

Umberto Emanuele Villa

CONTACT INFORMATION	The University of Texas at Austin Institute for Computational Engineering and Sciences (ICES) 201 E. 24th Street, Stop C0200 Austin, TX, 78712-0027	+1 408-334-0327 uvilla@ices.utexas.edu umberto.villa@gmail.com http://users.ices.utexas.edu/~uvilla
RESEARCH HIGHLIGHTS	My research interest focuses on the numerical simulation of physical problems of practical relevance in various fields of engineering, including porous media flow, petroleum industry, electromagnetism, thermodynamics, fluid-dynamics, and solid mechanics. My areas of expertise include numerical methods for partial differential equations (PDE), high performance computing, finite element analysis, numerical linear algebra, algebraic multigrid, numerical upscaling, PDE constrained optimization, uncertainty quantification and fluid-dynamics.	
EDUCATION	Emory University , Atlanta, GA (United States) <i>PhD in Computational Mathematics</i>	2012
	Politecnico di Milano , Milan (Italy) & Politecnico di Torino , Turin (Italy) <i>ASP diploma - Alta Scuola Politecnica</i>	2008
	Politecnico di Milano , Milan (Italy) & Politecnico di Torino , Turin (Italy) <i>Dual Master's degree in Mathematical Engineering, cum laude</i>	2007
	Politecnico di Milano , Milan (Italy) <i>Bachelor's degree in Mathematical Engineering, cum laude</i>	2005
EMPLOYMENT	University of Texas at Austin , Austin, TX The Institute for Computational Engineering and Science <i>Research Associate</i>	2015 –
	Lawrence Livermore National Laboratory (LLNL) , Livermore, CA Center for Applied Scientific Computing <i>Visiting Scientist</i>	2015 –
	<i>Postdoctoral Fellowship</i>	2013 – 2015
	<i>Student Internship</i>	Summers 2011 & 2012
	Oak Ridge National Laboratory (ORNL) , Oak Ridge, TN Computer Science and Mathematics division <i>Student Internship</i>	Summers 2009 & 2010
HONORS AND AWARDS	Best Student Paper Award, Copper Mountain Conference, Copper Mountain, Colorado, US	2012
	Medal for best graduate recipient, Politecnico of Milano, Milan, Italy	2005
	Invited to participate to the national (Italian) phase of the International Mathematical Olympiad, Cesenatico, Italy	2001
GRANTS AND CONTRACTS	O. Ghattas (PI) and U. Villa (Co-PI), <i>Collaborative Research: SI2-SSI: Integrating Data with Complex Predictive Models under Uncertainty: An Extensible Software Framework for Large-Scale Bayesian Inversion</i> , National Science Foundation, Division of Advanced Cyberinfrastructure, Grant ACI-1550593, 09/01/1608/31/19, \$350,885. A collaborative research project with N. Petra (UC-Merced) and Y. Marzouk and M. Parno (MIT) with total funding of \$1.35M. O. Ghattas and Y. Marzouk (organizers); M. Parno, N. Petra, G. Stadler, and U. Villa (co-organizers), <i>2018 Gene Golub SIAM Summer School</i> entitled <i>Inverse Problems: Systematic Integration of Data with Models under Uncertainty</i> , \$109,200 funding from SIAM. F. Alexander (Lead PI); O. Ghattas (Scientific Director) and C. Willcox (Scientific Directors); B. van Bloemen Waanders, E. Dougherty, D. Estep, J. Turner, V. Vesselinov, L. Ying (Inst. PIs);...	

U. Villa (Co-I), *Diamond-2: A Mathematical Framework for Integrating Multiscale Models and Multimodal Data through Physics-Based Inference and Optimal Experimental Design*, DOE/Office of Science, Advanced Scientific Computing Research Program (*PENDING*).

