

Prof. Riccardo Vesipa, PhD, PE

CURRICULUM VITAE

Education

- 20/03/2013 – PhD in “Engineering for the Management of Water and Land”. University: Politecnico di Torino, Italy. Thesis: “River antidunes and bars: new models and nonmodal analysis”.
- 15/12/2009 - MS in “Civil Engineering” University: Politecnico di Torino, Italy.
- 02/10/2007- BS in “Civil Engineering” University: Politecnico di Torino, Italy.

Current Position

Associate Professor at Politecnico di Torino, Italy, at the Department of Environment, Land and Infrastructure Engineering (PoliTO-DIATI).

Previous Positions

- From 16/01/2021 to 15/01/2024 – Assistant Professor in tenure track at PoliTO-DIATI.
- From 16/02/2018 to 15/01/2021 – Research fellow at PoliTO-DIATI.
- From 16/01/2013 to 16/02/2018 – Postdoc at PoliTO-DIATI.
- During March - April 2013 visitor at École Polytechnique.
- During March - April 2012 visitor at Duke University.

Fellowships and awards

- Award for best conference paper (13/04/2023) by the Scientific Committee of the 14th International Conference on Pressure Surges. Eindhoven, Netherlands; 12 – 14 April 2023. “Best Paper Prize” for the paper “Stability of water-level controls in hydropower plants accounting for backlash, delays, and instrumental errors”.
- Award for doctoral thesis. (01/07/2013) by the GII - Gruppo Italiano Idraulica (Italian Group of Hydraulic Engineering). “Gii Special Mention for Doctoral Thesis in Water Engineering”.

Teaching activities

- Leader of the courses "Civil and industrial Hydraulic systems" (Since 2023) and “Flow transients in pressure pipe systems – Modelling and Practice” (Since 2020), Politecnico di Torino.
- Leader of the courses " Fluid Mechanics " (Since 2022) and “Hydraulic Infrastructures” (Since 2022), Turin Polytechnic University in Tashkent, Uzbekistan.
- Lecturer in the courses "Hydraulic Engineering" (2017-2019), "Advanced Hydraulic Engineering" (2020-2021), "Fluid Mechanics" (Since 2019) "Industrial Fluid Mechanics" (2014-2022), Politecnico di Torino.

Institutional responsibilities

- Member of the working group "Improving Employment opportunities" (since October 2018, Politecnico di Torino, School of Environmental and Land Engineering).
- Manager of the working group “Innovation in Teaching” (since July 2019, Politecnico di Torino, School of Environmental and Land Engineering).
- Member of the board of the “TLLab - Teaching and Language Laboratory” (since July 2019, Politecnico di Torino).
- Coordinator of WP4 of the Erasmus+ “Unite!” project (Since November 2022, Politecnico di Torino).
- Examiner of the PhD candidate “Ivan Pascal”, thesis “Experimental Study on Bedload Transport and Bedforms: Behavior and Interplay in Steep Turbulent Streams”) (May 31, 2022, École Polytechnique Fédérale de Lausanne, EPFL).
- Examiner of the PhD candidate “Markeljan Fishta”, thesis “Acoustic Wave-Based Wireless Data Communication in Urban Water Supply Networks” (July 14, 2023, Politecnico di Torino).
- Member of the examining commission for the admission exams for the PhD in “Defense against natural risks and ecological transition of buildings”, XXXIX Cycle.

Memberships of scientific societies

- 2022 CSSI - Centro Studi Sistemi Idrici - Society for the study of hydraulic systems.
- 2011 - Register of Professional Engineers of the Province of Biella.
- 2010 - GII - Gruppo Italiano Idraulica (Italian Group of Hydraulic Engineering).
- 2010 IAHR - International Association for Hydro-Environment Engineering and Research.

Major collaborations

- École Polytechnique, Paris (France), Prof. Jean Marc Chomaz. Topic: “Study of the convective-absolute nature of river bedform instabilities”.
- Imperial College, London (UK), Prof. Peter Schmid. Topic: “Application of hydrodynamic stability theory to river morphodynamics”.
- Royal Institute of Technology, Stockholm (Sweden), Prof. Luca Brandt. Topic: “Numerical modeling of multiphase cavitating flow for water treatment”.
- Università degli Studi di Perugia (Italy), Prof. Bruno Brunone and Prof. Silvia Meniconi. Topic: “Use of flow transient for water mains monitoring”.

TRACK RECORD

The main topic of my research activities is the “Modeling of Dynamical Systems”. During my career I have analyzed dynamical systems that are relevant in the field of fluid mechanics [13], ecology [9], and engineering. The engineering application ranged from river-morphodynamics [1-8], natural ventilation in buildings [15], hydropower plants [11,14], water distribution networks [10,12].

