

FIRB - 2012

Line [01, 02, 03], Position	03				
Research Title	Fluorescent particles and image analysis for hydrological, ecological, environmental and biomedical studies				
Horizon 2020: field [cross]	SH-social sciences, humanities		PE-mathematics, physics, etc.	X	LS-life sciences

Part I – General Principal Investigator/Responsible of the Unit 1

A.A. General Informations

Full name, position	Salvatore Grimaldi, Associate Professor			
Born (year)	Ago - 1972	CUN Area	SSD	
		7	AGR/08	
Department	DIBAF			

A.B. Research Project

Keywords

Water tracing
Fluorescent particles
Sensor networks
Runoff velocity
Plant pathogen propagation
Dispersion of pollutants
Heart valves

Short summary [state of art, aim; maximum 200 words]

Fluorescent particles are currently used as tracers to characterize water flow kinetic properties which are crucial for the comprehension of several physical processes. However, their use is mostly limited to laboratory studies and to a small number of disciplines. The main objective of this proposal is transforming current practice in water flow tracers. This will be accomplished by addressing the following integrated aims:

Aim 1. Formulation of methodologies for the synthesis of low cost and biodegradable particles with controlled fluorescence, density, and dimensions.

Aim 2. Implementation of image-based methodologies, and terrestrial and aerial sensor networks to detect fluorescent particles in natural and controlled aqueous environments, and under adverse conditions.

Aim 3. Tailor the proposed methodology for improving the knowledge of flood formation processes, plant pathogen dispersal, pollution diffusion, and flow properties in heart ventricles.

The proposal is developed in collaboration with the Polytechnic Institute of New York University (NYU-Poly). This collaboration is supported by the double affiliation of the Principal Investigator that is faculty of both University of Tuscia and NYU-Poly.

The proposal fits well with the Horizon2020 aims, indeed the project will improve the knowledge of processes related to climate change effects, food safety, and health.

A.C. Summary of Scientific Achievements

A.C.1 Product type	Number	Data Base (ISI, Scopus, Pub Med etc)	Year	pages
Papers [international]	23	ISI - Scopus		
Papers [national]	5	1 su Scopus		
Books [scientific]	1	ISI – Scopus (book chapter)		
		I have not included peer-reviewed international and national proceedings (39)		

A.C.2 Scientometric [optional]

Additional evaluation parameters

Total Impact Factor (2010)	36.1	
Total Citations	193 (they will around 210 at the submission deadline)	
Hirsch (H) index	9 (it will be 10 at the submission deadline)	

Normalized H index*	0.6	
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*H index versus/divided by the academic seniority (time span from graduation)

A.D. Selected Publications - List of the publications (5, 10, 15 respectively for Line 1, 2 or 3). For each publication report: authors, title, reference data (journal, year, volume, pages)