SCHOLARSHIPS	Laney Graduate School Scholarship, Emory University, Atlanta, GA	2008 – 2012
	Alta Scuola Politecnica Scholarship, Politecnico of Milano, Milan, Italy,	2005 – 2007

RESEARCH EXPERIENCE	<p>University of Texas at Austin, Austin, TX 2015 –</p> <p>Investigation of scalable numerical methods for PDE-constrained optimization, uncertainty quantification, optimization under uncertainty, optimal design of experiments, model inadequacy.</p> <p>Application of end-to-end uncertainty quantification techniques to subsurface flow, turbulent flow, combustion, biological tissues mechanics, ice-ocean interaction and wave propagation problems.</p> <p>Development of a Python/FEniCS toolbox for deterministic and Bayesian inverse problems, uncertainty quantification and propagation.</p> <p>Preparation of proposals, annual reports, and final research reports to government agencies, industry, universities.</p> <p>PI: Prof. Omar Ghattas (Institute for Computational Engineering and Sciences - ICES).</p> <p>Projects:</p> <ul style="list-style-type: none"> - <i>Integrating Data with Complex Predictive Models under Uncertainty: An Extensible Software Framework for Large-Scale Bayesian Inversion</i>, National Science Foundation, Division of Advanced Cyberinfrastructure, Ghattas (PI), myself (Co-PI). - <i>Bayesian Optimal Experimental Design for Inverse Scattering</i>, Air Force Office of Scientific Research, Computational Mathematics program, O. Ghattas (PI), G. Biros and Y. Marzouk (Co-PIs); role: research scientists. - <i>Inference, Simulation, and Optimization of Complex Systems Under Uncertainty: Theory, Algorithms, and Applications to Turbulent Combustion</i>, Defense Advanced Research Projects Agency, EQUIPS program, O. Ghattas (PI), R. Moser, G. Biros, K. Willcox, M. Heinkenschloss, A. Stuart, M. Girolami, A. Philpott (Co-PIs), role: research scientists. - <i>Large-scale Inverse Problems and Uncertainty Quantification for Reservoir Modeling</i>, Joint ExxonMobil-UT Energy Institute Project, O. Ghattas (PI), G. Biros, T. Bui-Thanh, C. Dawson (Co-PIs), role: consultant.
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	<p>Lawrence Livermore National Laboratory (LLNL), Livermore, CA 2011 – 2015</p> <p>Investigation of highly parallel and scalable numerical solvers for mixed finite element discretizations: element agglomeration algebraic multigrid (AMGe), numerical upscaling.</p> <p>Hybrid MPI/OPENMP implementation of scalable and efficient numerical solver for mixed finite elements discretizations based on AMGe techniques.</p> <p>Investigation of stochastic models for subsurface flow problems: multilevel acceleration of Monte Carlo methods by using algebraically constructed coarse spaces (upscaled discretizations).</p> <p>Development and parallel c++ implementation of stable and robust finite element discretizations and efficient solvers for oil reservoir simulation.</p> <p>Mentor: Dr. Panayot Vassilevski (Center for Applied Scientific Computing - CASC).</p> <p>Projects:</p>
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- *Towards Optimal Order Resilient Solvers at Extreme Scale (TOORSES)*, DOE Office of Advanced Scientific Computing Research, X.-S. Li (lead PI), P. Vassilevski (LLNL PI), role: postdoctoral researcher.
- *Scalable Multilevel UQ Concepts for Extreme-Scale Multiscale Problems*, DOE Office of Advanced Scientific Computing Research, Y. Efendiev (lead PI), P. Vassilevski (LLNL PI), role: postdoctoral researcher.
- *Adaptive Dimension Reduction via Coarsening and Multilevel Solvers*, DOE Office of Advanced Scientific Computing Research, P. Vassilevski (PI), role: postdoctoral researcher.