During my early career (PhD+PostDoc), I mostly focused on dynamical systems that describe natural processes, and on more mathematical aspects of dynamical systems’ theory. During this period, I built a network of international relations involving some of the most estimated experts on the assessment of dynamical systems stability (Chomaz, Schmidt, Brandt, see the CV).

Later in my career, I focused more on controlled technological dynamical systems. I worked in dozens of commercial and applied research projects.

My involvement in commercial research projects shaped my academic career and contributed to build one of the main traits. I work at the edge between fundamental research, applied research, and consultancy for companies. I find inspiration from real world problems that I meet in consultancies, and that require applied or fundamental research to be solved in an optimized way.

It is exactly in this spirit that the ideas behind many of my research paper on flow transients, water distribution networks, and drainage systems were born.

List of the most relevant publications

1. Transient growths of stable modes in riverbed dynamics (2012)
2. A shallow-water theory of river bedforms in supercritical conditions (2012)
3. On the convective-absolute nature of river bedform instabilities (2014)
4. Thin-film-induced morphological instabilities over calcite surfaces (2015)
5. Noise-driven cooperative dynamics between vegetation and topography in riparian zones (2015)
6. Recovery time of riparian vegetation (2016)
7. River bedform inception by flow unsteadiness: A modal and nonmodal analysis (2016)
8. Convective-absolute nature of ripple instabilities on ice and icicles (2017)
9. Impact of seasonal forcing on reactive ecological systems (2017)
10. Multipurpose design of the flow control system of a steep water main (2017)
11. Overshoots in the water-level control of hydropower plants (2019)
12. Instability of the Tank-Level Control System of Water Mains in Mountainous Environments (2019)
13. Fault detection in level and flow rate sensors for safe and performant remote-control in a water supply system
14. Dynamics of bubbles under stochastic pressure forcing (2021)
15. Stability of water-level controls in hydropower plants accounting for backlash, delays, and instrumental errors (2023)
16. Wind fluctuations affect the mean behaviour of naturally ventilated systems (2023)

List of the most relevant research project

1. Hydraulic and chemical dynamical modelling of chlorine concentration in water distribution networks
2. Hydraulic modelling of the water distribution networks of the city of Torino
3. Analysis of the functionality, management and risk reduction of the “Susa Valley Aqueduct”
4. Detection of leakages in the “Susa Valley Aqueduct” with an innovative method based on flow transients
5. Bubbles for life - water treatment through the use of hydrodynamic cavitation
6. Hydraulic modeling and analysis of the criticalities in the Turin drainage network
7. Hydraulic modeling and analysis of the intermunicipal collector system discharging in the water treatment plant located in Castiglione Torinese
8. SLAPIS Sahel – Development of a Flood Early Warning System for the Sirba and Niger rivers (Burkina Faso+Niger)
9. BIM, VPL and VR for projects of infrastructures starting from the contents of FM
10. Study of the interaction between vehicles and flood flows in the urban network
11. Hydrological and hydraulic analysis of the hydraulic junction of the Borbore river near Veza d'Alba
12. Algorithms for the optimized design of hydraulic infrastructures
13. Analysis of the flood occurred in Castelletto d'Orba on 21st October 2019
14. Design of a sustainable drainage with a flood lamination strategy in a town near Torino
15. Retrofitting of dismissed penstocks as conduits for conveying overfull spills from forebays
16. Resilience of critical water drainage infrastructures against urban flood hazard
17. Optimized sequence of pipe-replacement during refurbishing of water distribution networks

Brief description of project related with flow transients, water distribution network, drainage systems

Hydraulic and chemical dynamical modelling of chlorine concentration in water distribution networks

- Type of project: Applied research.
- Period: July 2014 - July 2015.
- Activities:
 - Coupled Chemical-Hydraulic model of the water distribution network of a city near Turin for the analysis of the chlorine dynamics.
 - Quantitative forecast of the chlorine concentration in the network areas not covered by monitoring.

Hydraulic modelling of the water distribution networks of the city of Torino

- Type of project: Applied research.
- Period: July 2014 - July 2016.
- Activities:
 - Calibrated hydraulic model of the water distribution network of Turin (1M inhabitants) for the analysis of pressure dynamics.
 - Pressure reduction for leakage management
 - Detection of anomalies

Analysis of the functionality, management, and risk reduction of the “Susa Valley Aqueduct”

- Type of project: Consulting.
- Period: April 2014 - April 2017.
- Activities:
 - Analysis of the “Acquedotto della Valle di Susa”, a new hydraulic infrastructure for water distribution in the Susa valley.
 - Development of a numerical code for the network modeling and analysis.
 - Design of the system for the automatic regulation of the flow and of the tank levels.
 - Study of the functionality of the infrastructure in case of consumption peaks, production downs, conduit breakdowns, and maintenance activities.
 - Reduction of criticalities in the event of breakdowns.

