Umberto Emanuele Villa

CONTACT INFORMATION

The University of Texas at Austin
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I define myself as a computational scientist and mathematical engineer. My research focuses on advancing the use of high-performance computing, trustworthy machine learning, and physics-based predictive numerical simulations in the fields of medical imaging and engineering. My research enables solving biomedical, biological, and engineering problems through the development of computational frameworks and software infrastructures that integrate data, high-performance computing, and machine learning methods. I have expertise in parallel computing, data science, inverse problems, large-scale optimization, imaging, Bayesian inference, and numerical analysis. Throughout my career, I have led the development of novel formulations and algorithms for the solution of both forward and inverse problems. I have achieved this by establishing a close working collaboration with some of the leading research experts in the fields of geophysics, biomedical imaging, computational sciences, applied mathematics, and engineering.

EDUCATION

Emory University, Atlanta, GA (United States)
PhD in Mathematics — **2012**

Politecnico di Milano, Milan (Italy) & **Politecnico di Torino**, Turin (Italy)
ASP diploma - Alta Scuola Politecnica — **2008**

Politecnico di Milano, Milan (Italy) & **Politecnico di Torino**, Turin (Italy)
Dual Master's degree in Mathematical Engineering, cum laude — **2007**

Politecnico di Milano, Milan (Italy)
Bachelor's degree in Mathematical Engineering, cum laude — **2005**

EMPLOYMENT

The University of Texas at Austin, Austin, TX
Oden Institute for Computational Engineering and Science
Research Scientist — **2022 –**

University of Illinois, Urbana-Champaign, IL
Department of Bioengineering
Adjunct Research Assistant Professor — **2020 –**

Washington University in St. Louis, St. Louis, MO
Electrical & Systems Engineering
Research Assistant Professor — **2018 – 2022**
Imaging Science Ph.D. Program Faculty — **2018 – 2022**
Institute of Public Health Faculty Scholar — **2020 – 2022**

The University of Texas at Austin, Austin, TX
Institute for Computational Engineering and Science
Research Associate — **2015 – 2018**

Lawrence Livermore National Laboratory (LLNL), Livermore, CA
Center for Applied Scientific Computing
Visiting Scientist — **2015 – 2021**
Postdoctoral Fellowship — **2013 – 2015**
Student Internship — **Summers 2011 & 2012**

Oak Ridge National Laboratory (ORNL), Oak Ridge, TN
Computer Science and Mathematics Division
Student Internship — **Summers 2009 & 2010**

Honors and Awards

Seno Medical Best Paper Award, Photons Plus Ultrasound: Imaging and Sensing 2022, SPIE Photonics West BIOS, San Francisco, CA, US (co-author) **2022**

Best Student Paper Award, 12th Copper Mountain Conference on Iterative Methods, Copper Mountain, Colorado, US **2012**

Medal for best graduate recipient, B.S. in Mathematical Engineering, Politecnico of Milano, Milan, Italy **2005**

Competed in the national phase of the International Mathematical Olympiad, Cesenatico, Italy **2001**

Grants and Contracts

Awarded

U. Villa, M. Pagel (**MPIs**), *Safe, Accurate Assessment of Treatment Response via Dynamic Contrast Enhanced Multispectral Optoacoustic Tomography Imaging of Tumor Perfusion*, The Joint Center for Computational Oncology (JCCO), Oncological Data and Computational Sciences program.
09/01/23 – 08/31/24 **$50,000** (Direct Costs)

M. Anastasio, A. Oraevsky (MPIs); F. Brooks (Co-I), **U. Villa (Co-I and subaward PI)**, *A Computational Framework Enabling Virtual Imaging Trials of 3D Quantitative Optoacoustic Tomography Breast Imaging*, National Institute of Health (NIH), National Institute of Biomedical Imaging and Bioengineering, NIH R01EB031585
08/01/22 — 04/30/26 awarded to date $1,297,368; expected **$2,318,539**
Subaward amount $391,984

S. Ermilov (PI), M. Anastasio (Co-I), S. Emelianov (Co-I), **U. Villa (Co-I and subaward PI)**. *Integrated photoacoustic and fluorescence imaging system for anatomical, functional, and molecular characterization of murine models*, National Institute of Health (NIH), Novel Tools and Devices for Animal Research Facilities and to Support Care of Animal Models, NIH R44OD023029
08/15/22—07/31/24 **$1,924,204**
Subaward amount $96,068

T. Kim (PI); L. Henke, G. Hugo, C. Park, M. Schmidt,**U. Villa**, H. Yi (**Co-Is**), *MRI augmented X-ray imaging-guided adaptive radiotherapy for pancreatic cancer (MAX-guided ART)*, Siteman Investment Program (Pre-R01 Award)
07/01/2021–06/30/2023 **$200,000**

M. Anastasio and N. Duric (MPIs); **U. Villa (Co-I and subaward PI)**, *Advanced image reconstruction for accurate and high-resolution breast ultrasound tomography*, National Institute of Health, National Institute of Biomedical Imaging and Bioengineering, NIH R01EB028652
09/01/19—08/31/24 **$2,179,420**
Subaward amount $250,761

U. Villa (PI), *ADLA: Automatic differentiation and local assembly of exotic finite element variational forms in MFEM*, LLNL B638337 subcontract
11/01/19–10/31/20 **$59,999**

O. Ghattas (PI) and **U. Villa (Co-PI)**, *Collaborative Research: SI2-SSI: Integrating Data with Complex Predictive Models under Uncertainty: An Extensible Software Framework for Large-Scale Bayesian Inversion*, National Science Foundation, Division of Advanced Cyberinfrastructure, Grant ACI-1550593
09/01/16—08/31/20 **$350,885**
Note: A collaborative research project (separate awards) with N. Petra (UC-Merced), Y. Marzouk and M. Parno (MIT) with total funding of $1.35M

0. Ghattas, Y. Marzouk, M. Parno, N. Petra, G. Stadler, and **U. Villa**,
2018 Gene Golub SIAM Summer School entitled *Inverse Problems: Systematic Integration of Data with Models under Uncertainty*, Society for Industrial and Applied Mathematics (SIAM)
Note: training grant for organizing a 2-week summer school on inverse problems in Breckenridge, CO
June 16—30, 2018 **$109,200**

Computational resources awards

U. Villa (PI), Computing resources for the graduate level course *Computational and Variational Inverse Problems*, Explore ACCESS (educational) allocation MTH230002, 100,000 SUs, 2023

