Alessandro Stocchino

Associate professor

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Education and training

1998
Master degree in Environmental Engineering
104/110 e dignità di stampa
Università degli Studi di Genova - Genova - IT

2001
PhD in Hydraulic Engineering
University of Padua - Padova - IT

1998
State certification Exam for the Professional Association of Engineers Civil Engineering Sector
Ordine Ingegneri Provincia di Genova - Genova - IT

Academic experience

2001 - 2015
Assistant Professor in Fluid Mechanics
Department of Civil Chemical and Environmental Engineering - Genova - IT
Teaching and research

2015 - ONGOING
Associate Professor in Fluid Mechanics
Department of Civil Chemical and Environmental Engineering - Genova - IT
Teaching and research

1999 - 2001
Visiting Researcher
GFDI - Florida State University - Tallahassee - US
reasearch

Language skills

English
Proficient

Teaching activity

Undergraduate and Master Courses

From 2001 to 2003: practical lessons for the courses “Environmental Hydraulics” and “fundamentals of Hydraulics” for undergraduate students in Civil Engineering.

Master Courses

Since 2003: classes on Environmental Fluid Mechanics, Fluid Mechanics and Computer Programming for Engineers for master students in Chemical, Biomedical and Civil Engineering at the University of Genova

PhD Courses

2017: PhD course in “Mixing processes in Fluids” (http://dottorato.dicca.unige.it/eng/schede_corsi_2017/ProcessiMiscelamento.pdf)

Since 2002, courses for the Doctoral School of the University of Genoa and the University of Trento on Turbulence, Fluid Mechanics and Experimental Techniques

Postgraduate research and teaching activity

Supervision of PhD students, residents and post-doctoral fellows

I have supervised seven PhD students of the Doctoral School of the Department of Civil, Chemical and Environmental Engineering.

Research interests

My background is primarily in applied fluid mechanics, turbulence and mass transport. I had a long training in mathematical modelling and laboratory techniques applied mainly in bio-fluid mechanics. My research interest can be summarized as follows:

· ***Mass transport and Mixing Processes***.

I have been interested in this topic since the beginning of my PhD and, in these years, I have studied these processes either theoretically and experimentally. I have applied these concepts in several fields (environmental flows, bio-fluid mechanical applications such as the human eye and vascular diseases), which can be studied under common theoretical frameworks.

I am currently devoted to apply the most updated Lagrangian mixing measures (Finite time and Space Lyapunov exponents, Lagrangian Coherent Structures) in several geophysical context. Another hot topic of this line of research is the analysis of how micro-plastic is transported in marine environment. The pollution transport, including micro-plastic is the object of two European Interreg Projects that have been funded in these months.

· ***Coastal and Estuarine circulation, Coastal Management***

Directly connected to the previous topic, in these last two years our group has established a strong collaboration with important national and international research centres that control the Mediterranean HF-Radar

coastal network, with the aim to investigate coastal circulation and several environmental issues. Indeed, the HF-radar data have been used in order to evaluate the dispersion properties of the circulation. This topics are carried out in synergy with the Maritime Authorities with the future goal to develop prevention measures and rapid response tools against marine pollution. Coastal circulation studies are also carried out using open source numerical models widely used in this field (DELF-3D, ROMS).

· *River Hydro-Morphodynamics*

In several studies I have applied the stability linear and weakly non-linear theories with the aim to investigate the formation of small and meso-scale river bedforms (ripples, dunes and antidunes). As a research group, we have an internationally recognized expertise in river restoration and river morphodynamics. Besides, the theoretical studies, we have a deep knowledge of several numerical models commonly used for steady and unsteady flow simulations. The results have been collected in a series of scientific papers.

· *Flood risk Management*

1D and 2D numerical modelling is a powerful tools to be applied in river engineering in order to study the flooding risk and its mitigation measures. This line of research is the focus of one of the European project that started in 2017.