	<p>Oak Ridge National Laboratory (ORNL), Oak Ridge, TN 2009 – 2010</p> <p>Development of a general optimization-based framework for multiphysics multimodel Domain Decomposition.</p> <p>Application of the multi-physics framework to conjugate heat transfer and fluid structure interaction problems.</p> <p>Mentor: Dr. Judith Hill (Computer Science and Mathematics division of ORNL).</p>
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Emory University, Atlanta, GA **2008 – 2012**
 Analysis and implementation of a new time-adaptive algorithm for the solution of the unsteady Navier-Stokes equations.
 Development of parallel and scalable block preconditioners for saddle point problems.
 Application of these new numerical methods to patient specific blood flow simulations with the aim to numerically investigate pathological or clinical flow conditions (e.g. formation of aneurysms in the carotid artery, design of left ventricle assisting devices).
 Development of software to analyze bouted accelerometer data for physical activity studies (collaboration with D. Salvo Dominguez and M. Pratt).
 PhD Advisor: Prof. Alessandro Veneziani.

TEACHING
EXPERIENCE

University of Texas, Austin, TX

Guest lecturer (2 classes) for the graduate course “Finite Element Method in Geophysics” (Prof. Ghattas) **Fall 2016**
Guest lecturer (1 class) for the graduate course “Computational & Variational Inverse Problems” (Prof. Petra, UC Merced) **Spring 2015**
Guest lecturer (3 classes) for graduate course “Computational & Variational Inverse Problems” (Prof. Ghattas) **Fall 2015**

Emory University, Atlanta, GA

Instructor for undergraduate courses in Calculus I and II **2011 – 2012**
Teaching Assistant for undergraduate courses in Life Science Calculus I and II **2008 – 2010**

MENTORING
EXPERIENCE

University of Texas at Austin, Austin, TX **2015 –**

PhD students co-advised (adviser: O. Ghattas):
 Tom O’Leary-Roseberry (2015 –), dissertation topic: inversion for coupled ice-ocean interaction, coached in writing effective statements of purpose to apply for summer schools and short courses
 Joshua Chen (2016 –), dissertation topic: bayesian inference of material properties of cardiac tissue
Master students co-supervised (supervisor: O. Ghattas):
 Di Liu (CSEM), *hIPPYLearn: An inexact Stochastic Newton-CG method for training neural networks*, 2017.
 Ge Gao (CSEM), *hIPPYLearn: An inexact Newton-CG method for training neural networks with analysis of the Hessian*, 2017.

Undegraduate students co-mentored (mentor: O. Ghattas):
 Bassel Saleh (Moncrief Undergraduate Summer Internship), *Neural Networks as Surrogate Models for Forward and Inverse Problems*, 2016.

Informal mentoring:

Trained several graduate students in using the hIPPYlib software to solve inverse problem: A. Alghamdi and B. Crestel (ICES, adviser O. Ghattas), S. Wahal (ICES, adviser G. Biros), and K. McCormack (Jackson School of Geosciences, adviser M. Hesse).
 Provided a detailed introduction to the finite element method and the FEniCS software to Samuel Estes (Ph.D student, adviser C. Dawson).

Lawrence Livermore National Laboratory (LLNL), Livermore, CA **2013 – 2015**

PhD students intern supervised (mentor: P. Vassilevski):
 M. Christensen (Technical University of Denmark, summers 2013 and 2014): mixed finite element methods and numerical upscaling with application to subsurface flow and petroleum engineering.
 S. Ladenheim (Temple University, summer 2013): generation of Gaussian random field by solving PDEs
 D. Emerson (Tufts University, summer 2013): nonlinear multilevel methods
 C. S. Lee (Texas A& M, summer 2014): spectral upscaling method for mixed formulation of Darcy equation.

Informal mentoring:

Coached graduate students from Emory University (L. Bertagna, S. Guzzetti) in preparing strong

applications for summer internship at national laboratories (LLNL and Sandia, respectively).

