

Federico Piscaglia - curriculum vitae

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PROFESSIONAL POSITIONS

Associate Professor	Politecnico di Milano	2015-Present
Assistant Professor	Politecnico di Milano	2008-2015
Post-Doc Researcher	Politecnico di Milano	2005-2008

PROFESSIONAL EXPERIENCE

Visiting PhD student, Univ. of Wisconsin-Madison, USA (Prof. C. Rutland, D. Foster, R. Reitz)	2003-2004
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EDUCATION

Ph.D. in Mechanical Engineering	Politecnico di Milano	2005
MS in Mechanical Engineering	Politecnico di Milano	2001
Abilitazione alla Professione di Ingegnere		2002

TEACHING

051176 - <i>Computational Techniques for Thermochemical Propulsion</i> Graduate Course, Dept. of Aerospace Science and Technology Politecnico di Milano	2017-present
086052 - <i>Internal Combustion Engines-L</i> Undergraduate Course, Dept. of Mechanical Engineering Politecnico di Milano	2008-present
087570 - <i>Energy Systems</i> Graduate Course, Dept. of Mechanical Engineering Politecnico di Milano	2016-2017

090925 - <i>CFD with Open-Source Software</i> PhD Course, Dept. of Energy Engineering Politecnico di Milano	2013-2015
087570 - <i>Combustion in Propulsion Systems</i> (Prof. L. Galfetti) Graduate Course, Dept. of Aerospace Engineering Politecnico di Milano	2015-present
090925 - <i>Termo-fluidodinamica computazionale per l'ingegneria</i> (Prof. F. Inzoli) Graduate Course, Dept. of Energy Engineering Politecnico di Milano	2010-2015
061196 - <i>Energy Systems</i> Undergraduate Course, Dept. of Industrial Engineering Politecnico di Milano	2005-2009
091128 - <i>Motori a Combustione Interna</i> (Prof. G. Ferrari) Graduate Course, Dept. of Mechanical Engineering Politecnico di Milano	2001-2008
061196 - <i>Energy Systems</i> (Prof. G. Ferrari) Undergraduate Course, Dept. of Industrial Engineering Politecnico di Milano	2001-2005

PROFESSIONAL SERVICE

Reviewer for Elsevier, ImechE, ASME, SAE-Society of Automotive Engineering.

Editorial Board Member of the technical magazines “Autotecnica” and “Mototecnica”,
Ed. Nuovi Periodici Milanesi

RESEARCH INTERESTS

My research activity lies in the area of Computational Fluid Dynamics (CFD); my interest is primarily focused on the development of computational assessment procedures, together with efficient numerical solvers and boundary conditions that could facilitate the numerical solution of partial differential equations. My main topics are the study of gasdynamics, fluid dynamics, sprays, turbulence LES modeling, acoustics, heat transfer. Implemented codes and libraries are included in a library developed in the OpenFOAM® Technology, that can be applied in a wide number of research and industrial applications involving compressible reacting turbulent flows. At the time this document is written, my activity is focused on:

- hybrid RANS/LES models for wall bounded flow calculations;
- automatic parallel algorithms for mesh motion with topological changes;
- cavitation models in multiphase compressible VOF solvers for the simulation of high pressure injection in vessels;
- high order temporal discretization schemes for topologically changing grids.