- Design of the system of energy recovery from overpressure dissipation.
- Study of the flow transients occurring in the system

Detection of leakages in the “Susa Valley Aqueduct” with an innovative method based on flow transients

- Type of project: Consulting.
- Period: April 2020 - April 2021.
- Premise:
 - The time-series of pressure oscillations resulting from a flow transient are affected by leakages occurring in the conduit
- Activities:
 - Demonstration (numerical analysis) that leakages larger than 1 l/s can be detected in the “Susa Valley Aqueduct” (500 l/s) with wavelet analysis of pressure signals acquired with commercially available pressure transducers after a proper hydraulic transient has been generated.
 - Design of the system for the generation of the hydraulic transient used to locate leakages
 - Design of the system for the acquisition of the pressure time series

Hydraulic modeling and analysis of the criticalities in the Turin drainage network

- Type of project: Consulting.
- Period: December 2021- December 2023.
- Activities:
 - Development of a hydraulic numerical model of the Turin drainage network.
 - Identification of the optimal positioning of level sensors for calibrating the model.
 - Identification of (possible) rain events that lead to urban flooding events.
 - Assessment of the effectiveness of flooding reduction measures.
 - Assessment of the risk of pressurization of the sewer pipes.

Hydraulic modeling and analysis of the intermunicipal collector system discharging in the water treatment plant located in Castiglione Torinese

- Type of project: Consulting.
- Period: December 2021- December 2023.
- Activities:
 - Development of a hydraulic numerical model of the intermunicipal collector system discharging in the water treatment plant located in Castiglione Torinese.
 - Identification of the optimal positioning of level sensors for triggering alarms in the event of overflows.
 - Identification of (possible) rain events that lead to the overflow of part of the conveyed water.
 - Test of the effectiveness of overflow reduction measures.

BIM, VPL and VR for projects of infrastructures starting from the contents of FM

- Type of project: Applied research.
- Period: November 2023- November 2026.
- Activities:
 - definition of standards relating to the graphic (LoG) and information (LoI) content of complex hydraulic systems, using a top-down approach and advanced Building Information Modeling (BIM) tools, Visual Programming Language (VPL) and Virtual Reality (VR) for the definition of Digital Twin (DT) for Facility Management (FM).
 - Virtual commissioning of complex hydraulic systems.
 - Numerical modelling of the stability of control systems.
 - Evaluation of flow transients associated with maneuvers automatically implemented by control systems.

Design of a sustainable drainage with a flood lamination strategy in a town near Torino

- Type of project: Consultancy.
- Period: April 2022- April 2023.
- Activities:
 - Improvement of the drainage system (stormwater) of a town near Torino.

- Current system is insufficient for storms with return period larger than 5 years
- Due to dense urban setting, installation of additional conduits/replacement of existing is extremely costly and would induce long traffic problems
- Flood lamination is used as alternative strategy to (largely) keep the existing drainage networks
- Flood lamination requires punctual structures that can be nicely located within the existing urban setting.

Retrofitting of dismissed penstocks as conduits for conveying overfull spills from forebays

- Type of project: Applied research.
- Period: April 2022- April 2023.
- Activities:
 - Numerical modelling of the transient filling of dismissed penstocks that are used as conduits for conveying the overfull spills of forebays.
 - Identification of (possible) scenarios of risk related to this procedure, and in particular the formation of roll waves that can induce the pressurization and pressure pikes along the conduit.
 - Design of the energy dissipators to be built in the downstream end of the retrofitted penstocks.

Resilience of critical water drainage infrastructures against urban flood hazard

- Type of project: Applied research.
- Period: November 2023- November 2026.
- Activities:
 - Improvement of the modelling techniques to be used for assessing the drainage capacity of urban infrastructures.
 - Analysis of the transient filling phases of large underground drainage infrastructures, where streams exhibit sudden variations between open channel flow and pressure pipe flow.

Optimized sequence of pipe-replacement during refurbishing of water distribution networks

- Type of project: Applied research.
- Period: November 2023- November 2024.
- Activities:
 - During refurbishing of water distribution networks several conduits are to be replaced to reduce leakages.
 - Replacement of a conduit can induce effects (typically, pressure reduction) in large parts of the WDN
 - The sequence of replacement is crucial to avoid severe and long-lasting pressure reduction in parts of the WDN
 - Genetic algorithms are used to find the sequence of pipe-replacement that minimizes the disturbances to the WDN during refurbishing works.