PUBLICATIONS

Peer-Reviewed Journal Articles

- M. Christensen, U. Villa, A. Engsig-Karup, and P. S. Vassilevski. “Numerical upscaling for incompressible flow in reservoir simulation: an element-based algebraic multigrid (AMGe) approach”. *SIAM J. Sci. Comput.*, 39(1):B102–B137, 2017.
- S. Guzzetti, T. Passerini, J. Slawinski, U. Villa, A. Veneziani, and V. Sunderam. “Platform and algorithm effects on computational fluid dynamics applications in life sciences”. *Future Generation Computer Systems*, 67:382 – 396, 2017.
- S. Osborn, P. S. Vassilevski, and U. Villa. “A Multilevel Hierarchical Sampling Technique for Spatially Correlated Random Fields”. *SIAM J. Sci. Comput.*, in press, 2017.
- D. Kalchev, C. S. Lee, U. Villa, Y. Efendiev, and P. S. Vassilevski. “Upscaling of mixed finite element discretization problems by the spectral AMGe method”. *SIAM J. Sci. Comput.*, 38(5):A2912–A2933, 2016.
- D. Salvo, C. Torres, U. Villa, J. A. Rivera, O. L. Sarmiento, R. S. Reis, and M. Pratt. “Accelerometer-based physical activity levels among Mexican adults and their relation with sociodemographic characteristics and BMI: a cross-sectional study”. *Int. J. Behavioral Nutrition and Physical Activity*, 12(79):1–11, 2015.
- P. S. Vassilevski and U. Villa. “A mixed formulation for the Brinkman problem”. *SIAM J. Numer. Anal.*, 52(1):258–281, 2014.
- K. W. Desmond, U. Villa, M. Newey, and W. Losert. “Characterizing the rheology of fluidized granular matter”. *Physical Review E*, 88(3):032202, 2013.
- T. Passerini, A. Quaini, U. Villa, A. Veneziani, and S. Canic. “Validation of an open source framework for the simulation of blood flow in rigid and deformable vessels”. *Int. J. Numer. Meth. Biomed. Engng.*, 29(11):1192–1213, 2013.
- P. S. Vassilevski and U. Villa. “A block-diagonal algebraic multigrid preconditioner for the Brinkman problem”. *SIAM J. Sci. Comput.*, 35(5):S3–S17, 2013.
- A. Veneziani and U. Villa. “ALADINS: An ALgebraic splitting time ADaptive solver for the Incompressible Navier–Stokes equations”. *J. Comput. Phys.*, 238:359–375, 2013.

Peer-Reviewed Conference Papers

- M. Neumüller, P. S. Vassilevski, and U. Villa. *Space-time constrained First Order Systems Least Squares (CFOSLS) with AMGe upscaling*, pages 253–260. Springer, 2017.
- M. Christensen, U. Villa, and P. S. Vassilevski. “Multilevel techniques lead to accurate numerical upscaling and scalable robust solvers for reservoir simulation”. In *SPE Reservoir Simulation Symposium*. Society of Petroleum Engineers, 2015.
- T. Passerini, J. Slawinski, U. Villa, and V. Sunderam. “Experiences with Cost and Utility Trade-offs on IaaS Clouds, Grids, and On-Premise Resources”. In *Proc. IEEE Intl. Conference on Cloud Engineering (IC2E) - Cloud Analytics Workshop*, pages 391–396. IEEE, 2014.
- J. Slawinski, U. Villa, T. Passerini, A. Veneziani, and V. Sunderam. “Issues in Communication Heterogeneity for Message-Passing Concurrent Computing”. In *27th IEEE Intl. Parallel and Distributed Processing Symposium Workshops & PhD Forum (IPDPSW)*, pages 93–102. IEEE, 2013.
- J. Slawinski, U. Villa, T. Passerini, A. Veneziani, and V. Sunderam. “Experiences with Target-Platform Heterogeneity in Clouds, Grids, and On-Premises Resources”. In *26th IEEE Intl. Parallel and Distributed Processing Symposium Workshops & PhD Forum (IPDPSW)*, pages 41–52. IEEE, 2012.