HONORS AND AWARDS

- April 2016 Keynote invited talk for advanced development of the OpenFOAM CFD software in Academia, *The 4th Annual OpenFOAM User Conference 2016*, Cologne (Germany).
- April 2015 *Recognition for Excellence in Oral Presentation*, “A Scale Adaptive Filtering Technique for Turbulence Modeling in IC Engines”. SAE paper 2015-01-0395, SAE World Congress and Exhibition 2015, Detroit, MI (USA).
- April 2015 *Recognition for Excellence in Oral Presentation*, “An Extension of the Dynamic Mesh Handling with Topological Changes for LES of ICE in OpenFOAM”. SAE paper 2015-01-0395, SAE World Congress and Exhibition 2015, Detroit, MI (USA).
- July 2014 The software Company Pointwise selected the development work done on dynamic meshes in OpenFOAM[®] as one of the most advanced examples of mesh handling for IC engine simulation [26, 21, 17, 15]. A brief description of the work has been published under invitation on their website:
<http://www.pointwise.com/theconnector/July-2014/Unsteady-Engine-Analysis.shtml>
- June 2013 The development done in the OpenFOAM[®] technology (mesh motion, compressible solver and turbulence models) has been selected by PRACE (Partnership for Advanced Computing in Europe, <http://www.prace-ri.eu/>) as reference test case for the work of the HPC centers. A summary of an interview by PRACE commissioners has been included in the article “Faster and Open Engine Simulations for Automotive Industry” within the magazine “Prace Digest 2013, Industrial Edition” (http://www.prace-ri.eu/IMG/pdf/prace_digest_2013-2-industrial_edition.pdf).

TECHNOLOGICAL TRANSFER

Results of the scientific research have been applied for research contracts with private Companies. In some cases, the technology developed in my research activity was transferred to products that are currently available on the market. Among the several case, the most popular are:

OpenFOAM Foundation
www.openfoam.org

Patch contributions to the official code release.
Info at <https://openfoam.org/release/6/> in the Credits.

Siemens PLM Software
R&D Department

I worked with software developers of LMS International (now Siemens PLM Software) to design the structure of the library AIRPATH 1D and to support the R&D department of LMS in the definition and implementation of the numerical solver and the boundary conditions, including models for turbocharging. The library AIRPATH 1D is included in the software LMS Imagine.Lab AMESIM, which is distributed worldwide. The collaboration with the ICE Group of Politecnico di Milano is mentioned on Siemens' website [<https://www.plm.automation.siemens.com/ko/products/lms/imagine-lab/automotive/combustion-engine/air-path.shtml>].

KEYNOTE LECTURES AT INTERNATIONAL CONFERENCES

- "Developments in transient modeling, moving mesh, turbulence and multiphase methodologies in OpenFOAM". *The 4th Annual OpenFOAM User Conference 2016*, Cologne (Germany). Oct 2016
- "Advanced methods for high fidelity simulations of compressible turbulent flows in IC Engines". *2nd VERIFI Workshop*, Argonne National Laboratory, Lemont (IL), USA June 2016
- "Development of OpenFOAM-based libraries for multiphase turbulent flows in dynamic grids". University of Santiago, Chile. Aug 2016
- "A C++ object-oriented library for IC Engines simulation - acoustics and aftertreatment". *Plenary session "New Implementations in OpenFOAM"*, *5th OpenFOAM Workshop*, Gothenburg (Sweden). June 2010

INVITED TALKS

- “Time-Resolved High-Fidelity Simulations of Moving Boundary Problems in OpenFOAM: an Application to the Simulation of Primary Jet Atomization and Cavitation in High-Pressure Fuel Injectors”. *Invited Talk at the Argentine National Congress on Numerical Methods and their Application, Santa-Fe, Argentina.* Aug 2018
- "Development of OpenFOAM-based libraries for massive parallel simulation of compressible turbulent flows in topologically changing meshes". Plenary lecture at the “PC methods for Engineering CINECA, 17th-19th June, 2015”, Milano, Italy. June 2015
- "Advanced visualization methods for large simulations on HPC systems". Invited lecture at the 8th "Advanced School on Scientific Visualization", PRACE EU Framework, CINECA HPC Center, 15 October 2013, Bologna (Italy). Oct 2013
- "Implementation of Parallel Algorithms for Fully-Automatic Mesh Motion and Handling with Parallel Topologically Changing Meshes in OpenFOAM". Invited talk at the Queen Mary University, London, UK, September 2013. Sept 2013
- "Development of an Open-Source CFD Library for Fluid Mechanics Simulation". Invited lecture at the KTH - Royal Institute of Technology, Stockholm (Sweden). Dec 2012
- "Introduzione alla simulazione CFD attraverso strumenti computazionali Open Source". Lectures at CINECA HPC Center, 15-16 November 2012, Milan (Italy). Nov 2012
- "Development of Open-Source CFD tools for the ICE simulation". Invited talk at the KTH - Royal Institute of Technology, Stockholm (Sweden). Dec 2011

