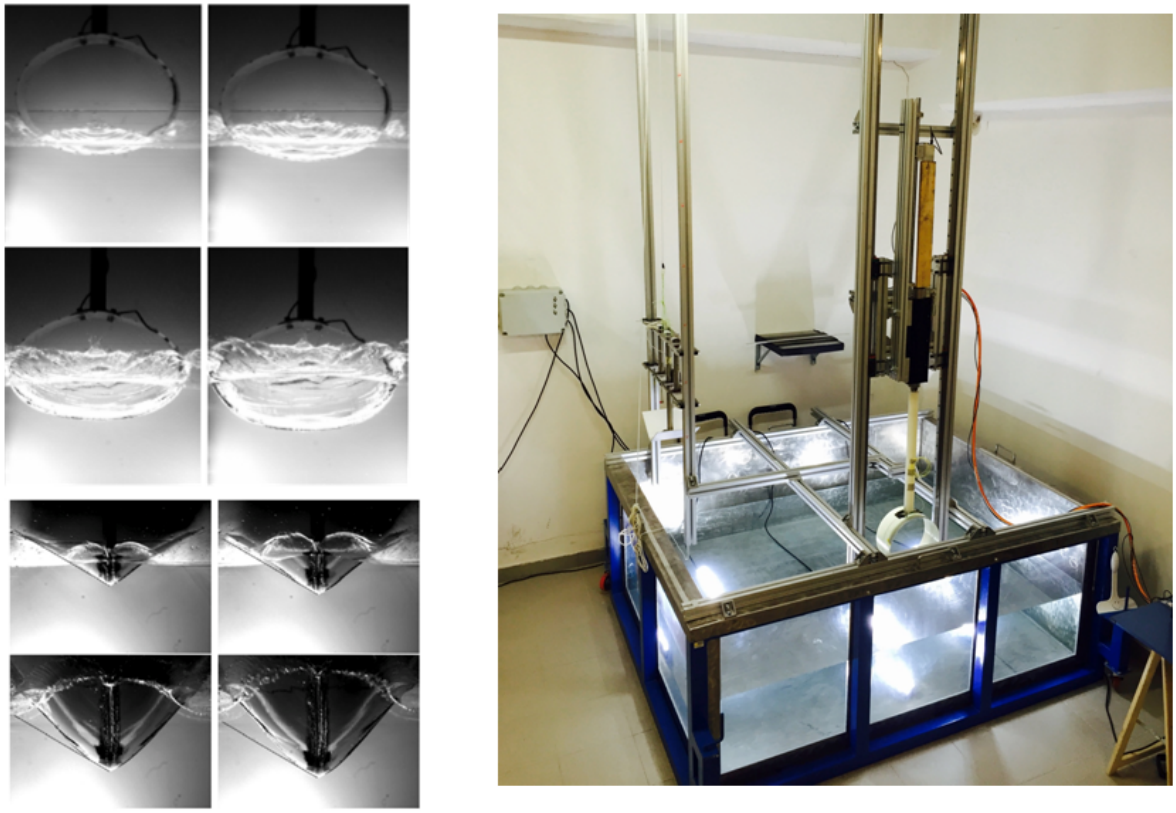
The activity of the Operating Unit of Naples consists in executing the experimental tests and developing innovative techniques to employ the measurements for design purposes (i.e. reconstruction methodologies). The experiments will be conducted on the experimental apparatus already available at UNIPARTHENOPE. The test bench features a water tank 2 m large, 1.75 m long, and 1 m deep and filled up to 0.6 m to prevent the water to overflow. A sledge runs over two vertical rails 3 m long at a distance of 65 cm. The rails are rigidly connected to the roof of the laboratory and to the water tank to maximize their stiffness and minimize vibrations. The rails are suspended approximately 15 cm above the water surface to avoid possible contact with the water splash-up generated as the water piles up the sides of the falling body during the water entry. The setup allows performing free fall impacts up to 2.5 m height and controlled velocity and acceleration impacts through electric actuators.

The solid bodies impacting the water will be equipped with two stud-mounting piezo-ceramic accelerometers (measurement specialties 805M1) with ranges of ±20 g and ±200 g excited by 5 V DC. A linear potentiometer with nominal infinite definition is embedded in one of the two rails and records the sledge position over a 75 cm run.

The linear position sensor is actuated by a stud mounted Derlin wiper with tip diameter of 2.7 mm embedded into the sledge. A high speed camera (Phantom Miro M10) is utilized to acquire the images of the falling body during the water entry at 2000 frames per second with a maximum definition of 1152×720 pixels. A photodiode (Markteck Optoelectronics MTRS4720D) with response time of 1 μs is utilized to trigger the high speed camera to start the acquisition when the wedge keel is 5 cm above the water surface.

The analog signals from the accelerometers, the displacement sensor, and the photodiode are synchronously acquired by a National Instrument NI USB-6009 at a maximum sample rate of 10 kHz. The photodiode is also utilized to trigger the high speed camera recordings.

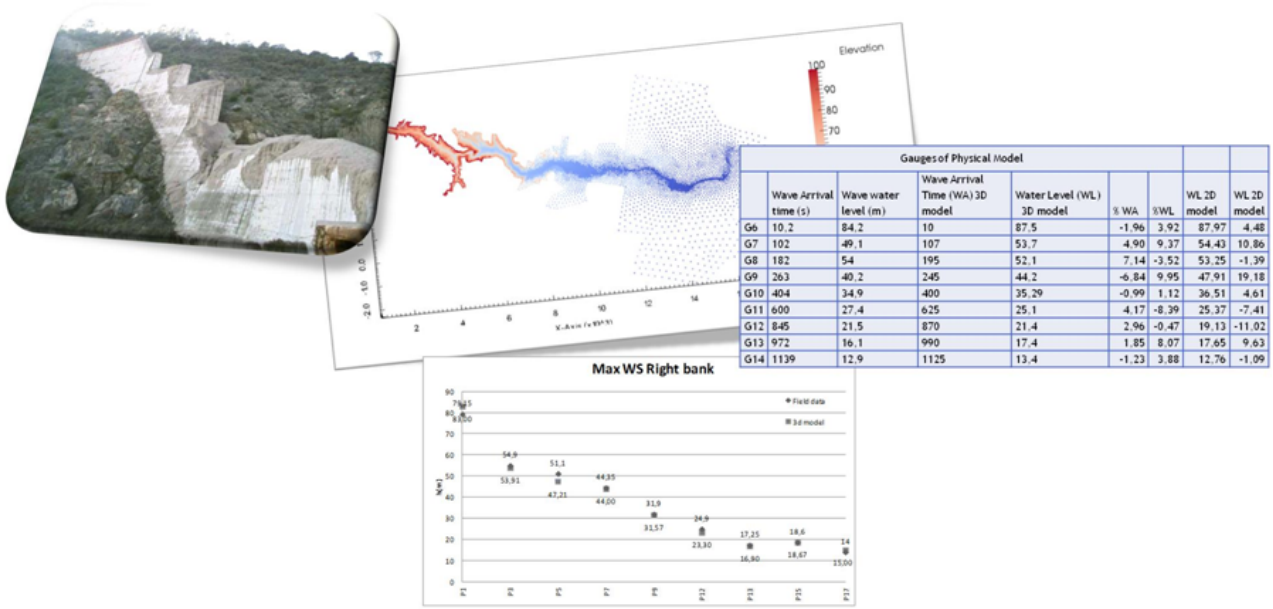
The unit has also an FBG measuring system. Strains are synchronously measured by an interrogation system, which integrates a laser source with an average optical power output of 3 mW and a wavelength band width of 80nm. The sampling frequency is 6kHz.



Experimental test bench at the University of Naples "Parthenope" (right). Examples of images from the high speed camera of water entry problems (left).

