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**List of Positions and Fellowships for
Science and Technology – Information Science and Complex Systems**

FORMAL METHODS AND COMPUTATIONAL MODELLING

<http://www.cs.unicam.it/home/component/content/section/2-research>

PROJECT n.1 Algebraic approach for modelling and analysing spatio-temporal dynamics of ecosystem

Supervisor: Proff. Luca Tesei - Emanuela Merelli

Stipend financed by: CINFAI

Research financed by grants: Emanuela Merelli

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The project aims to define a modelling approach, based on Shape Calculus, suitable for an ecosystem (multi-species, community, environment). Specific formal methods will be defined for understanding and evaluating the relationship between the dynamic of resources in time and space, the influence of environmental changes and anthropogenic disturbances on biota and resources, and the fishing.

PROJECT n.2 Adaptive modelling for monitoring and analysing the dynamic of an ecosystem

Supervisor: Proff. Emanuela Merelli

Stipend financed by: CNR-ISMAR-AN

Research financed by grants: Emanuela Merelli

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The project is interdisciplinary and it aims to define a model for an adaptive system able to monitor and regulate the dynamics of an ecosystem. The adaptive system will combine several theories such as the control theory developed for feedback systems, the Bayesian analysis and the model checking for analysing and regulating the properties of an ecosystem in relation to the environmental ones such as that chemical-physical.

PROJECT n.3 Modelling and analysing the particles tracking with BioShape

Supervisor: Prof. Maria Rita Di Bernardini – Emanuela Merelli

Stipend financed by: without fellowship, in collaboration with IIT-Genova, Nanosciences group

Research financed by grants: Emanuela Merelli

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Particle tracking velocimetry is a velocimetry method, i.e a technique to measure velocity of particles. The project aims to study a new method for measure and analyse velocity of particles moving in a cell, based on shape calculus and bioshape modelling.

PROJECT n.4 Adaptive-learning for elderly people

Supervisor: Proff. Diletta Cacciagrano - Emanuela Merelli

Stipend financed by: LABORATORIO DELLE IDEE

Research financed by grants: Emanuela Merelli

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The project will consider several use cases scenarios among which UC1) users with poor physical health learning in hospital or at home; UC2) users living in a isolated mountain area; it aims at determining the best living context. Given a personal user needs and a specific use case scenario, the idea at the base of the project is to develop an intelligent system that defines and personalizes specific learning units to support the daily activities. The intelligent system can be considered as a "daily help" able to set proper goals, identify the best plan and provide the fitting set of services by brokering them with Core Platform. The proposed adaptive-learning (a-learning) will be laid on multiagent systems and cloud computing "AAL cloud".

PROJECT n.5 A self-adaptive domestic system

Supervisor: Proff Rosario Culmone - Emanuela Merelli

Stipend financed by: local industry

Research financed by grants: Emanuela Merelli

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Self-adaptive environments/systems are able to detect, prevent and repair spatial and temporal unwanted configurations generated by unexpected human actions or unpredictable events. There is a need of flexible ICT tools for supporting software developing in this new application domain. The idea at the basis of the project is to develop a coherent and integrated set of methods and tools in order to build an intelligent system for regulating a physical environment. The project will, a) integrate the RFID and sensors technology in a self-learning framework, b) represent physical environments as spatial constrained environments (space, objects, users, interactions), c) self-adapt to the dynamic changes of the physical environment, d) maintain a virtual systems description, that contains physiological and environmental data continuously updates. The self-adaptive system will be built as an ensemble of adaptive components and a control system supported by intelligent systems and advanced formal methods.

SOFTWARE ENGINEERING, COMPUTER NETWORKS AND DISTRIBUTED SYSTEMS

(http://ueg.blog.cs.unicam.it/?page_id=4)

PROJECT n.1 Internet of Things framework for objects with enhanced capabilities

Supervisor: Dr. Fausto Marcantoni – Dr. Alberto Polzonetti

Stipend available: E-LIOS srl convenzione con UNICAM

Research financed by grants: A.Polzonetti and M. Marcantoni

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The Internet of Things refers to the link of virtual and physical worlds. In the IoT vision, physical devices and simple objects of our life are connected each other through the Internet making the object in the environment an extension of the World Wide Web. The presence of IoT will become

ubiquitous in our lives in the next years and the realization of its potential require adequate research on the deployment, management and evolution of these systems.

Dealing with the integration of heterogeneous objects a software framework able to coordinate and manage a large amount of data derived by a large number of physical devices is a crucial point for an effective development of the IoT vision. Indeed, IoT requires the development of management tools and framework to enable the discovery of devices, the communication among a set of specified objects, the delivery of services, the interaction with human beings, and so on. This require new technologies and software frameworks to be developed and engineered to allow the emergence of a sort of intelligence from the environment exploiting the collaboration and competition of devices.