Selected Publications

- [1] F. Piscaglia, F. Giussani, A. Montorfano, J. Hélie, and S. Aithal, “A MultiPhase Dynamic-VoF solver to model primary jet atomization and cavitation inside high-pressure fuel injectors in OpenFOAM,” *Acta Astronautica*, 2018.
- [2] F. Piscaglia, A. Onorati, S. Marelli, and M. Capobianco, “A detailed one-dimensional model to predict the unsteady behavior of turbocharger turbines for internal combustion engine applications,” *International Journal of Engine Research*, 2018.
- [3] Y. Wu, A. Montorfano, F. Piscaglia, and A. Onorati, “A study of the organized in-cylinder motion by a dynamic adaptive scale-resolving turbulence model,” *Flow, Turbulence and Combustion*, vol. 100, pp. 797–827, Apr 2018.
- [4] F. Piscaglia, A. Onorati, S. Marelli, and M. Capobianco, “A detailed one-dimensional model to predict the unsteady behavior of turbocharger turbines for internal combustion engine applications,” *International Journal of Engine Research*, vol. 0, no. 0, p. 1468087417752525, 0.
- [5] A. Montorfano, F. Piscaglia, F. Giussani, J. Helie, and S. Aithal, “A Study of Primary Atomization in High-Pressure Fuel Injectors by a Dynamic VOF Solver in OpenFOAM,” 2017. 7th European Conference for Aeronautics and Aerospace Sciences (EUCASS).
- [6] I. Di Piazza, R. Marinari, N. Forgione, F. Magugliani, W. Borreani, D. H., F. Roelofs, F. Piscaglia, A. Montorfano, and V. Moreau, “CFD analyses of the internal blockage in the NACIE_UP fuel pin bundle simulator,” in *The 17th international topical meeting on nuclear reactor thermal hydraulics (NURETH-17)*, Quijiang Int’l Convergence Center, Xi’an, China, September 2017.
- [7] E. Baudoin, J. Kunoy, F. Piscaglia, and A. Montorfano, “In-cylinder flow simulations in large marine two-stroke engines,” October 17th-19th 2017. 5th Annual OpenFOAM User Conference.
- [8] F. Piscaglia, A. Montorfano, *et al.*, “Hybrid RANS/LES of Moving Boundary Problems: Application to Cavitating Sprays and In-Cylinder Flows,” in *International Multidimensional Engine Modeling User’s Group Meeting At the SAE Congress*, April 11th, 2016.
- [9] J. Martínez, F. Piscaglia, A. Montorfano, A. Onorati, and S. Aithal, “Influence of momentum interpolation methods on the accuracy and convergence of pressure-velocity coupling algorithms in OpenFOAM,” *Accepted in Journal of Computational & Applied Mathematics*, 2016.
- [10] F. Piscaglia, A. Montorfano, J. Hélie, and F. X. Demoulin, “Development of a Multi-Phase VOF Dynamic Solver in OpenFOAM: an Application to the Simulation of the Opening and Closure Events in High Pressure GDI Injectors,” in *ICMF-2016 – 9th International Conference on Multiphase Flow, Firenze, Italy*, 2016.
- [11] F. Piscaglia, A. Montorfano, J. Martinez, Y. Wu, F. Giussani, J. Hélie, and S. Aithal, “Development of compressible solvers for the simulation of turbulent flows over dynamic topologically changing grids: an application to the simulation of GDI injectors,” in *Second Two-day Meeting on Internal Combustion Engine Simulations Using the OpenFOAM Technology*, Politecnico di Milano, November, 2015.
- [12] A. Montorfano, F. Piscaglia, G. Baldassarra, A. Onorati, and S. Aithal, “Application of a dynamic model with lengthscale-dependent RANS/LES hybrid functioning to a wind turbine simulation,” in *3rd Symposium on OpenFOAM for wind energy*, Politecnico di Milano, 2015.