5) UNIPG

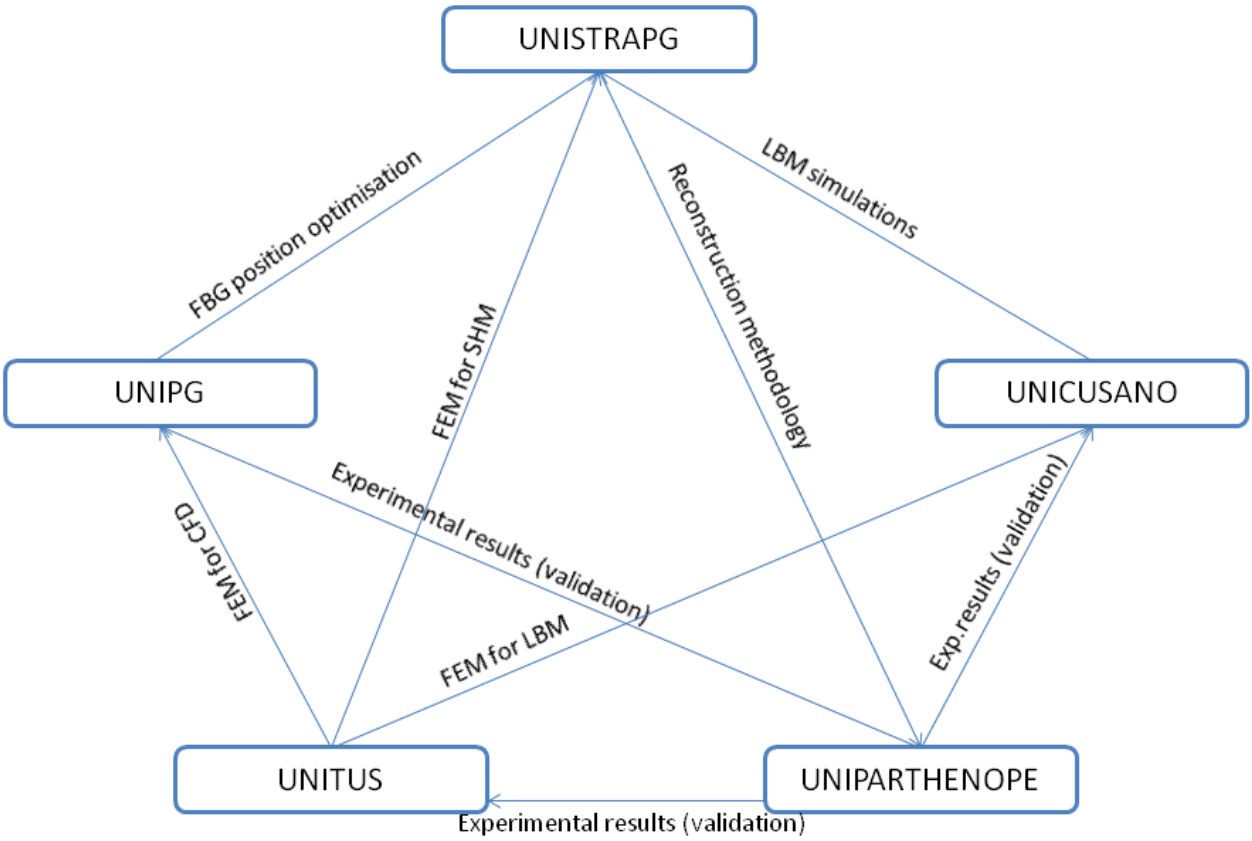
The University of Perugia will select the real world applications to be analyzed within the WP 6 and, given the expertise of the research group, will take care of the application of the methodologies to hydraulic structures. As a matter of facts, the researchers involved have a long experience in this field and will make available several data to this aim.
Moreover UNIPG will contribute to the SHM system development through the optimization of the FBG sensors positioning. This will be performed through an entropy method successfully applied in the past to hydrological problems.



Gauges of Physical Model								
	Wave Arrival time (s)	Wave water level (m)	Wave Arrival Time (WA) 3D model	Water Level (WL) 3D model	% WA	%WL	WL 2D model	WL 2D model
G6	10,2	84,2	10	87,5	-1,96	3,92	87,97	4,48
G7	102	49,1	107	53,7	4,90	9,37	54,43	10,86
G8	182	54	195	52,1	7,14	-3,52	53,25	-1,39
G9	263	40,2	245	44,2	-6,84	9,95	47,91	19,18
G10	404	34,9	400	35,29	-0,99	1,12	36,51	4,61
G11	600	27,4	625	25,1	4,17	-8,39	25,37	-7,41
G12	845	21,5	870	21,4	2,96	-0,47	19,13	-11,02
G13	972	16,1	990	17,4	1,85	8,07	17,65	9,63
G14	1139	12,9	1125	13,4	-1,23	3,88	12,76	-1,09

Set of results from the simulation of a real dam break case study in the OpenFoam framework.

The main information flows among the research units are presented in the following figure, which shows the information exchange among all the operating units during the working packages.



4 – Possibile application potentialities and scientific and/or technological and/or social and/or economic impact of the project

The project features several innovative elements. The most significant scientific impact is expected in the fields of experimental and computational fluid-structure interaction thanks to the development and validation of coupled fluid-structural numerical solvers, innovative experimental techniques and monitoring systems, and design procedures and criteria that can be applied in several engineering disciplines, such as naval and aerospace, hydraulic structures, energy converters. Furthermore, the thorough study of the physical mechanisms underlying the energy transfer process between the fluid flow and the structure is relevant for a wide range of continuum mechanics studies.
To date, an integrated methodology for the reliable analysis of free-surface fluid-structure interaction is missing, especially for impulsive events. This is due to the scarcity of experimental data, to the lack of numerical models of fluid-structure interaction at the same time accurate and with acceptable computational costs and to the absence of reliable theoretical models to be used in the design phase. The innovation of the project is related to the need of filling these gaps, addressing all three issues together, being them inseparably linked.
The development of a monitoring system able to reconstruct the displacements of a structure starting from deformation punctual measurements is itself innovative and attractive to the market in almost all the engineering fields; it would also serves to produce those experimental data absolutely necessary for the validation of numerical models, which in turn allow to produce a set of data and test cases wide enough to realize simplified theoretical models.
Except from the three specific applications that will be addressed in the project, the development of measuring devices for the analysis of structure deformations in dynamic conditions is also fundamental in the design of surface vehicles for civil and military applications that are to be used in extreme conditions, for extended time, and be subject at great speed and accelerations.
The project has a high degree of innovation also in the proposed techniques, that the various partners have been developing for years, also in collaboration with each others, as evidenced by the several common publications.
The monitoring system will be based on a high frequency interrogation system for FBG sensors, whose development has been started in collaboration between the units of Naples and of Foreigners of Perugia, using two leading technologies, the opto-acoustic and the transmission gratings, resulting in a product more powerful than those currently marketed. FBG are one of the most promising strain sensing technologies and their applications and reliability are growing fast. They present several advantages with respect to other technologies.
For what concerns the numerical part, the development of a numerical model in an open source environment, such the one employed in the project, could have several fallouts in scientific research. Moreover, the use of the Lattice Boltzmann method as the fluid solver should lead to a ”non-boundary-fitted” fluid-structure interaction model, requiring lower computational times compared to traditional CFD, given that the solid boundaries do not lie on the fluid nodes, similarly to immersed boundaries.
Another distinctive aspect of the project is the generality and usability of scientific results for design purposes, as we intend to consolidate a rigorous procedure to transit results obtained under laboratory scales to real world dimensions, which means the identification of the similitude criteria for such problems. These criteria will also allow to understand the limitations, or,

conversely the possibility, of realizing devices characterized by different dimensional scales.
From a commercial point of view, the project has several fallouts:
- The marine industry, in which Italy is a major player in the world (Italy holds 43% of the world share in the segment of the cruise ships and 44% in the ferry);
- The hydraulic structures design and monitoring, whose importance is also related to civil protection and security;
- Energy harvesting from fluids, which is an emerging area of research in which the fluid is treated as a source of usable energy rather than a mere source of mechanical damping. This opportunity could revolutionize the approach to renewable energy and energy conservation, allowing to obtain usable energy from a massive, but unexploited source. The project is thus also focused on the compelling problem of sustainable and clean energy generation, providing a practical answer to the need of reducing pollutants and saving natural resources.
In conclusion this project is characterized by a high scientific as well as socio-economic impact, in different fields such as hydraulic structures design, naval design, energy conservation, but also remote sensing and actuation, unmanned mobile devices.

5 – Costs and fundings, for each research unit (automatically calculated)

nº	Associated or principal investigator	Total cost	Co-funding (item A.1)	MIUR funding (other items)
1.	BISCARINI Chiara	197.736 €	50.400 €	147.336 €
2.	FALCUCCI Giacomo	124.800 €	0 €	124.800 €
3.	FANELLI Pierluigi	154.800 €	30.000 €	124.800 €
4.	MANCIOLA Piergiorgio	165.600 €	50.000 €	115.600 €
5.	DI FRANCESCO Silvia	121.400 €	0 €	121.400 €
	Total	**764.336 €**	**130.400 €**	**633.936 €**

B.2

1 – Scientific curriculum of PI (highlighting, for LS and PE fields, of bibliometric indicators related to publications and citations, and, for SH field, of the quality and impact of publications; awards and other honors; degree of success in Italian or international previous projects)

BISCARINI Chiara

PRESENT POSITIONS
since 2015 - Member of the Senate of the University for Foreigners Perugia
since 2014 - Vice-chair - UNESCO CHAIR Water Resources Management and Culture
since 2014 – Member of the Quality Presidium of the University for Foreigners Perugia
since 2007– Assistant Professor of Hydraulic and Hydrology (ICAR/02) at the University for Foreigners Perugia.