1. Grimaldi S., Linear parametric models applied on daily hydrological series, *Journal of Hydrologic Engineering*, 9 (5), pp. 383-391, 2004.
2. Grimaldi S., Teles V., Bras R.L., Sensitivity of a physically-based method of terrain interpolation to variance of input data and to the constraint of an enforced surface drainage direction, *Earth Surface Processes and Landform*, 29 (5), pp. 587-597, 2004.
3. Grimaldi S., Teles V., Bras R.L., Preserving First And Second Moments of The Slope Area Relationship During The Interpolation Of Digital Elevation Models, *Advances in Water Resources*, 28 (6), pp. 583-588, 2005.
4. Nardi F., Vivoni E. R., Grimaldi S., Investigating a floodplain scaling relation using a hydrogeomorphic delineation method, *Water Resources Research*, 42 (9), 15 pp., 2006.
5. Grimaldi S., Serinaldi F., Design hyetograph analysis with 3-copula function, *Hydrological Science Journal*, 51(2) , pp. 223-238, 2006.
6. Grimaldi S., Serinaldi F., Asymmetric copula in multivariate flood frequency analysis, *Advances in Water Resources*, 29 (8), pp. 1155-1167, 2006.
7. Grimaldi S., Nardi F., Di Benedetto F., Istanbuloglu E., Bras R.L., A physically-based method for removing pits in digital elevation models, *Advances in Water Resources*, 30 (10), pp. 2151-2158, 2007.
8. Nardi F., Grimaldi S., Santini M., Petroselli A., Ubertini L., Hydrogeomorphic properties of simulated drainage patterns using digital elevation models: the flat area issue, *Hydrological Science Journal*, 53 (6), pp. 1176-1193, 2008.
9. Vivoni, E. R., Di Benedetto F., Grimaldi S., Eltahir E. A. B., Hypsometric control on surface and subsurface runoff, *Water Resources Research*, 44 (12), art. no. W12502, 2008.
10. Santini M., Grimaldi S., Rulli M.C., Petroselli A., Nardi F., Pre-Processing algorithms and landslide modelling on remotely sensed DEMs, *Geomorphology*, 113 (1-2), pp. 110-125, 2009.
11. Serinaldi F., Bonaccorso B., Cancelliere A., Grimaldi S., Probabilistic characterization of drought properties through copulas, *Physics and Chemistry of the Earth Journal*, 34 (10-12), pp. 596-605, 2009.
12. Grimaldi S., Petroselli A., Alonso G., Nardi F., Flow time estimation with variable hillslope velocity in ungauged basins, *Advances in Water Resources*, 33 (10), 216-223, 2010.
13. Tauro F., Aureli, M., Porfiri M., Grimaldi S., Characterization of Buoyant Fluorescent Particles for Field Observations of Water Flows, *Sensors*, 10, no. 12: 11512-11529, 2010.
14. Serinaldi F., Grimaldi S., Synthetic design hydrograph based on distribution functions with finite support, *Journal of Hydrologic Engineering*, 16(5), 434-446; doi:10.1061/(ASCE)HE.1943-5584.0000339 (2011).
15. Grimaldi S., Petroselli A., Nardi F., A parsimonious geomorphological unit hydrograph for rainfall runoff modeling in small ungauged basins, *Hydrological Science Journal*, 57(1) 73-83, 2012.

Part II – Responsibles of Research Unit PIs [almeno 3, max 5]

B.1

B.1.A General Informations, Unit 1

Responsible of the Unit 1 is the General Principal Investigator

B.1.B. Research of the Unit

Keywords

Fluorescent particles
Hydrological tracers
Runoff formation
Plant pathogen diffusion

Summary [aim] [maximum 100 words]

The project will investigate hydrological and ecological processes using novel methodologies for in situ surface water velocity measurements. Four integrated aims are planned:

Aim 1. Formulation of methodologies for the synthesis of low cost and biodegradable fluorescent particles.

Aim 2. Design of surface flow velocity measurement techniques at different scales using fluorescent particles, unmanned aerial vehicles, and large scale particle image velocimetry.

Aim 3. Integration of surface velocity measurements in sheet-flow and rainfall-runoff modeling for a better comprehension of flood formation processes.

Aim 4. Integration of the fluorescent particle tracer in the investigation of plant pathogen dispersal in natural terrains.

B.2

B.2.A General Informations, Unit 2

Full name, position	Pietro De Lellis, Ph.D.		
Born (year)	1983	CUN Area	SSD
		09	ING-INF/04
Department, University	Systems and Computer Engineering, University of Naples "Federico II" (Dipartimento di Informatica e Sistemistica, Università di Napoli Federico II)		

B.2.B. Research of the Unit

Keywords	Summary [aim] [maximum 100 words]
Adaptive control	An increasing number of complex systems in applied science and engineering can be described by mutually interconnected agents communicating over a network with a complex topology. Examples include electrical, biological and sensor networks. All of these systems are modeled as complex networks of dynamical systems. Our research focuses on the modeling, analysis and control of complex systems and networks, with specific reference to both terrestrial and aerial sensor networks. In particular, as the sensors topological configuration needs to adapt to varying environmental conditions, we aim at developing innovative decentralized control techniques based on new adaptive and evolving strategies.
Networked control systems	
Sensor networks	
Consensus protocols	