- [13] A. Montorfano, F. Piscaglia, M. Schmitt, Y. Wright, C. Frouzakis, A. Tomboulides, K. Boulouchos, and A. Onorati, “Comparison of Direct and Large Eddy Simulations of the Turbulent Flow in a Valve/Piston Assembly,” *Flow, Turbulence and Combustion*, vol. 95, pp. 461–480, October 2015.
- [14] J. Martínez, F. Piscaglia, A. Montorfano, A. Onorati, and S. Aithal, “Influence of spatial discretization schemes on accuracy of explicit LES: Canonical problems to engine-like geometries,” *Computers & Fluids*, vol. 117, no. 0, pp. 62 – 78, 2015.
- [15] A. Montorfano, F. Piscaglia, and A. Onorati, “An extension of the dynamic mesh handling with topological changes for LES of ICE in OpenFOAM,” *SAE Technical Paper 2015-01-0384*, 2015.
- [16] F. Piscaglia, A. Montorfano, and A. Onorati, “A Scale Adaptive Filtering Technique for Turbulence Modeling of Unsteady Flows in IC Engines,” *SAE Transactions, Journal of Engines, Paper 2015-01-0395*, 2015.
- [17] F. Piscaglia, A. Montorfano, and A. Onorati, “ A Compressible Dynamic Solver for the Simulation of Turbulent Flows in IC Engine Geometries,” in *International Multidimensional Engine Modeling User’s Group Meeting at the SAE Congress, The Detroit Downtown Courtyard by Marriott Hotel, Detroit, MI (USA)*, April 20th 2015.
- [18] D. Dietzel, D. Messig, F. Piscaglia, A. Montorfano, G. Olenik, O. Stein, A. Kronenburg, A. Onorati, and C. Hasse, “Evaluation of Scale Resolving Turbulence Generation Methods for Large Eddy Simulation of Turbulent Flows ,” *Computers & Fluids*, vol. 93, pp. 116 – 128, 2014.
- [19] F. Piscaglia, A. Montorfano, A. Onorati, and F. Brusiani, “Boundary Conditions and SGS Models for LES of Wall-Bounded Separated Flows: An Application to Engine-Like Geometries,” *Oil Gas Sci. Technol. - Rev. IFP Energies nouvelles*, vol. 69, no. 1, pp. 11–27, 2014.
- [20] A. Montorfano, F. Piscaglia, and A. Onorati, “A LES study on the evolution of turbulent structures in moving engine geometries by an open-source CFD code,” *SAE Technical Paper 2014-01-1147*, 2014.
- [21] F. Piscaglia, A. Montorfano, and A. Onorati, “A Moving Mesh Strategy to Perform Adaptive Large Eddy Simulation of IC Engines in OpenFOAM,” in *International Multidimensional Engine Modeling User’s Group Meeting 2014, The Detroit Downtown Courtyard by Marriott Hotel, Detroit, MI (USA)*, April 7th 2014.
- [22] A. Montorfano, F. Piscaglia, M. Schmitt, C. E. Frouzakis, A. G. Tomboulides, K. Boulouchos, and A. Onorati, “Comparison of Direct and Large Eddy Simulation of the Turbulent Flow in a Valve/Piston Assembly,” in *10th International ERCOFTAC Symposium on Engineering Turbulence Modelling and Measurements*, 2014.
- [23] F. Piscaglia, A. Montorfano, and A. Onorati, “Development of a Non-Reflecting Boundary Condition for Multidimensional Nonlinear Duct Acoustic Computation,” *Journal of Sound and Vibration*, vol. 332, no. 4, pp. 922–935, 2013.
- [24] F. Piscaglia, A. Montorfano, and A. Onorati, “Towards the LES Simulation of IC Engines with Parallel Topologically Changing Meshes,” *SAE Int. J. Engines*, vol. 6, no. 2, pp. 926–940, 2013.