STUDIES AND ACADEMIC CAREER
• 2007 to date University for Foreigners of Perugia, Assistant professor in Hydraulics and Maritime Works and Hydrology (ICAR/02) - affiliated to the UNESCO CHAIR Water Resources Management and Culture and to the Department of Human and Social Sciences.
• 2006 Doctoral Degree in Ph.D. degree in Sea and Engineering Sciences
• 2005 Reasearch grant for cooperation in research activities at the University of Perugia
• 2002-2006 Ph.D. student in Sea and Engineering Sciences (XVII cycle), University of Naples "Federico II".
• 2001 Member of the Society of Engineers of the Province of Perugia N° 2047.
• 9 July 2001 License to practice as an engineer with a final vote 120/120.
• 6 April 2001 MSc in Civil Engineering (1999-2000) at the Faculty of Engineering of the University of Perugia with a final vote of 110/110 cum laude.

SCIENTIFIC ACTIVITY
-----Roles in research organizations and scientific committees-----
• Since 2013 Member of the Scientific Committee of the inter-university research centre CIRIAF (Centro Interuniversitario di Ricerca sull'Inquinamento e sull'Ambiente) at University of Perugia and University of Roma Tre.
• Since 2013 Member of the Scientific Committee of the UNESCO Chair on Water Resources Management and Culture
• Since 2008 External collaboration - Headquarters of the World Water Assessment Programme (WWAP) – UNESCO, Perugia.
• Since 2007 CENTRO WARREDOC - Water Resources Research and Documentation Centre - Università per

Stranieri di Perugia 03/2007 – today
• Since 2007 Member of the Scientific Committee of Honors Center of Italian Universities (H2CU) at Sapienza Università of Rome since 2007
-----Invitations and awards-----
• 2014 Invited speaker at the workshop "Water and Human Heritage: Aniene river e Tivoli citiy", 19 december 2014, Tivoli, Roma.
• 2012 Evaluation of Research Quality (VQR 2004-2010): 100% of excellent products.
• 2010 Invited Seminar "Methodological Responses to support decision making in flood stressed areas" Seminar Series 8 Dept. of Civil Engineering, the City College of New York
• 2010 Invited speaker at the World Water Day UNESCO-WWAP, Perugia.
• 2010 Invited speaker at the Workshop "World Water Day 2010: Clean Water for a Healthy World" World Water Assessment Program WWAP- UNESCO Perugia.
• 2009 Invited speaker at the Unesco - IHP International Hydrological Program Workshop "Water for life: System under Stress and Societal Responses", Roma.
• 2009 Invited speaker at the 9th World Water Day, Roma, Accademia dei Lincei.
• 2008 Invited speaker at the Symposium "The role of hydrology in water resources management", organised by The IHP-Committee of Italy, sponsored by IAHS and co-sponsored by UNESCO, Capri.
• 2005 Invited speaker at the 1st Seminar of the Italian National Committee of IHP-UNESCO under the 2005-2015 United Nations Decade for Action "Water for Life".
-----Organization and coordination of inte2rnational scientific initiatives-----
• 2014 Chairman of the grant "Best practices for lakes" promoted by the Italian Ministry of the Environment Land and Sea, ISPRA - Institute for Environmental Protection and Research, H2CU, UNESCO Chair of Università per Stranieri di Perugia, Italian hydrotechnical Association,15° World Lake Conferences.
• 2014 Organiz. Comm. of the Fifteenth World Lake Conference (WLC15) "Lakes: the mirror of the earth." ILEC, Perugia.
• 2013 Organiz. Comm. of the "Workshop on Science, Cultural and Human Wellbeing in Lake Areas: Trasimeno Lake case study ". Pre-Conference Meeting of 15th World Lake Conference.
• 2013 Organiz. Comm. of the Workshop "Workshop on UNESCO AND WATER" with the patronage of: UNESCO, H2CU, ILEC.
• 2012 Curator of the International Film Festival ACQUADOC 2012 within the Umbria Water Festival Perugia, 17-20 may 2012.
• 2012 Organiz. Comm. of the Workshop "Bidimensional hydraulic modeling with RiverFLO-2D", 10-12 July, 2012, Perugia, Italy.
• 2010 Organiz. Comm. of the Workshop "World Water Day 2010: Clean Water for a Healthy World" World Water Assessment Program WWAP- UNESCO.
• 2007 Local Organization Committee - General Assembly - International Union of Geodesy and Geophysics (IUGG), Perugia, July 2007.
• 2008 Organiz. Comm. "Second Preparatory Meeting on the Third World Water Development Report (WWDR-3)", UNESCO-WWAP.
• 2008 Organiz. Comm. of the International Course "An introduction to Lattice Boltzmann Methods for complex flow simulations", CNR, Roma.
-----Organization and coordination of national scientific initiatives-----
• 2012 Organiz. Comm. of the conference "Diga 33 - Viaggio attraverso 33 dighe nel mondo. Utilizzi, soluzioni costruttive e impatto socio-economico", 19 maggio 2012 Magione (PG) within the Umbria Water Festival Perugia.
• 2012 Organiz. Comm. of the workshop "Le sfide del nord e del sud del mondo: tutela ambientale e sviluppo sostenibile", University for Foreigners of Perugia, 27 June 2012.
• 2010 Organiz. Comm. of the "Programma Idrologico Internazionale IHP – UNESCO - Illustrazione del "World Water Assessment Programme" of United Nations. Roma
• 2010 Organiz. Comm. of the scientific event "Acqua: priorità in America Latina", 25 march 2010, Istituto Italo Latino Americano, Roma. Promoted by The International Commission on Irrigation and Drainage (ICID).
• 2009 Local Organiz. Comm. of the Conference "Galileo e l'Acqua: guardare il cielo per capire la terra" 17 december 2009 - Aula Marconi CNR, Roma and 18 december 2009 State Archives in Rome.
• 2009 Organiz. Comm. of the "Giornata di Studio in ricordo di Filippo Arredi" 19 december 2009 - Teatro Clitunno, Trevi (Perugia).

RESEARCH PROJECTS
------Selected for funding on the basis of competitive calls-----
• MIUR – SIR programme; MediAsylum, Crisis management in the Mediterranean Sea under the new Regulation (EU) No 604/2013 in the context of a substantiated risk of particular pressure being placed on a Member State's asylum system, 36 months, Participant.
• COLISEE project, ERASMUS +2014-1-FR01-K203-008505, 36 months, Member of the Scientific Committee of the partner institution
• MaReMaP-AIR Marine Resources management plan of the Adriaitic and Ionian Region funded by the University of Macerata within EU funds, 14 months, Participant.
• Progetto Operativo Difesa Suolo (PODiS) – PON ATAS QCS 2000/2006 - Linea attività di supporto indiretto: predisposizione di metodologie e linee guida - Ministero dell'Ambiente e Tutela del Territorio (Roma) funded by the European Commission, 72 months, Head of Hydraulics area
• Progetto Operativo Difesa Suolo (PODiS) – PON ATAS QCS 2000/2006 - Linea attività di supporto diretto: Supporto per problematiche di notevole complessità. - Ministero dell'Ambiente e Tutela del Territorio (Roma) funded by the European Commission, 72 months, Head of the working group on coasts
• Research grant "Modeling analysis of the events of the hydraulic system Black-Niagara Falls – Velino" funded

within "Funding of research projects of young researchers of the University for Foreigners of Perugia" 2009, 12 months, Principal Investigator
• Research grant "Numerical modeling of hydraulic flows through a mesoscopic approach" funded within "Funding of research projects of young researchers of the University for Foreigners of Perugia" 2010, 12 months, Principal Investigator
• Research grant "Lattice Boltzmann method for the simulation of rapidly changed currents" funded within "Funding of research projects of young researchers of the University for Foreigners of Perugia" 2012, 12 months, Principal Investigator
• USA National Science Foundation – Fluid dynamics (2013-2016): "Particle Image Baro-Velocimetry (PIBV): simultaneous measurement of pressure and velocity in fluids" award n. 1332204– Polytechnic Institute NYU, 36 months, Participant
• Bragg grating optical fiber sensors" financed by the Lazio Region through FILAS S.p.A. - Business Lab Centro Atena. (2005-2006), 12 months, Scientific Tutor

-----Scientific and technical activities in other research projects------
She has been collaborating and co-directing over 30 research and technical projects on hydrology, hydraulics, GIS, and civil engineering.