U. Villa (PI), Computing resources for the graduate level course *Tools and Techniques of Computational Science*, TACC Instructional allocation CSE-380-Tools-and-Te, 2000 SUs, 2022

M. Anastasio (PI), **U. Villa (Co-PI)**, *Distributed GPU-accelerated image reconstruction methods*

for breast ultrasound computed tomography, Illinois Delta research allocation, 16,000 GPU-hours, 2022

M. Anastasio (PI), **U. Villa (Co-PI)**, *A computational framework integrating wave physics simulation and machine learning for fast and accurate transcranial photoacoustic tomography reconstruction*, Illinois Blue Waters research allocation, 210,000 node-hours, 2021

M. Anastasio (PI); J. Poudel, **U. Villa (Co-PI)**, *Safe and rapid functional brain imaging with transcranial photoacoustic tomography: Accelerating iterative image reconstruction algorithms using GPUs*, Illinois Blue Waters research allocation, 210,000 node-hours (estimated value of awarded resources $130,263), 2020

U. Villa (PI), Cloud computing resources for the graduate level course on *Computational Methods in Imaging Science*, XSEDE educational allocation TG-SEE190001, 100,000 CPU hours (estimated value of awarded resources $8,445), 2019–2020,.

U. Villa (PI) and N. Petra (Co-PI), Cloud computing resources for the *2018 Gene Golub SIAM Summer School* entitled *Inverse Problems: Systematic Integration of Data with Models under Uncertainty*, XSEDE educational allocation TG-DMS180009, 60,000 CPU hours (estimated value of awarded resources $10,014), 2018.

Scholarships

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

Research Experience

A Computational Framework Enabling Virtual Imaging Trials of 3D Quantitative Optoacoustic Tomography Breast Imaging
This project addresses the challenges of reducing over-diagnosis and over-treatment of breast cancer by developing transformative computational methods to enable three-dimensional (3D) quantitative optoacoustic tomography (OAT) of the vasculature and oxygen saturation distribution within the human breast.
Funding: NIH, National Institute of Biomedical Imaging and Bioengineering (NIBIB), R01EB031585. M. Anastasio, A. Oraevsky (PI)
Role: **Co-Investigator/Subaward PI** **2022 –**

Integrated photoacoustic and fluorescence imaging system for anatomical, functional, and molecular characterization of murine models
This project aims at developing learning-enhanced image reconstruction to enable quantitative dynamic PACT imaging from a reduced number of tomographic views.
Funding: NIH, Small Business Innovation Research Grants (SBIR) , R44OD023029. S. Ermilov (PI)
Role: **Co-Investigator/Subaward PI** **2022 –**

Predictive modeling for computational oncology The overarching goal of this project is to develop computational models and algorithms to make a reliable prediction of tumor growth and patient-specific response to radiotherapy treatment, thus advancing current standard-of-care.
Collaboration with D. Faghihi (The University at Buffalo) **2020 –**

Predictive modeling for material science The overarching goal of this project is to develop, calibrate, and validate multiscale computational models to characterize microstructure properties of aerogel materials and predict their macroscopic thermal and mechanical behavior.
Collaboration with D. Faghihi (The University at Buffalo) **2020 –**

Advanced image reconstruction for accurate and high-resolution breast ultrasound tomography
The broad objective of this project is to maximize the clinical utility of ultrasound computed tomography (USCT) for whole breast imaging by significantly advancing the state-of-the-art in USCT image reconstruction methods.
Funding: NIH, National Institute of Biomedical Imaging and Bioengineering (NIBIB), R01EB028652. M. Anastasio, N. Duric (PIs)
Role: **Co-Investigator/Subaward PI** **2018 –**

Safe, rapid & functional pediatric brain imaging using photoacoustic computed tomography
The goal of this project is to develop and evaluate a safe, rapid, and functional three-dimensional (3D) pediatric neuroimaging modality based on photoacoustic computed tomography (PACT).
Funding: NIH, National Institute of Neurological Disorders and Stroke (NINDS), R01NS102213. L. Wang, M. Anastasio (PIs)

Role: Unfunded collaborator **2018 –**

Integrating Data with Complex Predictive Models under Uncertainty: An Extensible Software Framework for Large-Scale Bayesian Inversion
The goal of this study is to develop, disseminate, and support a robust, scalable, high-performance, open-source software framework incorporating a suite of advanced Bayesian inversion algorithms.
Funding: NSF, Office of Advanced Cyberinfrastructure, ACI-1550593. O. Ghattas (PI)
Role: **Co-PI** **2016 – 2020**

Large-scale Inverse Problems and Uncertainty Quantification for Reservoir Modeling
The focus of this joint ExxonMobil–UTEI project is to develop state-of-the-art inversion and uncertainty quantification methods to reservoir models with complex features including faults.
Funding: Joint ExxonMobil-UT Energy Institute Project, UTA17-000408 (EM10480.14). O. Ghattas (PI), G. Biros, T. Bui-Thanh, C. Dawson (Co-PIs)
Role: Research scientist **2017 – 2019**

Bayesian Optimal Experimental Design for Inverse Scattering
The goal of this study is to develop a rigorous Bayesian framework to design source/receiver configuration to maximize identifiability.
Funding: AFOSR, Computational Mathematics program, FA9550-17-1-0190. O. Ghattas (PI), G. Biros and Y. Marzouk (Co-PIs)
Role: Research scientist **2017 – 2018**

Inference, Simulation, and Optimization of Complex Systems Under Uncertainty: Theory, Algorithms, and Applications to Turbulent Combustion
This project developed an end-to-end, integrated uncertainty quantification framework enabling us to quantify, manage, and minimize uncertainty in large scale multiscale/multiphysics problems.
Funding: DARPA, EQUiPS program, W911NF-15-2-0121. O. Ghattas (PI), R. Moser, G. Biros, K. Willcox, M. Heinkenschloss, A. Stuart, M. Girolami, A. Philpott (Co-PIs)
Role: Research scientist **2016 – 2017**

Towards Optimal Order Resilient Solvers at Extreme Scale (TOORSES)
This project developed large scale linear solvers and preconditioners exploiting multilevel techniques and hierarchical matrices factorizations.
Funding: DOE Office of Advanced Scientific Computing Research. X.-S. Li (lead PI), P. Vassilevski (LLNL PI)
Role: Postdoctoral researcher **2013 – 2015**