In particular will be investigated:(1) new tools for device management and interaction to help people to engage with complex situations emerging in a world with internet-connected and communicating devices; (2) a new framework for the creation of IoT environments for specific scenarios in with specific object with enhanced capabilities are able to communicate each other and with humans to reach complex goals.

PROJECT n.2 Theory and practice of business process management for public and private sectors

Domain : e-Gov

Supervisor: Dr. Alberto Polzonetti

Stipend available: Regione Marche PF Informatica

Research financed by Regione Marche PF Informatica

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Domain : e-Health

Supervisor: Dr. Roberto Gagliardi

Stipend available: ASUR MARCHE

Research financed by grants: R. Gagliardi

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Business Process Management (BPM) has gained tremendous importance in recent years and BPM technologies and techniques are widely applied in practice. However implementing BPM is still difficult. The main problems to any significant change are the human barriers — inertia and vested interests. The inflexibility of IT application systems and the immaturity of the necessary methods and tools are also problems. Moreover, it is clear that existing approaches have problems dealing with the enormous challenges real-life BPM projects are facing. Conventional BPM research seems to focus on situations with just a few isolated processes while in reality the real challenge is to cope with large collections of interconnected processes and with an enormous volumes of data generate by new ubiquitous technology and pervasive network. This complexity opens a wide range of challenge which are not well understood therefore a strong interest on the study in this area.

The idea at the basis of this project is to study and define user-friendly techniques and consolidate formal methods to improve organizations effectiveness and efficacy trying to align IT and process dealing with a vast amount of knowledge. This will be achieved either through existing public (e-government and e-health domains) and private (e-business) sectors services. In particular it will be investigated:

- 1) How IT and process can be dynamically aligned in a knowledge intensive domain;
- 2) Novel approaches, techniques and tools in order to close the gap between BPM techniques and formal methods.

PROJECT n.3 Derivation and execution of testing strategies for Service Based Systems

Supervisor: Dr. Alberto Polzonetti – Dr. Andrea Polini

Stipend available: CHOReOS EU project

Research financed by grants: CHOReOS EU project

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Service Based Systems promises to enable fast and secure integration of software infrastructures belonging to different organizations. The promise is mainly based on the concept of “service” and on the establishment and development of a suite of open standards fostering service interaction and composition.

In such a setting particularly interesting is the possibility of composing services from different organizations, in order to provide higher level functionalities. Different approaches can be applied to deal with application related interoperability mismatches in an open environment, i.e. in which services can enter and exit at any time.

Testing is certainly one of the most used approach to highlight integration problems through the use of integration test suites. Nevertheless testing is an engineering activity that must be always reconsidered when applied in the context of Service Based Systems. Testing should try to take profit of new opportunities for control and observation, and should address emerging hurdles. For instance run-time integration and discovery is certainly one of the major hurdle for testing service composition. The result is that in a certain sense the full application is never available before run-time. At the same time the availability of formal models, describing service integration, can be exploited in the testing activities such as test cases derivation.

In particular will be investigated: (1) new testing derivation strategies for service compositions in an open environment; (2) a new framework for the derivation and execution of test in Service Based Systems exploiting available standards.

Project N. 4 V&V for Large Scale Choreographies in the Future Internet

Supervisor: Andrea Polini

Stipend financed by: EU Project CHOReOS

Research financed by grants: Andrea Polini

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Large scale choreographies in the Future Internet presents many challenges with respect to V&V activities. Challenges are related to runtime integration of services, multi-ownership of cooperating services, multi-thread execution scenarios. All these characteristics typically reduce control over the service oriented application with negative effects on V&V. In large scale scenarios these problems are exacerbated by scalability issues, that suggest defining lightweight strategies, and by the relevance of QoS characteristics that need to be monitored and verified still avoiding to have effect on the characteristics themselves.

Research will be devoted to the study and development of strategies, frameworks and mechanisms for V&V support of large scale choreographies both from the functional and non-functional perspective. The general idea is that, within the Future Internet, V&V activities have to be revised from design-time approaches to mainly run-time approaches.

Moreover, to address adaptability of choreography it is also necessary to adapt V&V activities at run-time. This aspect will be pursued through the usage of formal models for run-time checking activities. ULS characteristics require instead to apply scalable techniques. These aspects will be

addressed deriving lightweight run-time techniques based on the definition of different V&V techniques having increasing pervasiveness and impact. In summary the research will be focused on:

- defining strategies for functional and non-functional V&V of services in ULS choreographies
- deriving mechanisms supporting V&V at development time to be integrated in the CHOReOS platform
- deriving a V&V run-time infrastructure to be integrated with the general CHOReOS run-time infrastructure.