EDITORIAL ACTIVITY
-----Editor of the following books-----
• Chiara Biscarini, Fabio Russo. Lectures on WATER FOR LIFE: SYSTEMS UNDER STRESS AND SOCIETAL RESPONSES. Science4 Press, 2010, ISBN 9788896504017.
• Chiara Biscarini, Valentina Abete, Arnaldo Pierleoni, Antonello Lamanna. Book of abstracts of 15° World Lake Conference. Lakes: the mirrors of the earth BALANCING ECOSYSTEM INTEGRITY AND HUMAN WELLBEING. Science4 Press, 2014, ISBN: 978-88-96504-03-1 (print), ISBN: 978-88-96504-05-5 (online)
• Chiara Biscarini, Arnaldo Pierleoni, Luigi Naselli-Flores, Proceedings of 15° World Lake Conference. Lakes: the mirrors of the earth BALANCING ECOSYSTEM INTEGRITY AND HUMAN WELLBEING. Science4 Press, 2014, ISBN: 978-88-96504-04-8 (print), ISBN: 978-88-96504-07-9 (online).

• Member of the technical review panel of several technical books published by PODIS, Ministero dell'Ambiente e Tutela del Territorio.
• Referee for several international journals, book publishers and international conference proceedings.

BIBLIOMETRIC INDICATORS (Database SCOPUS):
- Total citations = 154
- H-index = 6
- Number of publications in scientific journals = 66 (31 in the last 5 years)
BIBLIOMETRIC INDICATORS (Database GOOGLE SCHOLAR):
- Total citations = 251 (203 in the last 5 years)
- H-index = 8

2 - Scientific curriculum of associated investigators (highlighting, for LS and PE fields, of bibliometric indicators related to publications and citations, and, for SH field, of the quality and impact of publications; awards and other honors)

1. **FALCUCCI Giacomo**

   Born in Rome on 21/01/1980. In May 2005 he graduated with honors in Mechanical Engineering at the University of Rome "Roma Tre". In April 2009 he got the PhD in Machinery Engineering. From 2009 to 2012 he has been Post-Doc Researcher in Energy and Environmental Systems at the University of Naples "Parthenope". From June 2012 he is Assistant Professor at the University of Naples "Parthenope" – Department of Engineering.

   ACADEMIC APPOINTMENTS
   - Member of the Commission for Research Activity Promotion at the Department of Engineering of the University of Naples Parthenope.

   SCIENTIFIC ACTIVITY:
   --------- Organization and coordination of scientific activities---------
   - Scientific committee of the editions of the "European Fuel Cell Technology & Applications Conference" in the years 2011, 2013 and 2015.
   - Scientific committee of the Thermacomp 2009 First International Conference on Computational Methods for Thermal Problems, Napoli, 8-10 September, 2009.

   ---------Honors and awards---------
   2015 Capocaccia Prize for "Studio Sperimentale dell'interazione fluido struttura durante l'ingresso in acqua di corpi flessibili", provided by the Italian Association for Stress Analysis.
   2015 Invitation to the Oral Interview for ERC Starting Grant Proposal n. 680010.

---------Editor and Referee activity---------
- He has been serving as Review Editor the Editorial Board of Computational Physics, a specialty of Frontiers in Physics.
- He serve sas Reviewer for the following Scientific Journals: Nature - Scientific Reports; Journal of Fluid Mechanics; Europhysics Letters;Journal of Computational Physics; Physica A: Statistical Mechanics and its Applications; Physica D: Nonlinear Phenomena; Journal of Computational Physics;Communications in Computational Physics; Fuel;Energy;Applied Energy;International Journal of Modern Physics, C;International Journal for Numerical Methods in Fluids;Numerical Heat Transfer Journal;International Journal of Numerical Methods for Heat and Fluid Flow; International Journal of Thermal Sciences;International Journal of Hydrogen Energy;Progress in Computational Fluid Dynamics;AIChE Journal;Computers & Fluids;Computers & Chemical Engineering;Journal of Mechanical Engineering Science;Proceedings of the IMechE part C Journal of Mechanical Engineering Science; Proceedings of the IMechE part G Journal of Aerospace Science;ASME Journal of Fuel Cell Science and Technology;Mathematical Problems in Engineering;Measurement; Computers and Mathematics with Applications;
---------Visiting positions and invited seminars---------
- He has been appointed as Visiting Scholar at the School of Engineering and Applied Sciences of Harvard university in 2014.
- He has been appointed as Visiting Professor at the Department of Mechanical and Aerospace Engineering – Tandon School of Engineering - NYU (2010)
- Invited Speaker at the 22nd International Conference on Discrete Simulations of Fluid Dynamics (DSFD 2013), Yerevan (Armenia), in July 2013.
- Invited Lecturer at Princeton University and City College of New York in July 2012; title of the Seminars: "Lattice Boltzmann Simulation of Multiphase Flows with Multi-Range Pseudo-Potentials".
- Invited Lecturer at the Sloan Automotive Laboratory of MIT on April 2008.

EXPERIENCE ON RESEARCH PROJECTS:
--------- Participation in research projects, selected on calls with peer review ---------
- PON SmartGENERATION: "Sistemi e tecnologie sostenibili per la generazione di energia " PON03PE_00157_1; Prof. Ing. Elio Jannelli (Jan. 2015 - present day) : c/o DI – University of Naples "PARTHENOPE", Centro Direzionale, Isola C4, 80143, Naples, Italy; elio.jannelli@uniparthenope.it;
- PON FCLab "Sistemi innovativi e tecnologie ad alta efficienza per la poligenerazione" PON03PE_00109_1/F12 - CUP I62E14000000007;Prof. Ing. Elio Jannelli (Jan. 2015 - present day) : c/o DI – University of Naples "PARTHENOPE", Centro Direzionale, Isola C4, 80143, Naples, Italy; elio.jannelli@uniparthenope.it;
- IMASC: study and development of novel nanoscale catalysts for improved conversion processes;Prof. Cynthia M. Friend (May. 2014 - present day) : c/o Friend Lab, Harvard University, Dept. of Chemistry & Chemical Biology; friend@fas.harvard.edu;
- PON SmartGEN: "Celle a Combustibile e Piattaforme Ibride di Poligenerazione da Fonti Fossili e Rinnovabili", Smart Generation of Power from several sources, including Fuel Cells and Alternative Sources;Training Project: "Scuole di Formazione di Ricercatori e Tecnici per l'Innovazione e lo Sviluppo nel Settore della Generazione Distribuita di Energia da Fonti Fossili e Rinnovabili"; Prof. Ing. Mariagiovanna Minutillo (May 2010 - present day): c/o DI – University of Naples "PARTHENOPE", Centro Direzionale, Isola C4, 80143, Naples, Italy; mariagiovanna.minutillo@uniparthenope.it;
- MISE-ICE-CRUI: Study of fluid-structure interaction for hull slamming and water impacts; Prof. Ing. Elio Jannelli (Oct. 2012 - April 2014) : c/o DIT – University of Naples "PARTHENOPE", Centro Direzionale, Isola C4, 80143, Naples, Italy; elio.jannelli@uniparthenope.it;
- COELMO: Study of Power Systems based on PEM and HT-PEM Fuel Cells; Prof. Ing. Elio Jannelli (May 2010 - Dec. 2012) : c/o DIT – University of Naples "PARTHENOPE", Centro Direzionale, Isola C4, 80143, Naples, Italy; elio.jannelli@uniparthenope.it;
- FIRB 2005: Study of gas combustion to Internal Combustion Engines; Prof. Ing. Stefano Ubertini (Dec. 2008 - Dec. 2010) : c/o DEIM – University of Tuscia, Viterbo, Italy; stefano.ubertini@unitus.it;
- PRIN 2008: Study and realization of energy systems based on HT-PEM Fuel Cells; Prof. Ing. Stefano Ubertini (Dec. 2008 - Dec. 2010) : c/o DEIM – University of Tuscia, Viterbo, Italy; stefano.ubertini@unitus.it;
- LBM: Lattice Boltzmann study and applications to multiphase and reacting flows; Prof. Ing. Sauro Succi (Jan. 2006 - present day) : c/o Istituto per le Applicazioni del Calcolo, "IAC-CNR", Via dei Taurini 19, 00185, Rome, Italy; succi@iac.cnr.it;
- Office of Naval Research grant no. N00014-10-1-0988: Study of Energy Harvesting through Smart Materials;Prof. Maurizio Porfiri (June 2010 - Aug. 2010) : c/o Dept. of Mechanical and Aerospace Engineering, Polytechnic Institute of New York University, 6th Metrotech Center, Brooklyn, NY 11201, USA; mporfiri@poly.edu ;
- Lombardini: Study of combustion and emission control technologies;Prof. Ing. Giancarlo Chiatti (Oct. 2005 - Oct. 2008) : c/o DIMI – University of Rome "ROMA TRE", 79 Via della Vasca Navale, 00146 Rome, Italy; chiatti@uniroma3.it.