· *Bio-fluid mechanics.*

I have dedicated many years to the study of the human vitreous dynamics induced by eye movements and its relationship with several retinal diseases. I have been in charge mainly of the experimental activities of these researches. We based our works on the in-vitro experiments reproducing the vitreous chamber and its rotations with detailed physical models. We then applied the most sophisticated measuring techniques (Particle Image Velocimetry) to quantify the vitreous motion and its effects on the retina, mostly evaluating the mechanical stresses. Our group in collaboration with a surgical unit tested also the applicability of the Particle Image Velocimetry in-vivo in order to characterise the status of the vitreous of the patient. In fact, we have analysed a series of ultrasound recordings with the same technique of the PIV, which in this case is known as US_PIV, and measure the velocities of the vitreous during controlled eye movements. This non-invasive technique is a promising method for a direct evaluation of several vitreous and retinal diseases.
Moreover, the laboratory activities aimed to investigate the drug delivery via direct injection within the vitreous chamber. Our group is internationally recognized as one of the main centre for the human vitreous dynamics studies. Recently, I coordinate a starting project on the fluid mechanical aspects of the vitrectomy, in particular, analysing the performance of different vitreous cutters and their possible effects on the retina. Most of the research has been developed in strict collaboration with ophthalmologists and retinal surgeons.
Moreover, in collaboration with the vascular unit of the main local hospital,

we have conducted an interesting study on the biomechanical aspects of the aortic aneurysms. In particular, we have applied the same technique used within the vitreous chamber (US-PIV) with the aim to directly measure the hemodynamics within an AAA, evaluating the velocity fields and the mechanical stresses induced on the vessel wall and trying to use the information in for a future rupture risk analysis.

· ***Laboratory techniques and Image analysis.***

Since most of my research is related to experimental modelling, I have a great insight into several measuring techniques. In particular:
Particle Image Velocimetry: non-invasive technique based on laser illumination and digital imaging to measure 2d and/or 3D velocity fields. This is a sophisticated technique for laboratory measuring.
Ultrasound-Particle Image Velocimetry: digital cameras are substitute by the use of Ultrasound scanners. This technique can be successfully applied to patients.
Doppler Velocimetry: this technique is based on acoustic Doppler profiling and it is often employed in fluid mechanics and or solid mechanics;
Pressure and flow measurements: I have a great experience in using pressure transducers and flow meter based on different technologies (piezoresistive transducers, electromagnetic/ultrasound/Coriolis forces flow meters).
Image analysis: Velocity measurements often are based on image analysis that involves image segmentation, features tracking, image cross-correlation.

Grants

2017 - ONGOING

Augmentation de la résilience des territoires ALCOTRA face aux risques de crues éclairs et de pollutions des eaux - RISQEAU

Cooperazione Territoriale Transfrontaliera ITALIA-FRANCIA ALCOTRA - IT
1.605.65339 - Participant
Le projet lance un défi commun pour les territoires italiens et français qui présentent une problématique claire de fragilité et de vulnérabilité aux évènements météo de plus en plus fréquents et violents. Les pluies très intenses s'abattent sur les zones urbaines, provoquant des phénomènes soudains d'inondations causant des dommages importants aux biens, aux personnes, et des pertes de vies humaines. Les conséquences dramatiques de ces inondations doivent être limitées. L'objectif général est de sensibiliser de manière adéquate à ces risques et de permette la réactivité. Le projet mis en place par les zones italiennes et françaises similaires qui sont le théâtre de catastrophes analogues par les inondations et les évènements météorologiques extrêmes, a pour objectif général un ensemble d'actions conjointes, tirées de l'expérience commune acquise sur le terrain, et visant l'augmentation de la résilience des territoires aux risques naturels,

en définissant des procédures et des instruments innovants : des prévisions locales et des seuils de risques élaborés au niveau transfrontalier, en tirant parti de la complémentarité des expériences. Les bénéficiaires seront : les autorités des zones pilotes et de tous les bassins alpins à 25/30 km, caractérisés par des temps de réponse très brefs, les techniciens des différentes entités locales et les professionnels du secteur, par des rencontres de formation et de sensibilisation, impliquant la population à risque.