Scalable Multilevel UQ Concepts for Extreme-Scale Multiscale Problems
The objective of this project is to develop multilevel techniques to accelerate forward and inverse uncertainty quantification (UQ) tasks involving complex multiphysics partial differential equations models.
Funding: DOE Office of Advanced Scientific Computing Research. Y. Efendiev (lead PI), P. Vassilevski (LLNL PI)
Role: Postdoctoral researcher **2013 – 2015**

Adaptive Dimension Reduction via Coarsening and Multilevel Solvers
This project investigates highly efficient mathematical tools to construct coarse spaces and respective coarse models that are operator-dependent and to expand the applicability of multigrid methods to very general partial differential equations, such as mixed formulations and saddle point systems.
Funding: DOE Office of Advanced Scientific Computing Research. P. Vassilevski (PI)
Role: Graduate research assistant **2011 – 2012**

Multiphysics Multimodel Domain Decomposition: an Application to Conjugate Heat Transfer
This project investigates a general optimization-based framework for multiphysics multimodel Domain Decomposition with applications to conjugate heat transfer and fluid structure interaction problems.
Funding: ORNL Laboratory Directed Research and Development (LDRD). J. Hill (PI)
Role: Graduate research assistant **2009 – 2010**

Scalable Efficient Methods for Incompressible Fluid-dynamics in Engineering Problems (PhD thesis)
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).
Advisor: Dr. Alessandro Veneziani **2008 – 2012**

Teaching Experience

University of Texas, Austin, TX

Instructor of core curriculum courses for the Ph.D. program in Computational Science, Engineering, and Mathematics

Tools & Techniques of Computational Science **Fall 2023**

Tools & Techniques of Computational Science **Fall 2022**

Instructor of summer schools/short courses

- Gene Golub SIAM Summer School on Inverse Problems **June 17-30, 2018**
  Taught jointly with O. Ghattas, Y. Marzouk, M. Parno, N. Petra, G. Stadler

Co-instructor for graduate course

Computational & Variational Inverse Problems (Dr. Ghattas) **Spring 2023**

Computational & Variational Inverse Problems (Dr. Ghattas) **Fall 2017**

Guest lecturer for graduate level courses

Finite Element Method in Geophysics (Dr. Ghattas): 3 lectures **Fall 2016**

Computational & Variational Inverse Problems (Dr. Ghattas): 4 lectures **Fall 2015**

Comput. & Variational Inverse Problems (Dr. Petra, UC Merced): 1 lecture **Fall 2015**

Washington University, St. Louis, Mo

Instructor of core curriculum courses for the Ph.D. program in Imaging Science

Computational Methods in Imaging Science **Spring 2020**

Computational Methods in Imaging Science **Spring 2019**

Guest lecturer for undergraduate level courses

Optimization (Dr. Kamilov): 2 lectures **Spring 2020**

Optimization (Dr. Kamilov): 1 lecture **Spring 2019**

Emory University, Atlanta, GA

Instructor for undergraduate courses in Calculus I and II

Calculus II (Teaching mentor: Dr. Gould) **Spring 2012**

Calculus I (Teaching mentor: Dr. Garibaldi) **Fall 2011**

Calculus II (Teaching mentor: Dr. Batterson) **Spring 2011**

Teaching Assistant for undergraduate courses in Life Science Calculus and Linear Algebra

Linear Algebra (Lab instructor for Dr. Venapally) **Fall 2012**

Life Science Calculus I (Lab instructor for Dr. Duffus) **Fall 2010**

Life Science Calculus II (Lab instructor for Dr. Duffus) **Spring 2010**

Life Science Calculus I (Lab instructor for Dr. Duffus) **Fall 2009**

Life Science Calculus II (Grader for Dr. Duffus) **Spring 2009**

Life Science Calculus I (Grader for Dr. Duffus) **Fall 2008**

Life Science Calculus II (Grader for Dr. Duffus) **Spring 2008**

Mentoring Experience

Ph.D. students (main advisor):

Evan Scope Craft (CSEM, UT Austin, 2023 –): Optimal experimental design of photoacoustic tomography imaging systems

Luke Lozenski (Electrical & Systems Engineering, WUSTL, 2020 –): Integration of model-based and learned image reconstruction algorithms for quantitative dynamic multispectral photoacoustic imaging of small animal models

Ph.D. students (co-advisor/mentor):

Ziheng Zhang (advised by Dr. Ghattas, Computational Science, Engineering, and Mathematics, UT Austin, 2022 –): Fast approximation of Hessians arising from inverse problems governed by partial differential equations

Kevin Huang (advised by Dr. Anastasio, Bioengineering, UIUC, 2022 –): Advancing photoacoustic tomography neuroimaging through model-based image reconstruction and learning

Refik Cam (advised by Dr. Anastasio, Electrical & Computer Engineering, 2020 –): Small animal photoacoustic imaging

Fu Li (advised by Dr. Anastasio, Bioengineering, UIUC, 2018 –): Advanced image reconstruction algorithm for 3D accurate and high-resolution breast ultrasound tomography

Tom O'Leary-Roseberry (advised by Dr. Ghattas, Computational Science, Engineering, and Mathematics, UT Austin, 2020): *Efficient and dimension independent methods for neural network surrogate construction and training*

Amal Alghamdi (advised by Dr. Ghattas, Computational Science, Engineering, and Mathematics, UT Austin, 2020): *Bayesian inverse problems for quasi-static poroelasticity with application to ground water aquifer characterization from geodetic data*

Tao Ge (**rotation supervisor**, Electrical & Systems Engineering, WUSTL, Spring 2019): *Proximal Newton Methods for Inverse Problems with Non-Smooth Regularization Term*

C. S. Lee (**Summer Internship co-supervisor** with Dr. Vassilevski, LLNL, 2014): spectral upscaling method for mixed formulation of Darcy equation

M. Christensen (**Summer Internship co-supervisor** with Dr. Vassilevski, LLNL, 2013 & 2014): mixed finite element methods and numerical upscaling with application to subsurface flow and petroleum engineering

S. Ladenheim (**Summer Internship co-supervisor** with Dr. Vassilevski, LLNL, 2013): generation of Gaussian random field by solving stochastic PDEs

D. Emerson (**Summer Internship co-supervisor** with Dr. Vassilevski, LLNL, 2013): nonlinear multilevel methods

M.S. students:

Venugopal Ranganathan (**MS thesis co-supervisor** with Dr. Ghattas, Computational Science, Engineering and Mathematics, UT Austin, 2024): *hIPPYlibx: Solving inverse problems in hIPPYlib and FEniCSx*