BIBLIOMETRIC INDICATORS (Database SCOPUS):
- Total citations = 443 (401 in the last 5 years)
- H-index = 13
- Number of publications in scientific journals = 30

2. **FANELLI Pierluigi**

Pierluigi Fanelli was born in Rome, Italy, on 27th of July 1983. In 2005 obtained the Bachelor's Degree in Mechanical Engineering at the University of Rome "Tor Vergata", with a thesis entitled "Plastic deformation molding of thin sheets for automotive catalysts" (supervisor Prof. Vincenzo Tagliaferri), with a valuation of 110/110 cum laude. In 2007 he got Master's Degree in Mechanical Engineering at the University of Rome "Tor Vergata", with a thesis entitled "Theoretical and numerical analysis of the behavior of welded structures for points in the plastic range" (supervisor Prof. Ing . Vincenzo Vullo, co-Ing Francesco Vivio), reporting the assessment of 110/110 cum laude. In 2011 he received the degree of Doctor of Philosophy in Mechanical Systems Design at the University of Rome "Tor Vergata", with a thesis entitled "Structural Behavior Of Joints Spot: Theoretical Approaches And Numerical And Experimental Analyses "(Tutor and Coordinator Prof. Vincenzo Vullo).
From June 2011 to June 2012 he was employed as a Research fellow at the University of Rome "Tor Vergata". From 2012, he is an Assistant Professor in the scientific field ING-IND/14 at the Department DEIM of the University of Tuscia in Viterbo and teaches Solid Mechanics and Mechanical Design in the Course of Industrial Engineering.

Scientific Activity:
Pierluigi Fanelli (co)authored 19 papers in refereed international and national journals and conference proceedings, in the fields of structural analysis, statics and dynamics, using advanced methodologies aimed at the optimum design of components and mechanical systems. The methods used provide numerical methods such as finite element and concentrated parameters analyses, innovative methods for the fatigue characterization of particular types of components and mechanical joints, theoretical analysis and experimental measurements for the detection of reference parameters as well as analytical and numerical solutions to describe the behavior of mechanical structures. The research activity is divided into the lines of research described below: structural behavior of spot welded joints and friction stir spot welding joints; structural analysis and theoretical solutions of bending plates with variable profile and of plates subjected to bending loads beyond the elastic limit; innovation, advanced design and optimization of automotive chassis.
He has served as a refereed for Journals on mechanical design such as Materials&Design.
He has been collaborating to several research projects and contracts on mechanical design, internal combustion engines, thermo-fluid dynamics and fluid structure interaction. In particular:
- Progetto Industria 2015 – IQMMTM "studio, progettazione e sviluppo di un innovativo quadriciclo stradale multimodale e multipurpose, ecologico, ergonomico, economico, sicuro ed interconnesso, per il trasporto sostenibile di merci nei centri storici (in breve iqmmtm)"
-"Complete design of a chassis for light vehicles with innovative modularity" in collaboration with MATE S.r.l.,
– Research project " PON01_02864 FC SMART GEN - PON RICERCA E COMPETITIVITÀ 2007-2013"
– Research project " PRIN 2008 - 2008CZWPA9_002 - Analisi multidimensionale fluidodinamica, elettrochimica, termica e strutturale di celle a combustibile ad elettrolita polimerico ad elevata temperatura"
– Research project " PON03PE_00109_1/F12 FUEL CELL LAB - PON RICERCA E COMPETITIVITÀ 2007-2013"
– Research project "De Tech - Industria 2015 Made in Italy MI01_00260"
- Collaboration with Avio Group for structural optimization for Vega components
- Collaboration with Eleo2Engineering for structural and thermal design of components in energy plants.
In 2013 his work EXPERIMENTAL AND NUMERICAL CHARACTERIZATION OF FRICTION STIR SPOT WELDED JOINTS - ENGINEERING FRACTURE MECHANICS - VOLUME 81 has been awarded in the "ScienceDirect Top25 list of most downloaded articles" for Engineering Fracture Mechanics – January to December 2012 full year.

Scopus indexes:
Scopus Author ID: 25228585900
Orcid: 0000-0002-5095-4107
Documents: 10
Citations: 59
h-index: 4

Teaching activity:
---Own Courses
-Solid mechanics, Bachelor degree in Industrial Engineering, Università della Tuscia, from 2012/13 to now.
-Mechanical Design, Bachelor degree in Industrial Engineering, Università della Tuscia, from 2012/13 to now.
-Mechanical Design, Bachelor degree in Industrial Engineering, Università Telematica Niccolò Cusano, 2012/13.
-Mechanical Design, Master degree in Industrial Engineering, Università Telematica Niccolò Cusano, 2012/13.

---Seminars
-Machinery Design, Bachelor degree in Industrial Engineering, Università della Tuscia, from 2014/15 to now.

---Courses collaboration
-Mechanical Design, Bachelor degree in Mechanical Engineering, Università di Roma "Tor Vergata, from 2006/07 to 2011/12.

-Mechanical Design, Master degree in Mechanical Engineering, Università di Roma "Tor Vergata, from 2006/07 to 2011/12.
-Mechanical Design, Bachelor degree in Mechatronic Engineering, Università di Roma "Tor Vergata, from 2006/07 to 2007/08.
-Automotive Design, Master degree in Mechanical Engineering, Università di Roma "Tor Vergata, 2011/12.

He has directed and co-directed over 20 bachelor and master thesis in mechanical and industrial engineering at the Universities of Roma "Tor-Vergata" and of "Tuscia".