2018 - ONGOING

GEREMIA - Gestione dei reflui per il miglioramento delle acque portuali

Cooperazione Territoriale Transfrontaliera ITALIA-FRANCIA MARITTIMO - IT
1.784.43104 - Pricipal investigator
Crescita Blu, questo sarà il percorso a lungo termine che i nostri territori dovranno seguire e i porti, grazie alle loro attività, saranno tra gli attori principali. Conciliare la necessità della crescita con la preservazione del patrimonio culturale e ambientale sarà la sfida da affrontare. La valutazione degli impatti e pressioni sugli ecosistemi da parte delle attività antropiche dovrà essere sviluppata su solide basi scientifiche/tecniche così come suggerito dai più moderni approcci gestionali, quali ad esempio l'Ecosystem-based Management. Seguendo questo approccio e con la consapevolezza che la qualità ambientale di un porto influenza l'ambiente marino su scale spaziali molto grandi, la gestione del rischio da inquinamento deve essere condivisa su basi transfrontaliere. GEREMIA si propone come obiettivo generale di formare e supportare, con strumenti e soluzioni innovative, chi avrà la responsabilità di gestire le acque portuali. L'armonizzazione dei risultati delle azioni di modellistica, monitoraggio e analisi delle procedure di gestione del rischio, condurrà alla predisposizione di un Decision Support System sviluppato per le realtà portuali e facilmente esportabile ai diversi contesti, oltre ai siti pilota del progetto. Il DSS, grazie alla caratteristica di gestire diversi livelli di informazione e una grande mole di dati, rappresenterà un notevole accrescimento delle capacità gestionali degli operatori per azioni di prevenzione e d'intervento in caso di emergenze. Il progetto non solo sarà l'occasione per proporre strategie di gestione, ma queste verranno applicate in azioni pilota su diverse realtà portuali dei nostri territori (installazione sistemi di bioremediation e contenimento reflui, esercitazione delle procedure di intervento). Inoltre, durante il progetto si svilupperà la proposta di un nuovo indice integrato e ponderato di qualità ambientale da affiancare al TRIX, più idoneo per le specifiche e variegate realtà portuali.

2018 - ONGOING

SPlasH - Stop alle plastiche in H2O

Cooperazione Territoriale Transfrontaliera ITALIA-FRANCIA MARITTIMO - IT

689.75609 - Pricipal investigator

Il progetto SPlasH! analizzerà per la prima volta la presenza, l'origine e le dinamiche delle microplastiche nei porti del
Programma. Lo studio non si occuperà soltanto delle plastiche galleggianti sulla superficie del mare, ma anche delle fibre
presenti nella colonna d'acqua e sul fondale. La ricerca consentirà di fornire dati su alcuni aspetti ancora inesplorati:
comprendere la dinamica delle microplastiche; studiare l'afflusso e l'incidenza quantitativa delle varie 'sorgenti' di microplastiche
dalla terra ferma al mare e la distribuzione alle varie profondità in zone densamente antropizzate e attive. I dati forniranno
ulteriori elementi – anche alla comunità internazionale - per comprendere meglio come, quando e dove intervenire per ridurre
l'impatto di questo crescente inquinamento dell'ambiente marino, tenendo conto della situazione normativa – nazionale e
comunitaria - esistente in materia e le sue possibili evoluzioni. I campionamenti avverranno tramite uno strascico, un piccolo
sistema di pompaggio che consentirà di raccogliere dati a varie profondità e con prelievi di sedimenti dal fondale. I campioni
verranno poi analizzati per una definizione quantitativa e qualitativa dei detriti e lo sviluppo di un modello che possa svelare la
distribuzione e le concentrazioni di microplastiche nei diversi punti dell'ambito portuale. Si effettuerà un'analisi sui cefali, pesci
particolarmente numerosi nei porti, per valutare l'impatto biologico di queste fibre. Verrà, quindi, analizzato il miglior modello
numerico per lo studio della dinamica delle microplastiche che, abbinato allo studio climatologico, permetterà di sviluppare la
previsione sulle traiettorie dei detriti plastici dispersi in mare. SPlash! informerà e divulgherà il tema e la ricerca presso l'intera
popolazione delle aree interessate (e non solo), con strumenti multimediali, iniziative pubbliche e anche coinvolgendo
direttamente attori economici e cittadini.