B.2.C. Summary of Scientific Achievements

Product type	Number	Data Base (ISI, Scopus, Pub Med etc)	Year	pages
Papers [international]	10	ISI, Scopus		
Papers [national]				
Peer reviewed international conference papers	11			

B.2.D. Bibliometric parameters

Bibliometric parameters	Value	Additional evaluation parameters
Total Impact Factor (2010)	16.287	
Total Citations	83	
Hirsch (H) index	5	
Normalized H index*	1	

*H index versus/divided by the academic seniority (time span from graduation)

List of 5 selected publications:

- 1) P. De Lellis, M. di Bernardo, M. Porfiri *Pinning control of complex networks via edge snapping*, Chaos, 21, 033119, 2011.
- 2) P. De Lellis, M. di Bernardo, T. Goroehowsky, G. Russo, *Synchronization and Control of Complex Networks via Contraction, Adaptation and Evolution*, IEEE Circuits And Systems Magazine: Special Issue on Complex Networks, 10, 64-82, 2010.
- 3) P. De Lellis, M. di Bernardo, F. Garofalo, M. Porfiri, *Evolution of Complex Networks via Edge Snapping*, IEEE Transactions on Circuits and Systems I, 57, 2132-2143, 2010.
- 4) P. De Lellis, M. di Bernardo, F. Garofalo, *Novel decentralized adaptive strategies for the synchronization of complex networks*, Automatica, 45, 1312-1318, 2009.
- 5) P. De Lellis, M. di Bernardo, F. Garofalo, *Synchronization of complex networks through local adaptive coupling*, Chaos, 18, 037110, 2008.

B.3

B.3.B. Research of the Unit

Keywords	Summary [aim] [maximum 100 words]
Heart valves prothesis	The <i>in vitro</i> analysis of the heart prosthetic valves has widely studied due to the effects that

3D Vortex ring dynamics	those devices can produce after the surgical intervention; in particular, the hemodynamics modifications downstream the heart prosthesis have been studied in a transparent heart model, placed in a new Pulse Duplicator. The fluid-dynamics field is strongly 3D; the studies performed until now allowed to carry out bidimensional velocity field with several difficulties near the walls. In order to avoid both those inconveniences, fluorescent particles could be used and a new image analysis methodology will be achieved to have the 3D flow reconstruction.
Fluorescent particles	
New Particle Tracking Velocimetry algorithm	

B.3.C. Summary of Scientific Achievements

Product type	Number	Data Base (ISI, Scopus, Pub Med etc)	Year	pages
Papers [international]	5	ISI, Scopus		
Papers [national]	2			

B.3.D. Bibliometric parameters

		Additional evaluation parameters
Total Impact Factor (2010)	3.858	
Total Citations	1	
Hirsch (H) index	0	
Normalized H index*	0	

*H index versus/divided by the academic seniority (time span from graduation)

- Querzoli G., Fortini S., Cenedese A. (2010). "Effect of the prosthetic mitral valve on vortex dynamics and turbulence of the left ventricular flow". PHYSICS OF FLUIDS, vol. 22; p. 041901-1-041901-10.
- Fortini S., Querzoli G., Espa S., Cenedese A. (2011). "Three-dimensional flow inside the left ventricle model". EUROMECH 529 - CARDIOVASCULAR FLUID MECHANICS from theoretical aspects to diagnostic and therapeutic support - CVFM2011 27-29 June 2011, Faculty of Engineering - University of Cagliari.
- Fortini S., Querzoli G., Espa S., Cenedese A. "Effetto della valvola mitralica sul flusso nel ventricolo sinistro del cuore". XXXII Convegno Nazionale di Idraulica e Costruzioni Idrauliche Palermo, 14-17 settembre 2010.
- Fortini S., Querzoli G., Marchetti M, Cenedese A. "Transition to turbulence in a laboratory model of the left ventricle" proceedings of ETC11 - 11th European Turbulence Conference, Porto, 2007.
- Fortini S., Querzoli G., Marchetti M, Cenedese A., "Studio sperimentale di un modello da laboratorio di un ventricolo umano", XXX Convegno di Idraulica e Costruzioni Idrauliche – Roma Settembre 2006.