Karan Prakash Hiranandani (**MS report co-supervisor** with Dr. Ghattas, Computational Science, Engineering and Mathematics, UT Austin, 2023): *hIPPYfire: Solving inverse problems in hIPPYlib and Firedrake*

Joseph Kuo (advised by Dr. Anastasio, Electrical & Computer Engineering, 2022): *Advancing Photoacoustic Neuroimaging Through Deep Learning*

Ricardo Qiu (**advisor**, Computer Science Engineering, WUSTL, 2021): *Data-driven approaches to solve inverse problems*

Argho Dattas (*Research fellowship mentor*, Electrical & Systems Engineering, WUSTL, Spring 2020): *Learning adversarial regularizers for the solution of inverse problems*

Jieqiong Xiao (*Research fellowship mentor*, Computer Science Engineering, WUSTL, Spring 2020): *ADLA: Automatic differentiation and local assembly of exotic finite element variational forms in MFEM*

Di Liu (advised by Dr. Ghattas, Computational Science, Engineering and Mathematics, UT Austin, 2017): *hIPPYLearn: An inexact Stochastic Newton-CG method for training neural networks*

Ge Gao (advised by Dr. Ghattas, Computational Science, Engineering and Mathematics, UT Austin, 2017): *hIPPYLearn: An inexact Newton-CG method for training neural networks with analysis of the Hessian*

Undergraduate students' mentored research:

Thomas Wynn (**Summer internship**, UT Austin, Summer 2023): *Photoacoustic computed tomography imaging models*

Luke Lozenski (**Independent Study Supervisor**, Electrical & Systems Engineering, WUSTL, Summer 2019): *Learning forward modeling error in Photoacoustic tomography reconstruction*

Argho Datta (**Independent Study Supervisor**, Biomedical Engineering, WUSTL, Spring 2019): *Proximal Newton Methods for Medical Imaging*

Bassel Saleh (advised by Dr. Ghattas, Turing Scholars Honors thesis, UT Austin, 2018): *Scientific Machine Learning: A Neural Network-Based Estimator for Forward Uncertainty Quantification*

Bassel Saleh (**co-supervised** with Dr. Ghattas, Moncrief Undergraduate Summer Internship, UT Austin, 2016): *Neural Networks as Surrogate Models for Forward and Inverse Problems*

PUBLICATIONS

Peer-Reviewed Journal Articles

Publications with a leading role (first author, last author, equal contributions by all authors)[1]

Delyan Z Kalchev, Panayot S Vassilevski, and Umberto Villa. "Parallel Element-based Algebraic Multigrid for H(curl) and H(div) Problems Using the ParELAG Library". *SIAM Journal on Scientific Computing*, 2023.

Ki-Tae Kim, Umberto Villa, Matthew Parno, Youssef Marzouk, Omar Ghattas, and Noemi Petra. "hIPPYlib-MUQ: A Bayesian Inference Software Framework for Integration of Data with Complex Predictive Models under Uncertainty". *ACM Trans. Math. Softw.*, 2023.

Fu Li, Umberto Villa, Seonyeong Park, and Mark A Anastasio. "Three-dimensional stochastic numerical breast phantoms for enabling virtual imaging trials of ultrasound computed tomography". *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control*, 69(1):135–146, 2022.

Luke Lozenski, Mark A. Anastasio, and Umberto Villa. "A Memory-Efficient Self-Supervised Dynamic Image Reconstruction Method Using Neural Fields". *IEEE Transactions on Computational Imaging*, 8:879–892, 2022.

O. Babaniyi, R. Nicholson, U. Villa, and N. Petra. "Inferring the basal sliding coefficient field for the Stokes ice sheet model under rheological uncertainty". *The Cryosphere*, 15(4):1731–1750, 2021.

H. R. Fairbanks, U. Villa, and P. S. Vassilevski. "Multilevel Hierarchical Decomposition of Finite Element White Noise with Application to Multilevel Markov Chain Monte Carlo". *SIAM Journal on Scientific Computing*, 43(5):S293–S316, 2021.

U. Villa, N. Petra, and O. Ghattas. "hIPPYlib: An Extensible Software Framework for Large-Scale Inverse Problems Governed by PDEs; Part I: Deterministic Inversion and Linearized Bayesian Inference". *ACM Trans. Math. Softw.*, 47(2), April 2021.

B. Kramer, A. N. Marques, B. Peherstorfer, U. Villa, and K. Willcox. "Multifidelity probability estimation via fusion of estimators". *Journal of Computational Physics*, 392:385–402, 2019.

M. Christensen, P. S. Vassilevski, and U. Villa. "Nonlinear Multigrid solvers exploiting AMGe coarse spaces with approximation properties". *Journal of Computational and Applied Mathematics*, 340:691 – 708, 2018.

U. Villa, N. Petra, and O. Ghattas. "hIPPYlib: an Extensible Software Framework for Large-scale Deterministic and Bayesian Inverse Problems". *Journal of Open Source Software*, 3(30):940, 2018.

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 Journal on Scientific Computing*, 39(1):B102–B137, 2017.

S. Osborn, P. S. Vassilevski, and U. Villa. "A Multilevel Hierarchical Sampling Technique for Spatially Correlated Random Fields". *SIAM Journal on Scientific Computing*, 39(5):S543–S562, 2017.

P. S. Vassilevski and U. Villa. "A mixed formulation for the Brinkman problem". *SIAM Journal on Numerical Analysis*, 52(1):258–281, 2014.

P. S. Vassilevski and U. Villa. "A block-diagonal algebraic multigrid preconditioner for the Brinkman problem". *SIAM Journal on Scientific Computing*, 35(5):S3–S17, 2013.

A. Veneziani and U. Villa. "ALADINS: An ALgebraic splitting time ADaptive solver for the Incompressible Navier–Stokes equations". *Journal of Computational Physics*, 238:359–375, 2013.

Publications with significant contributions as co-author

Fu Li, Umberto Villa, Nebojsa Duric, and Mark A. Anastasio. "A forward model incorporating elevation-focused transducer properties for 3D full-waveform inversion in ultrasound computed tomography". *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control, accepted for publication*, 2023.

Baoshan Liang, Jingye Tan, Luke Lozenski, David A Hormuth II, Thomas E Yankeelov, Umberto Villa, and Danial Faghihi. "Bayesian Inference of Tissue Heterogeneity for Individualized Prediction of Glioma Growth". *IEEE Transactions on Medical Imaging*, Early Access:11, 2023.