3. **MANCIOLA Piergiorgio**

4. **DI FRANCESCO Silvia**

3 – Principal scientific publications of PI

1. Panciroli R, Biscarini C, Falcucci G, Jannelli E, Ubertini S (2016). Live monitoring of the distributed strain field in impulsive events through fiber Bragg gratings. JOURNAL OF FLUIDS AND STRUCTURES, vol. 61, p. 60-75, ISSN: 0889-9746 - **Articolo in rivista**
2. Zarghami A, Biscarini C, Succi S, Ubertini S (2014). Hydrodynamics in Porous Media: A Finite Volume Lattice Boltzmann Study. JOURNAL OF SCIENTIFIC COMPUTING, vol. April 2014, Volume 59,, p. 80-103, ISSN: 0885-7474, doi: 10.1007/s10915-013-9754-4 - **Articolo in rivista**
3. Biscarini C, Di Francesco S, Nardi F, Manciola P (2013). Detailed simulation of complex hydraulic problems with macroscopic and mesoscopic mathematical methods. MATHEMATICAL PROBLEMS IN ENGINEERING, vol. 2013, 928309, ISSN: 1563-5147, doi: 10.1155/2013/928309 - **Articolo in rivista**
4. FERNANDO F, BISCARINI C, DI FRANCESCO S, MANCIOLA P, UBERTINI L (2013). Comparing A Large-Scale Dem-Based Floodplain Delineation Algorithm With Standard Flood Maps: The Tiber River Basin Case Study. IRRIGATION AND DRAINAGE, vol. 62, p. 11-19, ISSN: 1531-0361, doi: 10.1002/ird.1818 - **Articolo in rivista**
5. Zarghami A, Biscarini C, Succi S, Ubertini S (2013). Hydrodynamics in Porous Media: A Finite Volume Lattice Boltzmann Study. JOURNAL OF SCIENTIFIC COMPUTING, ISSN: 0885-7474, doi: 10.1007/s10915-013-9754-4 - **Articolo in rivista**
6. Zarghami A, Di Francesco S, Biscarini C (2013). Porous substrate effects on thermal flows through a rev-scale finite volume lattice boltzmann model. INTERNATIONAL JOURNAL OF MODERN PHYSICS C, ISSN: 0129-1831, doi: 10.1142/S0129183113500861 - **Articolo in rivista**
7. Biscarini C, Di Francesco S, Mencattini M (2011). Application of the lattice Boltzmann method for large-scale hydraulic problems. INTERNATIONAL JOURNAL OF NUMERICAL METHODS FOR HEAT & FLUID FLOW, vol. 21, p. 584-601, ISSN: 0961-5539, doi: 10.1108/09615531111135846 - **Articolo in rivista**
8. Biscarini C, Testa M (2011). Three-Dimensional numerical modelling of the Marmore waterfalls. PROGRESS IN COMPUTATIONAL FLUID DYNAMICS, vol. 11, p. 105-115, ISSN: 1468-4349, doi: 10.1504/PCFD.2011.038836 - **Articolo in rivista**
9. Falcucci G, Ubertini S, Biscarini C, Di Francesco S, Chiappini D, Palpacelli S, De Maio A, Succi S (2011). Lattice Boltzmann Methods for Multiphase Flow Simulations across Scales. COMMUNICATIONS IN COMPUTATIONAL PHYSICS, vol. 9, p. 269-296, ISSN: 1815-2406, doi: 10.4208/cicp.221209.250510a - **Articolo in rivista**
10. BISCARINI C (2010). "Computational fluid dynamics modelling of landslide generated water waves". LANDSLIDES, vol. 7, p. 117-124, ISSN: 1612-510X, doi: 10.1007/S10346-009-0194-Z - **Articolo in rivista**
11. Biscarini C., Di Francesco S., Manciola P. (2010). CFD modelling approach for dam break flow studies. HYDROLOGY AND EARTH SYSTEM SCIENCES, vol. 14/2010, p. 705-718, ISSN: 1027-5606, doi: 10.5194/hess-14-705-2010 - **Articolo in rivista**
12. MANCIOLA P, DI FRANCESCO S, BISCARINI C (2009). Flood Protection and Risk Management: the case of Tescio River Basin. IAHS PUBLICATION, vol. 327, p. 174-183 - **Articolo in rivista**
13. VIOLANTE C, BISCARINI C, ESPOSITO E, MOLISSO F, PORFIDO S, SACCHI M (2009). The consequences of hydrological events on steep coastal watersheds: the Costa d'Amalfi, eastern Tyrrhenian Sea. IAHS PUBLICATION, vol. 327, p. 102-113 - **Articolo in rivista**
14. Esposito E, Porfido S, Violante C, Biscarini C, Alaia F, Esposito G (2004). Water events and historical flood recurrences in the Vietri sul Mare coastal area (Costiera Amalfitana, southern Italy). IAHS PUBLICATION, vol. 286, p. 95-106 - **Articolo in rivista**
15. Panciroli R, Biscarini C, Giovannozzi A, Maggiorana P Jannelli E (2015). Structural Health Monitoring through Fiber Bragg Grating Strain Sensing. In: PROCEEDINGS OF THE INTERNATIONAL CONFERENCE OF NUMERICAL ANALYSIS AND APPLIED MATHEMATICS 2014 (ICNAAM-2014). AIP CONFERENCE PROCEEDINGS, ISSN: 0094-243X - **Contributo in Atti di convegno**

16. Di Francesco S, Zarghami A, Biscarini C, and Manciola P (2013). Wall roughness effect in the lattice Boltzmann method. In: AIP Conference Proceedings. doi: http://dx.doi.org/10.1063/1.4825852 - **Contributo in Atti di convegno**
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18. Biscarini C, Di Francesco S, Manciola P (2010). Methodological responses to support decision making in flood stressed areas: plan formulation. In: (a cura di): Biscarini C, Russo F, Lectures on WATER FOR LIFE: SYSTEMS UNDER STRESS AND SOCIETAL RESPONSES. Science4 Press, ISBN: 9788896504017 - **Contributo in Atti di convegno**
19. Di Francesco S., Biscarini C., Manciola P. (2010). Mesoscopic modeling of dam break flow. In: -. Hydraulic Model Report CH80/10. Edinburgh, may, 2010, vol. CH80/10, p. 137-145, Brisbane, Australia:School of Civil Eng., The University of Queensland, Brisbane, Australia - **Contributo in Atti di convegno**
20. Biscarini C, Russo F (a cura di) (2010). Lectures on Water for life: Systems Under Stress and Societal Responses. Lectures from the workshop Water for life: Systems under stress and societal responses, Rome, Italy, July 15 2009 . Science4Press, ISBN: 9788896504017 - **Curatela**

4 - Principal scientific publications of associated investigators

1. **FALCUCCI Giacomo**

    1. Falcucci G, Ubertini S, Jannelli E (2013). Lattice Boltzmann simulation of hull slamming. In: Proceedings of DSFD 2013. - **Abstract in Atti di convegno**
    2. A. Zarghami, G. Falcucci, E. Jannelli, S. Succi, M. Porfiri, S. Ubertini (2014). Lattice Boltzmann modeling of water entry problems. INTERNATIONAL JOURNAL OF MODERN PHYSICS C, ISSN: 0129-1831 - **Articolo in rivista**
    3. De Rosis A, Falcucci G, Porfiri M, Ubertini S, Ubertini F (2014). Hydroelastic analysis of hull slamming coupling lattice Boltzmann and finite element methods. COMPUTERS & STRUCTURES, vol. 138, p. 24-35, ISSN: 0045-7949 - **Articolo in rivista**
    4. De Rosis Alessandro, Falcucci Giacomo, Ubertini Stefano, Ubertini Francesco (2014). Aeroelastic study of flexible flapping wings by a coupled lattice Boltzmann-finite element approach with immersed boundary method. JOURNAL OF FLUIDS AND STRUCTURES, vol. 49, p. 516-533, ISSN: 0889-9746 - **Articolo in rivista**
    5. Zarghami A, Falcucci G, Jannelli E, Succi S, Porfiri M, Ubertini S (2014). Lattice Boltzmann modeling of water entry problems. INTERNATIONAL JOURNAL OF MODERN PHYSICS C, vol. 25, ISSN: 0129-1831 - **Articolo in rivista**
    6. De Rosis A, Falcucci G, Ubertini S, Ubertini F (2013). A coupled lattice Boltzmann-finite element approach for two-dimensional fluid-structure interaction. COMPUTERS & FLUIDS, vol. 86, p. 558-568, ISSN: 0045-7930 - **Articolo in rivista**
    7. De Rosis A, Falcucci G, Ubertini S, Ubertini F (2013). Lattice Boltzmann Analysis of Fluid-Structure Interaction with Moving Boundaries. COMMUNICATIONS IN COMPUTATIONAL PHYSICS, vol. 13, p. 823-834, ISSN: 1815-2406 - **Articolo in rivista**
    8. Falcucci G, Jannelli E, Ubertini S, Succi S (2013). Direct Numerical Evidence of Stress-Induced Cavitation. JOURNAL OF FLUID MECHANICS, vol. 728, p. 362-375, ISSN: 0022-1120 - **Articolo in rivista**
    9. Falcucci G, Ubertini S, Bella G, Succi S (2013). Lattice Boltzmann Simulation of Cavitating Flows. COMMUNICATIONS IN COMPUTATIONAL PHYSICS, vol. 13, p. 685-695, ISSN: 1991-7120 - **Articolo in rivista**
    10. De Rosis A, Falcucci G, Ubertini S, Ubertini F (2012). Modelling fluid-structure interaction in flapping wings through a combined lattice Boltzmann-finite element method. MECCANICA DEI MATERIALI E DELLE STRUTTURE, vol. 3, p. 26-33, ISSN: 2035-679X - **Articolo in rivista**
    11. Falcucci G, Aureli M, Ubertini S, Porfiri M (2011). Transverse Harmonic Oscillations of Laminae in Viscous Fluids: a Lattice Boltzmann Study. PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY OF LONDON SERIES A: MATHEMATICAL PHYSICAL AND ENGINEERING SCIENCES, vol. 369, p. 2456-2466, ISSN: 1364-503X - **Articolo in rivista**
    12. Falcucci G, Ubertini S, Biscarini C, Di Francesco S, Chiappini D, Palpacelli S, De Maio A, Succi S (2011). Lattice Boltzmann Methods for multiphase flow simulations across scales. COMMUNICATIONS IN COMPUTATIONAL PHYSICS, vol. 9, p. 269-296, ISSN: 1991-7120 - **Articolo in rivista**
    13. FALCUCCI G, S. CHIBBARO, S. SUCCI, X. SHAN AND H. CHEN (2008). Lattice Boltzmann spray-like fluids. EUROPHYSICS LETTERS, vol. 82, ISSN: 0295-5075 - **Articolo in rivista**
    14. Panciroli R., Falcucci G., Erme G., De Santis E., Jannelli E. (2015). Fluid-structure interaction during the water entry of flexible cylinders. In: PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUMERICAL ANALYSIS AND APPLIED MATHEMATICS 2014. - **Contributo in Atti di convegno**
    15. De Rosis A, Falcucci G (2012). A Lattice Boltzmann Approach to Fluid-Structure Interaction Problems. In: Proceedings of WSEAS 2012. - **Contributo in Atti di convegno**
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high-performance sulla risoluzione del sistema lineare. In: AIMETA 2011. Bologna, Italy, 12-15 Settembre 2011 - **Contributo in Atti di convegno**