Submitted Manuscripts

- P. Chen, U. Villa, and O. Ghattas. “Hessian-based adaptive sparse quadrature for infinite-dimensional Bayesian inverse problems”, 2017.
- S. Osborn, P. Zulian, T. Benson, U. Villa, R. Krause, and P. Vassilevski. “Scalable hierarchical PDE sampler for generating spatially correlated random fields using non-matching meshes”, 2017.
- U. Villa, M. Christensen, and P. S. Vassilevski. “Nonlinear Multigrid solvers exploiting AMGe coarse spaces with approximation properties”, 2017.

N. Alger, U. Villa, T. Bui-Thanh, and O. Ghattas. “A data scalable augmented Lagrangian KKT preconditioner for large scale inverse problems”, 2016.

Manuscripts in preparation

U. Villa, P. Chen, O. Ghattas, “Bayesian Calibration of Inadequate Stochastic PDE Models”

P. Chen, U. Villa, O. Ghattas, “Taylor approximation and variance reduction for PDE-constrained optimal control under uncertainty”

U. Villa, N. Petra, O. Ghattas, “hIPPYlib: An extensible software framework for large-scale Bayesian Inversion”

P. Vassilevski, U. Villa, “Divergence-Free Multilevel AMGe Solver for Mixed Finite Elements”

P. Vassilevski, U. Villa, “Auxiliary Space $H(\text{curl})$ and $H(\text{div})$ Solvers Based on Upscaled AMGe De Rham Sequences”

THESES

Doctoral Dissertation: *Scalable Efficient Methods for Incompressible Fluid-dynamics in Engineering Problems*. Advisor: A. Veneziani.

Alta Scuola Politecnica diploma: *Environment & energy - Hydrogen: opportunities and utilization*. Advisors: F. Profumo, E. Paolucci, A. Tenconi. External Institutions: Centro Estero Camere di Commercio Piemontesi, STEP Ricerche S.r.l.

Master Dissertation: *Finite Element Analysis of the Brake Pad System and Multibody Modeling of Motor Vehicles in Braking-Phase*. Advisor: A. Veneziani, L. Trainelli, A. Vigliani. External Institutions: “Simulations and Computing” division of Brembo Sps.

Bachelor Dissertation: *Mathematical modeling and numerical simulation of hemodynamics problems in one dimension*. Advisor: A. Veneziani.

MINISYMPOSIA ORGANIZER

T. Bui-Thanh, O. Ghattas, V. Rao, U. Villa (organizers), *Efficient Algorithms for Bayesian Inverse Problems Governed by PDE Forward Problems*, SIAM Conference on Computational Science and Engineering, Feb 27-March 3, 2017, Atlanta, Georgia, US

CONFERENCE PRESENTATIONS

Award winning presentations

A Block-Diagonal Algebraic Multigrid Preconditioner for the Brinkman Problem, 12th Copper Mountain Meeting on Iterative Methods, March 25-30, 2012, Copper Mountain, Colorado, US (student paper competition)

Invited oral presentations in minisymposia

Taylor Approximation for PDE-Constrained Optimal Control Problems Under High-Dimensional Uncertainty: Application to a Turbulence Model, SIAM Conference on Control and its Applications, July 10-12, 2017, Pittsburgh, PA, US

Derivative-informed MCMC for Bayesian Calibration of Stochastic PDE Models, SIAM Annual Meeting, July 10-14, 2017, Pittsburgh, PA, US

Hessian-based Sampling Techniques for Bayesian Inverse Problems with Stochastic PDE Forward Model, Applied Inverse Problems, May 29-Jun 2, 2017, Hangzhou, China

Bayesian Calibration of Inadequate Stochastic PDE Models, SIAM Conference on Computer Science and Engineering, Feb 27-March 3, 2017, Atlanta, Georgia, US

Bayesian Inverse Problems Governed by Stochastic PDE Models, Joint Mathematics Meetings, January 4-7, 2017, Atlanta, Georgia, US