Ruanui Nicholson, Noemi Petra, Umberto Villa, and Jari P. Kaipio. "On global normal linear approximations for nonlinear Bayesian inverse problems". *Inverse Problems*, 2023.

[1] Order of authors does not always reflect level of contributions. Depending on the field, in some publications, authors are ordered alphabetically or by level of seniority (students firsts, postdoc and research scientists next, professors at last).

Thomas O'Leary-Roseberry, Peng Chen, Umberto Villa, and Omar Ghattas. "Derivative Informed Neural Operator: An Efficient Framework for High-Dimensional Parametric Derivative Learning". page 112555, 2023.

Seonyeong Park, Umberto Villa, Refik Mert Cam, Alexander Oraevsky, and Mark Anastasio. "Stochastic three-dimensional numerical phantoms to enable computational studies in quantitative optoacoustic tomography of breast cancer". *Journal of Biomedical Optics*, 28(6):066002, 2023.

Weimin Zhou, Umberto Villa, and Mark A. Anastasio. "Ideal Observer Computation by use of Markov-Chain Monte Carlo with Generative Adversarial Networks". *IEEE Transactions on Medical Imaging*, 2023.

Joseph Kuo, Jason Granstedt, Umberto Villa, and Mark A. Anastasio. "Computing a Projection Operator onto the Null Space of a Linear Imaging Operator: Tutorial". *Journal of the Optical Society of America A*, 39:470–481, 2022.

Jeonghun J Lee, Tan Bui-Thanh, Umberto Villa, and Omar Ghattas. "Forward and inverse modeling of fault transmissibility in subsurface flows". *Computers & Mathematics with Applications*, 128:354–367, 2022.

T. O'Leary-Roseberry, U. Villa, P. Chen, and O. Ghattas. "Derivative-Informed Projected Neural Networks for High-Dimensional Parametric Maps Governed by PDEs". *Computer Methods in Applied Mechanics and Engineering*, 388:114199, 2022.

Simone Puel, Eldar Khattatov, Umberto Villa, Dunyu Liu, Omar Ghattas, and Thorsten W Becker. "A Mixed, Unified Forward/Inverse Framework for Earthquake Problems: Fault Implementation and Coseismic Slip Estimate". *Geophysical Journal International*, 230:733–758, 2022.

A Alghamdi, M. Hesse, J. Chen, U. Villa, and O. Ghattas. "Bayesian Poroelastic Aquifer Characterization from InSAR Surface Deformation Data Part II: Quantifying the Uncertainty". *Water Resources Research*, 57(11):e2021WR029775, 2021.

P. Chen, U. Villa, and O. Ghattas. "Taylor approximation and variance reduction for PDE-constrained optimal control under uncertainty". *Journal of Computational Physics*, 385:163–186, 2019.

N. Alger, U. Villa, T. Bui-Thanh, and O. Ghattas. "A data scalable augmented Lagrangian KKT preconditioner for large scale inverse problems". *SIAM Journal on Scientific Computing*, 39(5):A2365–A2393, 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 Journal on Scientific Computing*, 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.

K. W. Desmond, U. Villa, M. Newey, and W. Losert. "Characterizing the rheology of fluidized granular matter". *Physical Review E*, 88(3):032202, 2013.

Other publications

Kevin Lanza, Melody Alcazar, Casey P Durand, Deborah Salvo, Umberto Villa, and Harold W Kohl. "Heat-Resilient Schoolyards: Relations Between Temperature, Shade, and Physical Activity of Children During Recess". *Journal of Physical Activity and Health*, 1(aop):1–8, 2022.

Seonyeong Park, Frank Brooks, Umberto Villa, Richard Su, Mark Anastasio, and Alexander Oraevsky. "Normalization of optical fluence distribution for three-dimensional functional optoacoustic tomography of the breast". *Journal of Biomedical Optics*, 27, 2022.

Jingye Tan, Pedram Maleki, Lu An, Massimigliano Di Luigi, Umberto Villa, Chi Zhou, Shenqiang Ren, and Danial Faghihi. "A Predictive Multiphase Model of Silica Aerogels for Building Envelope Insulations". *Computational Mechanics*, 69:1457–1479, 2022.

D. Faghihi, J. Tan, U. Villa, N. Shamsaei, S. Shao, and H. Zbib. "A Predictive Discrete-Continuum Multiscale Model of Plasticity With Quantified Uncertainty". *International Journal of Plasticity*, 138:102935, 2021.

A. Jáuregui, D. Salvo, A. García-Olvera, U. Villa, M. M. Téllez-Rojo, L. M. Schnaas, K. Svensson, E. Oken, R. O. Wright, A. A. Baccarelli, and A. Cantoral. "Physical activity, sedentary time and cardiometabolic health indicators among Mexican children". *Clinical Obesity*, page e12346, 2019.

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". *Numerical Linear Algebra with Applications*, 25(3):e2146, 2018.

P. Chen, U. Villa, and O. Ghattas. "Hessian-based adaptive sparse quadrature for infinite-dimensional Bayesian inverse problems". *Computer Methods in Applied Mechanics and Engineering*, 327:147–172, 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.

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. Numerical Methods in Biomedical Engineering*, 29(11):1192–1213, 2013.

Conference Proceedings

Refik Mert Cam, Chao Wang, Seonyeong Park, Weylan Thompson, Sergey A. Ermilov, Mark A. Anastasio, and Umberto Villa. "Dynamic image reconstruction to monitor tumor vascular perfusion in small animals using 3D photoacoustic computed-tomography imagers with rotating gantries". In Alexander A. Oraevsky and Lihong V. Wang, editors, *Photons Plus Ultrasound: Imaging and Sensing 2023*, volume 12379, page 123790F. International Society for Optics and Photonics, SPIE, 2023.

Refik Mert Cam, Chao Wang, Weylan Thompson, Sergey A. Ermilov, Mark A. Anastasio, and Umberto Villa. "Low-rank matrix estimation-based spatiotemporal image reconstruction from few tomographic measurements per frame for dynamic photoacoustic computed tomography". In Lifeng Yu, Rebecca Fahrig, and John M. Sabol, editors, *Medical Imaging 2023: Physics of Medical Imaging*, volume 12463, page 124630R. International Society for Optics and Photonics, SPIE, 2023.

Gangwon Jeong, Fu Li, Umberto Villa, and Mark Anastasio. "A deep learning-based image reconstruction method for USCT that employs multimodality inputs". In Christian Boehm and Nick Bottenus, editors, *Medical Imaging 2023: Ultrasonic Imaging and Tomography*, volume 12470, page 124700M. International Society for Optics and Photonics, SPIE, 2023.