B.4

B.4.A General Informations, Unit 4

Full name, position	Ferrari Simone, researcher		
Born (year)	1972	CUN Area	SSD
		08	ICAR/01 - IDRAULICA
Department, University	DICAAR, Dipartimento di Ingegneria Civile, Ambientale e Architettura, Università degli Studi di Cagliari		

B.4.B. Research of the Unit

Keywords	Summary [aim] [maximum 100 words]
Image Analysis	The main aim of U4 is the development and testing of Image Analysis techniques, in order to experimentally measure concentration and velocity fields (and, consequently, turbulent quantities) in environmental flows. The case study will be the dispersion of pollutants in the sea. In order to perform those measurements, fluorescent microspheres have to be employed as particle tracers in the experiments: these particles will be designed and produced to the specific purpose by the other Units. Allowing a deeper insight of both Eulerian (via PIV-LIF techniques) and Lagrangian (via PTV techniques) quantities, those techniques will allow a proper environmental impact assessment.
Dispersion of pollutants	
Particle tracking	

B.4.C. Summary of Scientific Achievements

Product type	Number	Data Base (ISI, Scopus, Pub Med etc)	Year	pages
Papers [international]	4	ISI, Scopus		
Monograph [international]	1		2009	1-90
Peer-reviewed conference papers [international]	9			
Peer-reviewed conference papers [national]	6			

B.4.D. Bibliometric parameters

Additional evaluation parameters

Total Impact Factor (2010)	6.128	
Total Citations	17	
Hirsch (H) index	3	
Normalized H index*	0.333	

*H index versus/divided by the academic seniority (time span from graduation)