An Analytical Technique for Forward and Inverse Propagation of Uncertainty, SIAM Conference on Uncertainty Quantification, April 5-8, 2016, Lausanne, Switzerland

Highly Scalable Hierarchical Sampling Algorithms for Gaussian Random Fields, SIAM Conference on Computer Science and Engineering, March 14-18, 2015, Salt Lake City, Utah, US

Robust Numerical Methods for the Brinkman Problem, 9th International Conference on Large-Scale Scientific Computations, June 3-7, 2013, Sozopol, Bulgaria (with travel support from symposium organizers)

PALADINS: Scalable Time-adaptive Algebraic Splitting and Preconditioners for the Navier-Stokes

Equations, SIAM Conference on Computer Science and Engineering, Feb 25-March 1, 2013, Boston, Massachusetts, US

ALADINS: an ALgebraic ADaptive Incompressible Navier-Stokes solver, XVIII International Conference on Computational Methods in Water Resources, June 21-24, 2010, Barcelona, Spain (student volunteer with partial travel support)

Oral presentations

AMG Solvers for Upscaled Mixed Finite Element Discretizations, 13th Copper Mountain Conference on Iterative Methods, Apr 6 - 11, 2014, Copper Mountain, Colorado, US

Multilevel Monte Carlo Simulations with Algebraically Constructed Coarse Spaces, SIAM Conference on Uncertainty Quantification, March 31 - Apr 3, 2014, Savannah, Georgia, US

Block AMG Preconditioners For Mixed Finite Element Discretization of Porous Media Flow Problems, 16th Copper Mountain Conference on Multigrid Methods, March 17-22, 2013, Copper Mountain, Colorado, US

PALADINS: a Scalable Solver for the Navier-Stokes Equations, SIAM Conference on Parallel Processing for Scientific Computing, Feb 15-17, 2012, Savannah, Georgia, US

PALADINS: A Parallel Algebraic Adaptive Navier-Stokes Solver, SIAM Conference on Computer Science and Engineering, Feb 28-March 4, 2011, Reno, Nevada, US

Poster presentations

Integrating Data with Complex Predictive Models under Uncertainty: An Extensible Software Framework for Large-Scale Bayesian Inversion, NSF SI2 PI Meeting, 2017, Arlington, VA, US

Hard problems are fine to coarsen, Computation Postdoc Poster Symposium, March 24th, 2014, Livermore, California, US

Upscaling Techniques for the Brinkman Problem, 2013 DOE Applied Mathematics Program meeting, August 6-8, 2013, Albuquerque, New Mexico, US

Towards Scalable Solvers for the Brinkman Problem, Lawrence Livermore Student Poster Symposium, August 8th, 2012, Livermore, California, US

Robust numerical methods for the Brinkman problem, Lawrence Livermore Student Poster Symposium, August 10th, 2011, Livermore, California, US

ALgebraic time ADaptive splitting schemes for the Incompressible Navier-Stokes equations, 2011 Georgia Scientific Computing Symposium, Feb. 12th, 2011, Atlanta, Georgia, US

Multiphysics Multimodel Domain Decomposition: An Application to Conjugate Heat Transfer, 2010 Georgia Scientific Computing Symposium, Feb. 20th, 2010, Atlanta, Georgia, US

SEMINARS

Numerical Upscaling and Multilevel Monte Carlo, Stanford University, Stanford, California, 12th November 2014, Algorithms and Architectures Initiative Annual Meeting.