Fu Li, Umberto Villa, Nebojsa Duric, and Mark Anastasio. "3D full-waveform inversion in ultrasound computed tomography employing a ring-array". In Christian Boehm and Nick Bottenus, editors, *Medical Imaging 2023: Ultrasonic Imaging and Tomography*, volume 12470, page 124700K. International Society for Optics and Photonics, SPIE, 2023.

Luke Lozenski, Hanchen Wang, Brendt Wohlberg, Umberto Villa, and Youzou Lin. "Data driven methods for ultrasound computed tomography". In Lifeng Yu, Rebecca Fahrig, and John M. Sabol, editors, *Medical Imaging 2023: Physics of Medical Imaging*, volume 12463, page 124630Q. International Society for Optics and Photonics, SPIE, 2023.

Seonyeong Park, Umberto Villa, Alexander Oraevsky, and Mark Anastasio. "Numerical investigation of impact of skin phototype on three-dimensional optoacoustic tomography of the breast". In Alexander A. Oraevsky and Lihong V. Wang, editors, *Photons Plus Ultrasound: Imaging and Sensing 2023*, volume PC12379, page PC123790E. International Society for Optics and Photonics, SPIE, 2023.

Albert Zhai, Joseph Kuo, Mark Anastasio, and Umberto Villa. "Memory-efficient self-supervised learning of null space projection operators". In Lifeng Yu, Rebecca Fahrig, and John M. Sabol, editors, *Medical Imaging 2023: Physics of Medical Imaging*, volume 12463, page 124631I. International Society for Optics and Photonics, SPIE, 2023.

Refik Cam, Umberto Villa, and Mark Anastasio. "A Learned Filtered Backprojection Method for use with Half-Time Circular Radon Transform Data". In *Medical Imaging 2022: Physics of Medical Imaging*, volume 12031, pages 787–792. International Society for Optics and Photonics, SPIE, 2022.

Jason Granstedt, Umberto Villa, and Mark Anastasio. "Learned Hotelling Observers for use with Multi-Modal Data". In *Medical Imaging 2022: Image Perception, Observer Performance, and Technology Assessment*, volume 12035, pages 262–268. International Society for Optics and Photonics, SPIE, 2022.

Fu Li, Umberto Villa, Neb Duric, and Mark A. Anastasio. "Investigation of an elevationally focused transducer model for three-dimensional full-waveform inversion in ultrasound computed tomography". In *Medical Imaging 2022: Ultrasonic Imaging and Tomography*, volume 12038, pages 206–214. International Society for Optics and Photonics, SPIE, 2022.

Luke Lozenski, Mark Anastasio, and Umberto Villa. "Implicit Neural Representation for Dynamic Imaging". In *Medical Imaging 2022: Physics of Medical Imaging*, volume 12031, pages 231–238. International Society for Optics and Photonics, SPIE, 2022.

Joseph Kuo, Jason Granstedt, Umberto Villa, and Mark A. Anastasio. "Learning a projection operator onto the null space of a linear imaging operator". In Hilde Bosmans, Wei Zhao, and Lifeng Yu, editors, *Medical Imaging 2021: Physics of Medical Imaging*, volume 11595, pages 1019 – 1025. International Society for Optics and Photonics, SPIE, 2021.

Fu Li, Umberto Villa, Seonyeong Park, Shenghua He, and Mark A. Anastasio. "A framework for ultrasound computed tomography virtual imaging trials that employs anatomically realistic numerical breast phantoms". In Brett C. Byram and Nicole V. Ruiter, editors, *Medical Imaging 2021: Ultrasonic Imaging and Tomography*, volume 11602. International Society for Optics and Photonics, SPIE, 2021.

Seonyeong Park, Umberto Villa, Frank J. Brooks, Richard Su, Alexander A. Oraevsky, and Mark A. Anastasio. "Three-dimensional quantitative functional optoacoustic tomography to estimate vascular blood oxygenation of the breast". In Alexander A. Oraevsky and Lihong V. Wang, editors, *Photons Plus Ultrasound: Imaging and Sensing 2021*, volume 11642. International Society for Optics and Photonics, SPIE, 2021.

Chao Wang, Umberto Villa, Weylan Thompson, Seonyeong Park, Sergey A. Ermilov, and Mark A. Anastasio. "Dynamic reconstruction of three-dimensional photoacoustic tomography from few projections". In Alexander A. Oraevsky and Lihong V. Wang, editors, *Photons Plus Ultrasound: Imaging and Sensing 2021*, volume 11642. International Society for Optics and Photonics, SPIE, 2021.

T. Ge, U. Villa, U. S. Kamilov, and J. A. O'Sullivan. "Proximal Newton Methods for X-Ray Imaging with Non-Smooth Regularization". In *Proc Electronic Imaging*. Society for Imaging Science and Technology, 2020.

Seonyeong Park, Umberto Villa, Richard Su, Alexander Oraevsky, Frank J. Brooks, and Mark A. Anastasio. "Realistic three-dimensional optoacoustic tomography imaging trials using the VICTRE breast phantom of FDA (Conference Presentation)". In Alexander A. Oraevsky and Lihong V. Wang, editors, *Photons Plus Ultrasound: Imaging and Sensing 2020*, volume 11240. International Society for Optics and Photonics, SPIE, 2020.

P. Chen, U. Villa, and O. Ghattas. "Taylor approximation for PDE-constrained optimization under uncertainty: Application to turbulent jet flow". In *Proceedings in Applied Mathematics and Mechanics - 89th GAMM Annual Meeting*, volume 18, page e201800466. 2018.

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 Tradeoffs 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.

Preprints

Refik M Cam, Chao Wang, Weylan Thompson, Sergey A Ermilov, Mark A Anastasio, and Umberto Villa. "Spatiotemporal Image Reconstruction to Enable High-Frame Rate Dynamic Photoacoustic Tomography with Rotating-Gantry Volumetric Imagers". *arXiv preprint arXiv:2310.00529*, 2023.

Luke Lozenski, Hanchen Wang, Fu Li, Mark Anastasio, Brendt Wohlberg, Youzuo Lin, and Umberto Villa. "Learned Full Waveform Inversion Incorporating Task Information for Ultrasound Computed Tomography". *arXiv preprint arXiv*, 2023.

Simone Puel, Thorsten W Becker, Umberto Villa, Omar Ghattas, and Dunyu Liu. "An adjoint-based optimization method for jointly inverting heterogeneous material properties and fault slip from earthquake surface deformation data". 2023.