2013 - 2014

Modellazione lagrangiana del trasporto di massa in ambiente marino e costiero strumenti per la gestione della qualità delle acque del Mar Ligure

PO CRO FSE 2007-2013 Asse IV Capitale Umano ob.Specifico I/6 - IT

52000 - Pricipal investigator

Editorial activity

In the last ten years, I have served as referee for several international journals, such as Journal of Fluid Mechanics, Physics in Medicine and Biology, Journal of Hydraulic Research, Water Resources Research, Chaos.

Other professional activities

2003-2005:
Client: Autorità di Bacino del Fiume Magra (Public Authority)
Total amount of the contract: approximately 150.000,00 €
purpose of the contract: to study the feasibility of a complex flood protection system for the river Vara in the north west of Italy. We applied numerical models and also build a physical scaled model of a river section to test the efficiency of the flood protection system

2006-2007:
Client: Fisia Italimpianti Spa
Total amount of the contract: approximately 220.000,00 €
purpose of the contract: to find the root cause of the malfunctioning of recirculation pumps of a desalination plant in the United Arab Emirates. We performed a very complex measurements campaign directly at site during several outages in the winter. Finding the cause of the malfunctioning was crucial to decide whether the defect was a responsibility of the main contractor of the plant construction (Fisia Italiampianti Spa) or of the provider of the pumps

2004-2010:
Client: Autorità Interregionale per il Fiume Po (Public Authority)
Total amount of the contract: approximately 250.000,00 €
Purpose of the contract: to study the effects of floods in the city of Alessandria (Italy) generated by the Tanaro River and to investigate the efficiency of some flood protection works. We also assisted the Client in the design and construction of a Laboratory dedicated to the physical modelling of river restoration works. The laboratory is the second in Italy for dimensions and probably the most equipped for this kind of models.

2011:
Client: SPEA, Ingegneria Europea Spa
Total amount of the contract: approximately 150.000,00 €
Purpose of the contract: to study the effects of the release of slurry, coming from the construction site of the new highway system around Genova (Italy), into the sea. Since the slurry contains asbestos, it was crucial to investigate the environmental impact of a possible release of asbestos in the atmosphere. The study was conducted by performing laboratory measurements on a physical model.

2012:
Client: DEAM srl
Total amount of the contract: approximately 15.000,00 €
Purpose of the contract: numerical simulation of the thermal plume release by the terminal FSRU offshore and its interactions with the surrounding environment.

2016-2017:
Client: D.O.R.C. Dutch Ophthalmic Research Center
Total amount of the contract: approximately 27.000,00 €
Purpose of the contract: Performance assessment of the vitrectomy device EVA. Experimental measurements using PIV of the flow around a vitreous cutter device.

2017-2018:
Client: RINA CONSULTING
Total amount of the contract: approximately 28.000,00 €
Purpose of the contract: physical modelling a tremie-diffuser system to release slurry into a marine area.
2017-2018:
Client: COMUNE DI GENOVA
Total amount of the contract: approximately 60.000,00 €
Purpose of the contract: physical modelling a flood defence system of Rio Rovare, Genova
2018:
Client: D.O.R.C. Dutch Ophthalmic Research Center
Total amount of the contract: approximately 55.000,00 €
Purpose of the contract: Performance assessment of the vitrectomy device EVA. Experimental measurements using PIV of the flow around a vitreous cutter device in a realistic physical model of the vitreous chamber.
2018:
Client: Baush + Lomb
Total amount of the contract: approximately 19.500,00 €
Purpose of the contract: Performance assessment of the vitrectomy device