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- [27] L. Cornolti, A. Onorati, T. Cerri, G. Montenegro, and F. Piscaglia, “1D simulation of a turbocharged Diesel engine with comparison of short and long EGR route solutions,” *Applied Energy*, vol. 111, pp. 1 – 15, 2013.
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- [31] F. Piscaglia, A. Montorfano, and A. Onorati, “Boundary Conditions and SGS Models for LES of Wall-Bounded Separated Flows: An Application to Engine-Like Geometries,” in *LES4ICE - LES for Internal Combustion Engine Flows@IFPEN, Rueil-Malmaison*, 2012.
- [32] F. Piscaglia, A. Montorfano, G. Ferrari, and G. Montenegro, “High Resolution Central Schemes for Multi-dimensional Non-Linear Acoustic Simulation of Silencers in Internal Combustion Engines,” *Mathematical and Computer Modelling*, vol. 54, no. 7-8, pp. 1720–1724, 2011. doi:10.1016/j.mcm.2010.12.020.
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- [36] F. Piscaglia, A. Montorfano, and A. Onorati, “Multi-dimensional Computation of Compressible Reacting Flows Through Porous Media to Apply to Internal Combustion Engine Simulation,” *Mathematical and Computer Modelling*, vol. 52, pp. 1133–1142, October 2010.
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- [38] F. Piscaglia, A. Montorfano, and A. Onorati, "Development of an Open Source C++ Toolkit for Full-Scale Diesel Particulate Filter Simulation," *SAE 2009-24-0137*, September 2009. ICE2009 - SAE International Conference on Internal Combustion Engine, Capri (Napoli, Italy).
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- [43] G. Montenegro, A. Onorati, and F. Piscaglia, "Impact of ultra low thermal inertia manifolds on emission performance," *Atti del Congresso Nazionale ATI, Salerno*, 2007.
- [44] F. Piscaglia and G. Ferrari, "Development of an Offline Simulation Tool to Test the On-Board Diagnostic Software for Diesel Aftertreatment Systems," *SAE paper n. 2007-01-0133*, 2007. doi:10.4271/2007-01-1133.
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- [51] G. Montenegro, A. Onorati, and F. Piscaglia, "Integrated 1d-multid fluid dynamic models for the simulation of internal combustion engines," *HTCES 2006, Convegno Internazionale "Automobili e motori Hi-Tech", Modena*, 2006.

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- [54] F. Piscaglia and A. Onorati, “A computational investigation of the hydrodynamics and the soot deposition mechanism on the channel walls of a diesel particulate filter,” *60° Congresso Nazionale ATI. Roma, Italy.*, 2005.
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- [57] G. Ferrari, A. Onorati, and F. Piscaglia, “Fluid Dynamic Simulation of a Six-Cylinder S.I. Engine with Secondary Air Injection in the Exhaust After-Treatment System,” *ICE 2003-SAE International Conference on Internal Combustion Engines. Capri, Italy*, 2003.
- [58] G. Ferrari, A. Onorati, F. Piscaglia, and L. Spaggiari, “1D Fluid Dynamic Modeling of Secondary Air Injection in the Exhaust AfterTreatment System of S.I. Engines,” in *HTCES 2003 - Convegno Internazionale “Automobili e Motori Hi-Tech”. Modena, 29-30 maggio*, 2003.

REFERENCES

Recommendations available upon request.