Luke Lozenski and Umberto Villa. "Consensus ADMM for Inverse Problems Governed by Multiple PDE Models". *arXiv preprint arXiv:2104.13899*, 2021.

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.

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

Low-Rank Matrix Estimation-Based Spatiotemporal Image Reconstruction for 4D Photoacoustic Computed Tomography , SIAM Conference on Optimization, May 31- June 2, 2023, Seattle, WA, US

Scalable Laplace Approximation for Bayesian Optimal Experimental Design, 13^{th} International Conference on Monte Carlo Methods, August 16-20, 2021, University of Mannheim, Germany (held virtually)

Curvature Enhanced MCMC Algorithms for Bayesian Inverse Problems Governed by PDEs, SIAM Conference on Computational Science and Engineering, March 1-5, 2021, Dallas, TX, US, held virtually

Proximal Newton Method for Inverse Problems with Non-smooth Regularization Term, SIAM Conference on Imaging Science, July 6-9, 2020, Toronto, Canada, held virtually

Scalable optimal experimental design for large scale non-linear Bayesian inverse problems, Applied Inverse Problems, July 8-12, 2019, Grenoble, France

Scalable Methods for Bayesian Optimal Experimental Design Using Laplace Approximation, SIAM Conference on Computational Science and Engineering, Feb 25- March 1, 2019, Spokane, WA, US

Maximize the Expected Information Gain in Bayesian Experimental Design Problems: a Fast Optimization Algorithm Based on Laplace Approximation and Randomized Eigensolvers, SIAM Conference on Uncertainty Quantification, April 16-19, 2018, Garden Grove, CA, US

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 Computational Science and Engineering, Feb 27-March 3, 2017, Atlanta, GA, US

Bayesian Inverse Problems Governed by Stochastic PDE Models, Joint Mathematics Meetings, January 4-7, 2017, Atlanta, GA, 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 Computational Science and Engineering, March 14-18, 2015, Salt Lake City, UT, 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 Computational Science and Engineering, Feb 25-March 1, 2013, Boston, MA, 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

Bayesian Inference of Fault Properties in Two-phase Porous Media Flow, 56^th Annual Technical Meeting of Society of Engineering Science, October 13-15, 2019, St. Louis, MO, US

hIPPYlib: An Extensible Software Framework for Large-Scale Bayesian Inverse Problems with Quantified Uncertainties, FEniCS Conference, June 12-14, 2019, Washington, D.C., US

hIPPYlib: An Extensible Software Framework for Large-Scale Deterministic and Linearized Bayesian Inverse Problems, Texas Applied Mathematics and Engineering Symposium, Sept. 21–23, 2017, Austin, TX, US

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

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

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

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

Poster presentations

Integrating Data with Complex Predictive Models under Uncertainty: An Extensible Software Framework for Large-Scale Bayesian Inversion, NSF CSSI PI Meeting, 2020, Seattle, Wa, US

Systematic Integration of Data with Models under Uncertainty, 21st Century Imaging Sciences Pathway Annual Retreat, June 7^th, 2019, St. Louis, MO, US

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 24^th, 2014, Livermore, CA, US

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

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

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

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

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

SEMINARS

Dynamic Imaging of Tumor Vascular Perfusion using 4D Photoacoustic Computed Tomography, Scientific Computing Seminars, University of Houston, Houston, TX, April 13^th, 2023, Host *Tsorng-*

Whay Pan

Dynamic Imaging of Tumor Vascular Perfusion using 4D Photoacoustic Computed Tomography, Babuška Forum, Oden Institute, Austin, TX, March 10^{th}, 2023, Host *Dingcheng Luo*

Advancing ultrasound and photoacoustic tomography via virtual imaging trials, Center for Computational Oncology, Oden Institute, Austin, TX, December 7^{th}, 2022, Host *T. Yankeelov*

Three-dimensional stochastic numerical breast phantoms for enabling virtual imaging trials of ultrasound and photoacoustic computed tomography, Department of Mechanical and Aerospace Engineering, University at Buffalo, Buffalo, NY, November 4^{th}, 2021. Host *D. Faghihi*

Quantitative Photoacoustic Tomography: Inversion Algorithms & Challenges, Georgia Tech, Atlanta, GA, June 25^{th}-26^{th}, 2019, *1st Annual Photoacoustic & Florescence Tomography Workshop*

Learning from data through the lens of mathematical models: Bayesian Inverse Problems and Uncertainty Quantification, Department of Mathematics, Emory University, Atlanta, GA, June 24^{th}, 2019. Host *A. Veneziani*

Learning from data through the lens of mathematical models: A gentle introduction to Bayesian Inverse Problems, Mathematics Department, Washington University, St. Louis, MO, January 28^{th}, 2019. Host *J. McCarthy*

Large Scale Inverse Problems and Uncertainty Quantification: Computational Tools and Imaging Applications, Electrical & Systems Engineering, Washington University, St. Louis, MO, January 24^{th}, 2019. Host *J. O'Sullivan*

Numerical Upscaling and Multilevel Monte Carlo, Stanford University, Palo Alto, CA, November 12^{th}, 2014, *Algorithms and Architectures Initiative Annual Meeting.*

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

Towards Scalable Solvers for the Brinkman Problem, Stanford University, Palo Alto, CA, March 4^{th}, 2014. Host *H. Techelepi*

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

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

An Optimal Control Approach for Multiphysics Multimodel Domain Decomposition, Stanford University, Palo Alto, CA, November 7^{th}, 2013. Host *M. Saunders*

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

Schools & workshops by invitation only

Computational Uncertainty Quantification: Mathematical Foundations, Methodology & Data, May 4-8, 2020, Erwin Schroedinger Institute for Mathematics and Physics (ESI), University of Vienna, Vienna, Austria (virtual)

IdeaLab 2015: Inverse Problems and Uncertainty Quantification, July 6-10, 2015, Institute for Computational and Experimental Research in Mathematics (ICERM), 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, Institute for Computational and Experimental Research in Mathematics (ICERM), Brown University, Providence, Rhode Island, US (with travel support from organizers)

Open source scientific software contributions

- Lead developer of hIPPYlib - **I**nverse **P**roblems **Py**thon **lib**rary (`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, `https://github.com/LLNL/parelagmc`)
- Contributor to the finite element library MFEM (`http://mfem.org`)
- Developer of the finite element library LifeV (`www.lifev.org`)

Open source Datasets

Fu Li and Umberto Villa. "3D Numerical Breast Phantoms and Ring-Array USCT measurements (3 rings)". Harvard Dataverse, 10.7910/DVN/8JVLAE, 2023.