Multilevel Monte Carlo Simulations with Algebraically Constructed Coarse Spaces, Emory University, Atlanta, Georgia, 28th March 2014. Host *A. Veneziani*

Towards Scalable Solvers for the Brinkman Problem, Stanford University, Stanford, California, 4th March 2014. Host *H. Techelepi*

Numerical Upscaling and Algebraic Multigrid for Mixed Finite Element discretizations, Lawrence Berkeley National Laboratory, Berkeley, 11th February 2014. Host *X. S. Li*

Numerical Upscaling and Algebraic Multigrid for Mixed Finite Element discretizations, Tuft University, Boston, Massachusetts, 6th December 2013. Host *J. Adler*

An Optimal Control Approach for Multiphysics Multimodel Domain Decomposition, Stanford University, Stanford, California, 7th November 2013. Host *M. Saunders*

Towards Scalable Solvers for the Brinkman Problem, Kennesaw State University, Kennesaw, Georgia, 5th October 2013. Host *Y. Babenko*

SCHOOLS, WORKSHOPS, AND THINK-TANKS ATTENDED

IdeaLab 2015: Inverse Problems and Uncertainty Quantification, July 6-10, 2015, Brown University, Providence, Rhode Island, Us (with travel support from organizers)

Algebraic Multigrid Summit, October 15-18, 2014, Boulder, Colorado, US

Algebraic Multigrid Summit, September 3-8, 2013, Lake City, Colorado, US

Finite Element Exterior Calculus Summer School, June 11-15, 2012, Brown University, Providence, Rhode Island, US (with travel support from organizers)

Adaptive Finite Elements and Domain Decomposition Methods Workshop, June 17-19, 2010, Milan State University, Milan, Italy

Parallel Numerical Simulation School (Athens Program), March 18-23, 2007, Technische Universität München, Munich, Germany

Crash Analysis and Car Dynamics School (Athens Program), November 12-17, 2006, Ecole Nationale des Ponts et Chaussees, Paris, France

SERVICE I interviewed candidates applying for postdoctoral and staff positions at Lawrence Livermore National Laboratory.

EDITORIAL WORK Serving as a reviewer for the following journals: “SIAM Journal on Scientific Computing” (SIAM), “Numerical Linear Algebra with Application”, “Numerical Methods in Engineering” (Wiley), “Computational Geosciences”, “Journal of Scientific Computing”, “Numerical Algorithms” (Springer), “Journal of Mathematical Analysis and Applications” (Elsevier)

PROFESSIONAL AFFILIATIONS SIAM member since 2009.

LANGUAGES Italian (primary), English (fluent), Spanish (basic)

COMPUTER SKILLS Operating System: Linux, MacOS
Text Editors: Latex, Microsoft Office
Web Editors: Markdown, MkDocs
Programming:
- C++, C, Fortran, Python
- Parallel Computing with MPI and OPENMP.
- Doxygen (source code documentation generator)
- Version control software tools (git, cvs)
- Build automation tools (cmake, automake, autoconf)
- Performance analysis debugging tools (valgrid, gdb, tau)
Scientific Computing libraries:
- Lead developer of hIPPYlib - **In**verse **P**roblems **P**ython **l**ibrary (<https://hippylib.github.io>)
- Lead developer of Elag, ParElag (element agglomeration multigrid solvers and upscaling tools, <http://github.com/LLNL/parelag>)
- Lead developer of ElagMC, ParElagMC (Multilevel Monte Carlo software based on Elag/ParElag, LLNL confidential)
- Contributor to the finite element library MFEM (<http://mfem.org>)
- Developer of the finite element library LifeV (www.lifev.org)
- Author of the sparse linear algebra library t-minres (<https://code.google.com/p/tminres/>)
- Expert user of the FEniCS, Trilinos, Hypre, Suitesparse libraries.
Scientific tools: Matlab, Octave, FreeFem, R (a Statistical Analysis software)

REFERENCES **Professor Omar Ghattas**
Inst. Computat. Engineering and Sciences
University of Texas at Austin
Austin, TX
e-mail: *available on request*

Dr Panayot Vassilevski
Center for Applied Scientific Computing
Lawrence Livermore National Laboratory
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Professor Alessandro Veneziani
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Emory University
Atlanta, GA
e-mail: *available on request*

Professor Michele Benzi
Dept. of Mathematics and Computer Science
Emory University
Atlanta, GA
e-mail: *available on request*