1. S.Ferrari e G.Querzoli, 2010, "Mixing and re-entrainment in a negatively buoyant jet", Journal of Hydraulic Research, IAHR (International Association of Hydraulic Engineering and Research), Volume 48 Issue 5, 632-640, Taylor & Francis Group, doi:10.1080/00221686.2010.512778 , ISSN 0022-1686 print/ISSN 1814-2079 online.
2. L. Rossi, S. Bocquet, S. Ferrari, J.M. Garcia de la Cruz e S. Lardeau, 2009, "Control of flow geometry using electromagnetic body forcing", International Journal of Heat and Fluid Flow 30 (2009) 505-513, Elsevier Inc., doi:10.1016/j.ijheatfluidflow.2009.02.024, ISBN: 0142-727X.
3. S.Lardeau, S.Ferrari e L.Rossi, 2008, "3D DNS of electromagnetically driven multi-scale shallow layer flows: numerical modeling and physical properties", Physics of Fluids, 20, 127101-1-127101-17 (2008), American Institute of Physics, DOI 10.1063/1.3025887.
4. S.Ferrari e L.Rossi, 2008, "Particle tracking velocimetry and accelerometry (PTVA) measurements applied to quasi-two-dimensional multi-scale flows", Experiments in Fluids, 44:873-886, Springer Verlag, DOI 10.1007/s00348-007-0443-7, ISSN 0723-4864 (Print) 1432-1114 (Online).
5. S. Ferrari, 2009, "Measures of fluid acceleration via PTVA - Particle Tracking Velocimetry and Accelerometry applied to turbulent-like flows", VDM Verlag, Saarbrücken (Germany), 90 pag., ISBN: 978-3-639-21560-1.
6. S.Ferrari e G.Querzoli, 2011, "Effects Of Stable And Unstable Stratification On Negatively Buoyant Jets", in A. Cenedese, S.Espa e R. Purini (eds.), Proceedings of VII International Symposium on Stratified Flows, Roma (Italia), 22-26 Agosto 2011, Casa Editrice Università degli Studi di Roma La Sapienza Roma (Italia), pp 1157/1-1157/8, ISBN: 978-88-95814-49-0.
7. S.Ferrari, P.Kewcharoenwong, L.Rossi e J.C.Vassilicos, 2008, "Multi-scale flow control for efficient mixing: laboratory generation of unsteady multi-scale flows controlled by multi-scale electromagnetic forces", in: J. F. Morrison, D. M. Birch and P. Lavoie (eds.), IUTAM Symposium on flow Control and MEMS Proceedings, Londra (UK), 19-22 Settembre 2006, Springer Verlag, New York, pp.267-272, ISBN 978-1-4020-6857-7 (hard cover), ISBN 978-9048177400 (soft cover).
8. S.Ferrari, L.Rossi e J.C.Vassilicos, 2007, "Acceleration measurements in turbulent-like flows", in: J. Palma and A. Silva Lopes (eds.), Advances in Turbulence XI, Proceedings of the 11th EUROMECH European Turbulence Conference, 25-28 Giugno 2007, Porto (Portogallo), Springer Proceedings in Physics 117, Springer Verlag, Heidelberg, pp. 485-487, ISBN: 978-3-540-72603-6.
9. S.Ferrari, 2006, "Design of diffusers for heavy fluid discharge", in: C. Avanzini (ed.), Proceedings of MWWD & IEMES 2006 - 4th International Conference on Marine Waste Water Disposal and Marine Environment, Antalya (Turchia), 6-10 Novembre 2006, p93/1-p93/27, Mem Ajans Istanbul (Turchia), ISBN: 9944-5566-0-2.
10. S.Ferrari e G.Querzoli, 2006, "An experimental investigation of the interaction between dense sea discharges and wave motion", in: C. Avanzini (ed.), Proceedings of MWWD & IEMES 2006 - 4th International Conference on Marine Waste Water Disposal and Marine Environment, Antalya (Turchia), 6-10 Novembre 2006, p22/1-p22/20, Mem Ajans Istanbul (Turchia), ISBN: 9944-5566-0-2.
11. L.Rossi e S.Ferrari, 2006, "Particle Tracking Velocimetry and Accelerometry (PTVA) on electromagnetically controlled quasi-two-dimensional multi-scale flows", in: 12th ISFV (International Symposium on Flow Visualization) Proceedings, Göttingen (Germania), 10-14 Settembre 2006, pp 201/1-201/10, ISBN: 0-9533991-8-4.
12. S.Ferrari, 2004, "Dense discharges", in: Short Courses of MWWD & IEMES 2004 - 3rd International Conference on Marine Waste Water Discharges and Marine Environment Proceedings, Catania (Italia), 24-25 Settembre 2004, p31/1-p31/38, ISBN 9944-5566-1-0.
13. S.Ferrari e G.Querzoli, 2004, "Sea discharge of brine from desalination plants: a laboratory model of negatively buoyant jets", in: MWWD & IEMES 2004 - 3rd International Conference on Marine Waste Water Discharges and

Marine Environment Proceedings, Catania (Italia), 27 Settembre – 2 Ottobre 2004, pp E23/1-E23/22, ISBN 9944-5566-1-0.

14. S.Ferrari e G.Querzoli, 2004, “Laboratory investigation on wave transformation and breaking over an obstacle”, in: 11th ISFV (International Symposium on Flow Visualization) Proceedings, Notre Dame, Indiana (USA), 9–12 Agosto 2004, 210/1-210/10, ISBN: 0-9533991-5-X.
15. S. Ferrari, M.G. Badas e G. Querzoli, 2011, “Ricerca sperimentale sugli scarichi in mare da impianti di dissalazione”, in Riassunti del Convegno Acqua ed Energia, XI Giornata Mondiale dell’Acqua, Accademia Nazionale dei Lincei, Roma (Italia), 22 Marzo 2011, in stampa su "Atti dei Convegni Lincei", Bardi Editore srl, Roma, ISSN: 0391-805X.