17. De Rosis A, Falcucci G, Ubertini F, Ubertini S (2011). Lattice Boltzmann Simulations of Cantilevers Intaractions with Viscous Fluids. In: 6th MIT Conference of Computational Fluid and Solid Mechanics. Boston (MA) USA, 15-17/06/2011 - **Contributo in Atti di convegno**
18. De Rosis A, Falcucci G, Ubertini F, Ubertini S (2011). Simulazioni Lattice Boltzmann dell'interazione di mensole con fluidi
viscosi. In: AIMETA 2011. Bologna, Italy, 12-15 Settembre 2011 - **Contributo in Atti di convegno**
19. De Rosis A, Falcucci G, Ubertini F, Ubertini S (2011). Valutazione dello stato tensionale nel metodo Lattice Boltzmann: un'efficace rappresentazione di contorni curvilinei. In: AIMETA 2011. Bologna, Italy, 12-15 Settembre 2011 - **Contributo in Atti di convegno**
20. Falcucci G, De Rosis A, Ubertini F, Ubertini S (2011). Lattice Boltzmann Study of Fluid-Structure Interaction. In: DSFD 2011. Fargo, ND (USA), Agosto 2011 - **Contributo in Atti di convegno**

2. **FANELLI Pierluigi**

1. Fanelli P, Fino A, Vivio F (2015). Analysis Of Elastic-Plastic Behavior And Of Plastic Front Evaluation In Spot Welded Joints. INTERNATIONAL JOURNAL OF MECHANICAL SCIENCES, vol. 90, p. 122-132, ISSN: 0020-7403, doi: 10.1016/j.ijmecsci.2014.10.013 - **Articolo in rivista**
2. Fanelli P, Vivio F (2015). A general formulation of an analytical model for the elastic-plastic behaviour of a spot weld finite element. MECHANICS RESEARCH COMMUNICATIONS, vol. 69, p. 54-65, ISSN: 0093-6413, doi: 10.1016/j.mechrescom.2015.06.010 - **Articolo in rivista**
3. Buffa G, Fanelli P, Fratini L, Vivio F (2014). Influence of Joint Geometry on Micro and Macro Mechanical Properties of Friction Stir Spot Welded Joints. PROCEDIA ENGINEERING, vol. 81, p. 2086-2091, ISSN: 1877-7058, doi: 10.1016/j.proeng.2014.10.290 - **Articolo in rivista**
4. Fanelli P, Vivio F (2014). Analytical characterization of plastic flow in spot welded joints. THEORETICAL AND APPLIED FRACTURE MECHANICS, vol. 74, p. 48-54, ISSN: 0167-8442, doi: 10.1016/j.tafmec.2014.06.014 - **Articolo in rivista**
5. Fanelli P, Vivio F, Vullo V (2012). Experimental and numerical characterization of Friction stir spot welded joints.. ENGINEERING FRACTURE MECHANICS, vol. 81, p. 17-25, ISSN: 0013-7944 - **Articolo in rivista**
6. Fanelli P, Montanari R, Rovatti L, Ucciardello N, Vivio F, Vullo V (2011). Caratterizzazione microstrutturale e modellazione di giunti saldati per Friction Stir Spot Welding in lega di Alluminio 6082.. METALLURGIA ITALIANA, vol. 4, ISSN: 0026-0843 - **Articolo in rivista**
7. FANELLI P, VIVIO F (2009). A new analytical model for the elastic-plastic behaviour of spot welded joints subjected to orthogonal load. INTERNATIONAL JOURNAL OF SOLIDS AND STRUCTURES, vol. 46, p. 572-586, ISSN: 0020-7683, doi: 10.1016/j.ijsolstr.2008.09.006 - **Articolo in rivista**
8. Fanelli P, Vivio F (2015). Influence of non-axisymmetric material anisotropy on FSSW static strength. In: ICNAAM 2015. AIP CONFERENCE PROCEEDINGS, vol. 1648, 570017, ISSN: 0094-243X, Rodi, 23-29 Settembre 2015, doi: 10.1063/1.4912803 - **Contributo in Atti di convegno**
9. Fanelli P, Vivio F (2015). Modelling spot welded joints in elastic-plastic field. In: ICNAAM 2015. AIP CONFERENCE PROCEEDINGS, vol. 1648, 570018, AIP conference series, ISSN: 0094-243X, Rodi, 23-29 Settembre 2015 - **Contributo in Atti di convegno**
10. Marotta E, Salvini S, Trotta A, Vivio F, Fanelli P (2015). Trattamento per incrementare le proprietà smorzanti di schiume metalliche a celle aperte
. In: AIAS - 44° CONVEGNO NAZIONALE – MESSINA, 2-5 SETTEMBRE 2015. MESSINA, , 2-5 SETTEMBRE 2015 - **Contributo in Atti di convegno**
11. Vivio F, Vullo V, Fanelli P (2014). Analysis Of Static Strength And Failure Mode Of Fssw Joint In Aluminium Alloy. In: Volume 1: Applied Mechanics; Automotive Systems; Biomedical Biotechnology Engineering; Computational Mechanics; Design; Digital Manufacturing; Education; Marine and Aerospace Applications. vol. 1, ASME, ISBN: 978-0-7918-4583-7, Copenhagen, Denmark, 25–27 June 2014, doi: 10.1115/ESDA2014-20419 - **Contributo in Atti di convegno**
12. FANELLI P, FINO A, VIVIO F (2013). Analisi del comportamento elasto-plastico e del fronte di plasticizzazione di una giunzione saldata per punti. In: Atti XXXXII Convegno AIAS. Salerno, 11-13 Settembre - **Contributo in Atti di convegno**
13. Fanelli P, Montanari R, Rovatti L, Ucciardello N, Vivio F, Vullo V (2010). Caratterizzazione microstrutturale e modellazione di giunti saldati per Friction Stir Spot Welding in lega di Alluminio 6082.. In: Atti 33° Convegno Nazionale AIM. Brescia, 10/11/2010 - 12/11/2010 - **Contributo in Atti di convegno**
14. Fanelli P, Vivio F (2010). Caratterizzazione analitica del fronte di plasticizzazione in strutture saldate per punti. . In: Atti XXXIX Convegno AIAS. Maratea, 7-10 settembre 2010 - **Contributo in Atti di convegno**
15. Fanelli P, Vivio F, Vullo V (2010). Caratterizzazione numerica e sperimentale di friction stir spot welds in alluminio 6082-t6.. In: Atti XXXIX Convegno AIAS. Maratea, Settembre 2010 - **Contributo in Atti di convegno**
16. Fanelli P, Vivio F, Vullo V (2010). Simulazione del fronte di plasticizzazione in un nuovo modello analitico del comportamento elasto-plastico di giunzioni saldate a punti.. In: Workshop IGF - Problematiche di Frattura nei Materiali per l'Ingegneria. ISBN: 978-88-95940-29-8, Forni di Sopra (UD), 7-9 gennaio 2010 - **Contributo in Atti di convegno**

17. Donati C, Fanelli P, Vivio F, Vullo V (2009). Sull' Influenza delle Caratteristiche Geometriche e della Zona Termicamente Alterata sul Comportamento Elasto-Plastico di Giunzioni Saldate per Punti.. In: Atti XXXVIII Convegno AIAS. Torino, 9-11 settembre 2009 - **Contributo in Atti di convegno**
18. Fanelli P, Vivio F (2009). Influenza delle Condizioni di Vincolo sul Modello Analitico del Comportamento Elasto-Plastico di Strutture Saldate a Punti.. In: Atti XXXVIII Convegno AIAS. Torino, 9-11 settembre 2009 - **Contributo in Atti di convegno**
19. Fanelli P, Vivio F, Vullo V (2009). Un criterio generale per la valutazione della durata a fatica di strutture saldate a punti.. In: Workshop sulla Fatica delle Giunzioni Saldature . Forni di Sopra UD, gennaio 2009 - **Contributo in Atti di convegno**