Seonyeong Park, Umberto Villa, Fu Li, Refik Cam, Alexander Oraevsky, and Mark Anastasio. "3D optoacoustic numerical breast phantoms and simulated OAT measurement data (hemispherical shape, 4 lesions)". Harvard Dataverse, 10.7910/DVN/AQZE3H, 2023.

Seonyeong Park, Umberto Villa, Fu Li, Refik Cam, Alexander Oraevsky, and Mark Anastasio. "3D optoacoustic numerical breast phantoms and simulated OAT measurement data (natural shape, 2 lesions)". Harvard Dataverse, 10.7910/DVN/OZRVX6, 2023.

Seonyeong Park, Umberto Villa, Fu Li, Refik Cam, Alexander Oraevsky, and Mark Anastasio. "3D optoacoustic numerical breast phantoms and simulated OAT measurement data (natural shape, 4 lesions)". Harvard Dataverse, 10.7910/DVN/1ZF0OW, 2023.

Luke Lozenski, Mark Anastasio, and Umberto Villa. "2D numerical mouse phantom for dynamic photoacoustic tomography virtual imaging studies of small animal models". Harvard Dataverse, 10.7910/DVN/3DXS18, 2022.

Seonyeong Park, Frank Brooks, Umberto Villa, Richard Su, Mark Anastasio, and Alexander Oraevsky. "3D numerical breast phantom: Normalization of optical fluence distribution for 3D functional OAT". Harvard Dataverse, 10.7910/DVN/1FW2I6, 2022.

Fu Li, Umberto Villa, Seonyeong Park, and Mark Anastasio. "2D Acoustic Numerical Breast Phantoms and USCT Measurement Data". Harvard Dataverse, 10.7910/DVN/CUFVKE, 2021.

Fu Li, Umberto Villa, Seonyeong Park, and Mark Anastasio. "3D Acoustic Numerical Breast Phantoms". Harvard Dataverse, 10.7910/DVN/KBYQQ7, 2021.

Service to scientific community

Editorial work

Serving as *editorial board member* of *Numerical Linear Algebra with Applications* since 2018.
Serving as a *reviewer* for the following journals: *SIAM Journal for Uncertainty Quantification*, *SIAM Journal on Scientific Computing* , *SIAM Journal on Imaging Sciences* (SIAM); *Transactions on Medical Imaging*, *Transactions on Computational Imaging*, *IEEE Photonics Journal* (IEEE); *Journal of Biomedical Optics* (SPIE); *Numerical Linear Algebra with Applications*, *International Journal for Numerical Methods in Engineering* (Wiley); *Computational Geosciences*, *Journal of Scientific Computing*, *Numerical Algorithms*, *Advances in Computational Mathematics*, *Numerische Mathematik* (Springer); *Photoacoustics*, *Journal of Mathematical Analysis and Applications*, *SoftwareX* (Elsevier); *Optics Letters* (Optica); *Ultrasonic Imaging* (SAGE); *Journal of Numerical Mathematics* (De Gruyter); *The Journal of Machine Learning for Biomedical Imaging*; *Communications Engineering*, *Scientific Reports* (Nature)

Grant reviews

Served in 1 NSF grant review panel (Office of Advanced Cyberinfrastructure)
Served as reviewer for the Swiss National Science Foundation (1 proposal)

Education and training

Organize and teach the *2018 Gene Golub SIAM Summer School* on *Inverse Problems: Systematic Integration of Data with Models under Uncertainty*, in collaboration with O. Ghattas, Y. Marzouk, M. Parno, N. Petra, and G. Stadler

Minisymposia/conference-session organization

S. Henneking, N. Petra, U. Villa, , O. Ghattas, *Computational tools for large-scale inverse problems and UQ*, SIAM Conference on Uncertainty Quantification, Feb 27 – Mar 1, 2024, Trieste, Italy
D. Faghihi, K. Maupin, A. Tabarraei, U. Villa, *Data-Enabled Predictive Modeling, Machine Learning, and Uncertainty Quantification in Computational Mechanics*, ASME's International Mechanical Engineering Congress & Exposition, Nov 1-4, 2021, *virtual*
D. Faghihi, K. Maupin, A. Tabarraei, U. Villa, *Data-Enabled Predictive Modeling, Machine Learning, and Uncertainty Quantification in Computational Mechanics*, ASME's International Mechanical Engineering Congress & Exposition, Nov 15-19, 2020, *virtual*
U. Villa, O. Ghattas, *Optimal Experimental Design for Bayesian Inverse Problems*, SIAM Conference on Computational Science and Engineering, Feb 25-March 1, 2019, Spokane, WA, US
U. Villa, T. Oliver, N. Petra, O. Ghattas, R. Moser, *Characterizing model inadequacy in Bayesian inference*, SIAM Conference on Uncertainty Quantification, April 16-19, 2018, Garden Grove, CA,

US

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

Departmental & Institutional service

UT Austin, Austin, TX

- Ph.D. thesis committee member: Siva Saket Sripada (BME, *current*)
- Teaching as a service: instructor of a core-curriculum course for the Oden's Institute graduate program in Computational Sciences, Engineering, and Mathematics.

Washington University, St. Louis, MO

- Member of the Ph.D. in Imaging Science curriculum committee (2020-2021)
- Ph.D. thesis committee member: : Tingting Wu (IS, 2023), Austen Curcuru (BME, 2023), Shuying Li (BME, 2023), Uri Goldsztejn (BME, 2022), Eghbal Amidi(BME, 2021), Jingwei Lu (ESE, 2019)[2]
- M.S. thesis committee member: Shangguan Wentao (ESE, 2021), Weiran Wang (ESE, 2019), Shiqi Xu (ESE, 2019)
- Ph.D. qualifying exam committee member: Senyue Hao (ESE, 2022), Tingting Wu (IS, 2020), Zhi Wang (IS, 2020), Soumyendu Ghosh (ESE, 2019), Jiaming Liu (ESE, 2019)
- Supervised undergraduate and master research
- Recruit activities for prospective undergraduate and master students

Lawrence Livermore National Laboratory, Livermore, CA

- Met and interviewed candidates applying for postdoctoral and staff positions

Professional affiliations

SIAM member since 2009.
IEEE member since 2019.

[2]BME=Biomedical Engineering, IS=Imaging Science Ph.D. ESE=Electrical & Systems Engineering