3. **MANCIOLA Piergiorgio**

4. **DI FRANCESCO Silvia**

5 – Main staff involved, highlighting the time commitment expected

List of the Research Units

Unit 1 - BISCARINI Chiara

Personnel of the research unit

nº	Surname Name	Category	University/Research Institution	E-mail address	Months/person expected
1.	BISCARINI Chiara	Ricercatore confermato	Università per Stranieri di PERUGIA	chiara.biscarini@unistrapg.it (adesione completata il 13/01/2016)	12,0

Possible sub-unit

Surname	Name	Category	E-mail address	Months/person expected

Total cost of the research unit, per single item

	Cost
item A.1	50.400 €
item A.2.1	46.000 €
item B	57.840 €
item C	6.000 €
item D	10.000 €
item E	10.000 €
item F	17.496 € *

Total	197.736 €

- item A.1: enhancement of months/person of permanent employees
- item A.2.1: cost of contracts of non-employees, specifically to recruit
- item B: Overheads (flat rate equal to 60% of the total cost of staff, A.1 + A.2.1, for each research unit)
- item C: cost of equipment, instruments and software
- item D: cost of consulting services and similar
- item E: other operating costs
- item F: prize (to take advantage of the prize it is mandatory to attach to the project a declaration signed by the Rector of the university, according to the outline of section B2.7)

Major new contracts for staff specifically to recruit

Number of contracts RTD expected	Number of research grants expected	Number of PhD expected	Predictable overall time commitment (months)
0	2	0	24

Unit 2 - FALCUCCI Giacomo

Personnel of the research unit

nº	Surname Name	Category	University/Research Institution	E-mail address	Months/person expected
1.	FALCUCCI Giacomo	Ricercatore a t.d. - t.pieno (art. 24 c.3-a L. 240/10) (*data fine contratto: 30/05/2017*)	Università degli Studi di NAPOLI "Parthenope"	giacomo.falcucci@uniparthenope.it (adesione completata il 08/01/2016)	12,0

Total cost of the research unit, per single item

	Cost
item A.1	0 €
item A.2.1	58.000 €
item B	34.800 €
item C	7.000 €
item D	10.000 €
item E	15.000 €
Total	124.800 €

- item A.1: enhancement of months/person of permanent employees
- item A.2.1: cost of contracts of non-employees, specifically to recruit
- item B: Overheads (flat rate equal to 60% of the total cost of staff, A.1 + A.2.1, for each research unit)
- item C: cost of equipment, instruments and software
- item D: cost of consulting services and similar
- item E: other operating costs
- item F: prize (to take advantage of the prize it is mandatory to attach to the project a declaration signed by the Rector of the university, according to the outline of section B2.7)

Major new contracts for staff specifically to recruit

Number of contracts RTD expected	Number of research grants expected	Number of PhD expected	Predictable overall time commitment (months)
0	3	0	36

Unit 3 - FANELLI Pierluigi

Personnel of the research unit

nº	Surname Name	Category	University/Research Institution	E-mail address	Months/person expected
1.	FANELLI Pierluigi	Ricercatore a t.d. - t.defin. (art. 24 c.3-a L. 240/10) (*data fine contratto: 14/06/2017*)	Università degli Studi della TUSCIA	pierluigi.fanelli@unitus.it (adesione completata il 31/12/2015)	12,0
2.	CATTANI Carlo	Professore Associato (L. 240/10)	Università degli Studi della TUSCIA	cattani@unitus.it (adesione completata il 05/01/2016)	5,0

Total cost of the research unit, per single item

	Cost
item A.1	30.000 €
item A.2.1	48.000 €
item B	46.800 €
item C	10.000 €
item D	10.000 €
item E	10.000 €
Total	154.800 €

- item A.1: enhancement of months/person of permanent employees
- item A.2.1: cost of contracts of non-employees, specifically to recruit
- item B: Overheads (flat rate equal to 60% of the total cost of staff, A.1 + A.2.1, for each research unit)
- item C: cost of equipment, instruments and software
- item D: cost of consulting services and similar
- item E: other operating costs
- item F: prize (to take advantage of the prize it is mandatory to attach to the project a declaration signed by the Rector of the university, according to the outline of section B2.7)

Major new contracts for staff specifically to recruit

Number of contracts RTD expected	Number of research grants expected	Number of PhD expected	Predictable overall time commitment (months)
0	3	0	30

Unit 4 - MANCIOLA Piergiorgio

Personnel of the research unit

nº	Surname Name	Category	University/Research Institution	E-mail address	Months/person expected
1.	MANCIOLA Piergiorgio	Professore Ordinario	Università degli Studi di PERUGIA	piergiorgio.manciola@unipg.it (manca l'adesione)	5,0

Total cost of the research unit, per single item

	Cost
item A.1	50.000 €
item A.2.1	46.000 €
item B	57.600 €
item C	5.000 €
item D	5.000 €
item E	2.000 €
Total	165.600 €

- item A.1: enhancement of months/person of permanent employees
- item A.2.1: cost of contracts of non-employees, specifically to recruit
- item B: Overheads (flat rate equal to 60% of the total cost of staff, A.1 + A.2.1, for each research unit)
- item C: cost of equipment, instruments and software
- item D: cost of consulting services and similar
- item E: other operating costs
- item F: prize (to take advantage of the prize it is mandatory to attach to the project a declaration signed by the Rector of the university, according to the outline of section B2.7)

Major new contracts for staff specifically to recruit

Number of contracts RTD expected	Number of research grants expected	Number of PhD expected	Predictable overall time commitment (months)
0	2	0	24

Unit 5 - DI FRANCESCO Silvia

Personnel of the research unit

nº	Surname Name	Category	University/Research Institution	E-mail address	Months/person expected
1.	DI FRANCESCO Silvia	Ricercatore a t.d. - t.pieno (art. 24 c.3-a L. 240/10) (*data fine contratto: 03/06/2016*)	UNICUSANO Università degli Studi Niccolò Cusano -Telematica Roma	silvia.difrancesco@unicusano.it (manca l'adesione)	12,0
2.	CHIAPPINI Daniele	Ricercatore a t.d. - t.pieno (art. 24 c.3-a L. 240/10) (*data fine contratto: 07/05/2017*)	UNICUSANO Università degli Studi Niccolò Cusano -Telematica Roma	daniele.chiappini@unicusano.it (manca l'adesione)	6,0

Total cost of the research unit, per single item

	Cost
item A.1	0 €
item A.2.1	69.000 €
item B	41.400 €
item C	6.000 €
item D	0 €
item E	5.000 €
Total	121.400 €

- item A.1: enhancement of months/person of permanent employees
- item A.2.1: cost of contracts of non-employees, specifically to recruit
- item B: Overheads (flat rate equal to 60% of the total cost of staff, A.1 + A.2.1, for each research unit)
- item C: cost of equipment, instruments and software
- item D: cost of consulting services and similar
- item E: other operating costs
- item F: prize (to take advantage of the prize it is mandatory to attach to the project a declaration signed by the Rector of the university, according to the outline of section B2.7)

Major new contracts for staff specifically to recruit

Number of contracts RTD expected	Number of research grants expected	Number of PhD expected	Predictable overall time commitment (months)
0	3	0	36

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6 - Major new contracts for staff specifically to recruit

nº	Associated or principal investigator	Number of contracts RTD expected	Number of research grants expected	Number of PhD expected	Predictable overall time commitment (months)
1.	BISCARINI Chiara	0	2	0	24
2.	FALCUCCI Giacomo	0	3	0	36
3.	FANELLI Pierluigi	0	3	0	30
4.	MANCIOLA Piergiorgio	0	2	0	24
5.	DI FRANCESCO Silvia	0	3	0	36
	Total	**0**	**13**	**0**	**150**

7 - Declaration Upload

- DICHIARAZIONE per QUOTA PREMIALE.pdf

"I dati contenuti nella domanda di finanziamento sono trattati esclusivamente per lo svolgimento delle funzioni istituzionali del MIUR. Incaricato del trattamento è il CINECA- Dipartimento Servizi per il MIUR. La consultazione è altresì riservata agli atenei e agli enti di ricerca (ciascuno per le parti di propria competenza), al MIUR - D.G. per il Coordinamento e lo Sviluppo della Ricerca - Ufficio V, al CNGR e ai CdS. Il MIUR potrà anche procedere alla diffusione dei principali dati economici e scientifici relativi ai progetti finanziati".

Date *(dal sistema alla chiusura della domanda)*