IRINA (KALASHNIKOVA) TEZAUR

Sandia National Laboratories
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EDUCATION

Stanford University, Stanford, CA, USA

Ph.D., Computational & Mathematical Engineering (09/2011)

- Thesis Title: "The Discontinuous Enrichment Method for Multi-Scale Fluid Problems"
- Advisor: Professor Charbel Farhat
- Cumulative GPA: 4.08/4.00

University of Pennsylvania, Philadelphia, PA, USA

M.A., Mathematics (05/2006)

- Thesis Title: "Local Behavior of Harmonic Functions on the Sierpinski Gasket"
- Advisor: Professor Alexandre A. Kirillov
- Cumulative GPA: 4.00/4.00

B.A., Mathematics, minor in Actuarial Mathematics (05/2006)

- *Summa Cum Laude*, *Phi Beta Kappa*, with Distinction in Mathematics
- Advisor: Professor Herman Gluck
- Cumulative GPA: 3.98/4.00, Major GPA: 4.00/4.00

AWARDS & FELLOWSHIPS

Sandia National Laboratories' Public Good Innovator Award for Albany 2.0 (08/2014).

Sandia National Laboratories' Employee Recognition Award (ERA) for work on Quantum Computed Aided Design (QCAD) (09/2012).

Sandia National Laboratories' Early Career Laboratory Directed Research and Development (LDRD): 235K/year, 2 years (06/2012-05/2014).

National Physical Science Consortium (NPSC) Graduate Fellowship (09/2010–09/2011).

U.S. Department of Defense National Defense Science & Engineering Graduate (NDSEG) Fellowship (09/2007–08/2010).

2008 Robert J. Melosh Medal for Best Paper in Finite Element Analysis (04/2008).

RESEARCH EXPERIENCE

Sandia National Laboratories, Albuquerque, NM and Livermore, CA, USA

Principal Member of Technical Staff, Quantitative Modeling & Analysis Department 01/2015–present
Senior Member of Technical Staff, Quantitative Modeling & Analysis Department 09/2014–01/2015
Senior Member of Technical Staff, Computational Mathematics Department 10/2011–09/2014

- Lead developer of Albany code.
- Lead developer of Finite Element for Land Ice eXperiments (FELIX) solver to be integrated into the DOE Earth System Model (ACME) for sea-level rise predictions.
- Lead team member in Aeras next generation atmospheric model LDRD project.
- Lead team member in project aimed to develop novel methods for continuum-to-continuum coupling for multiscale failure.
- Reduced order modeling for compressible flow (Principal Investigator: 06/2012–05/2014).
- Supervise students and post doctoral fellows.

Sandia National Laboratories, Albuquerque, NM, USA

Graduate Technical Research Intern, Aerosciences Department 07/2007–09/2011

- Reduced order modeling of fluid/structure interaction (Mentor: Matthew F. Barone)
- Modeling of Transitional and Fully Turbulent Pressure Fluctuation Loading (Mentor: Lawrence J. DeChant)

Stanford University, Stanford, CA, USA

Research Assistant, under supervision of Prof. Charbel Farhat 09/2006–09/2011

- Developed a multi-scale finite element method for advection-dominated fluid problems, in which the standard Galerkin polynomial finite element field is enriched by the free-space solutions of the governing homogeneous PDE, and inter-element continuity is enforced weakly using Lagrange multipliers.

Additional Graduate Research, under supervision of Prof. James V. Lambers 09/2008–06/2009

- In addition to dissertation work, helped advance the Krylov Subspace Spectral (KSS) method of J.V. Lambers, a high order accurate explicit time integration scheme, to time-dependent PDEs discretized in space by the finite element method (FEM).

University of Pennsylvania, Department of Mathematics, Philadelphia, PA, USA

Masters Thesis Work, under supervision of Prof. Alexandre A. Kirillov 09/2005–05/2006

- Studied the local behavior and differentiability of harmonic functions defined on the Sierpinski gasket.

REFEREED & PUBLISHED ARTICLES

I. Tezaur, R. Tuminaro, M. Perego, A. Salinger, S. Price. "On the scalability of the Albany/FELIX first-order Stokes approximation ice sheet solver for large-scale simulations of the Greenland and Antarctic ice sheets", *Procedia Computer Science, ICCS 2015 International Conference on Computational Science* **51** (2015) 2026–2035.

I. Tezaur, M. Perego, A. Salinger, R. Tuminaro, S. Price. "*Albany/FELIX:* A Parallel, Scalable and Robust Finite Element Higher-Order Stokes Ice Sheet Solver Built for Advanced Analysis", *Geosci. Model Develop.* **8** (2015) 1–24.

I. Kalashnikova, M.F. Barone, S. Arunajatesan, B.G. van Bloemen Waanders. "Construction of Energy-Stable Projection-Based Reduced Order Models", *Appl. Math. Computat.* **249** (2014) 569-596.

I. Kalashnikova, B.G. van Bloemen Waanders, S. Arunajatesan, M.F. Barone. "Stabilization of Projection-Based Reduced Order Models for Linear Time-Invariant Systems via Optimization-Based Eigenvalue Reassignment", *Comput. Meth. Appl. Mech. Engng.* 272 (2014) 251–270.

R. Tezaur, **I. Kalashnikova**. "Discontinuous Enrichment Method for Variable Wavenumber Medium-Frequency Helmholtz Problems", *Comput. Meth. in Appl. Mech. & Engng.* 268 (2014) 126–140.

I. Kalashnikova, M.F. Barone, M.R. Brake. "A Stable Reduced Order Model for Coupled Fluid/Structure Interaction Problems", *Int. J. Numer. Engng.* **95**(2) (2013) 121–144.

I. Kalashnikova, M.F. Barone. "Efficient Non-Linear Proper Orthogonal Decomposition (POD)/Galerkin Reduced Order Models with Stable Penalty Enforcement of Boundary Conditions". *Int. J. Numer. Meth. Engng.* **90**(11) (2012) 1337–1362.

I. Kalashnikova, R. Tezaur, C. Farhat. "A Discontinuous Enrichment Method for Variable Coefficient Advection-Diffusion at High Péclet Number". *Int. J. Numer. Meth. Engng.* **87** (2010) 309–335

I. Kalashnikova, M.F. Barone. "On the Stability and Convergence of a Galerkin Reduced Order Model (ROM) of Compressible Flow with Solid Wall and Far-Field Boundary Treatment". *Int. J. Numer. Meth. Engng* **83** (2010) 1345–1375.

C. Farhat, **I. Kalashnikova**, R. Tezaur. "A Higher-Order Discontinuous Enrichment Method for the Solution of High Péclet Advection-Diffusion Problems on Unstructured Meshes". *Int. J. Numer. Meth. Engng* **81** (2010) 604–636.

I. Kalashnikova, C. Farhat, R. Tezaur. "A Discontinuous Enrichment Method for the Solution of Advection-Diffusion Problems in High Péclet Number Regimes". *Fin. El. Anal. Des.* **45** (2009) 238–250.

M.F. Barone, **I. Kalashnikova**, D.J. Segalman, H. Thornquist. "Stable Galerkin Reduced Order Models for Linearized Compressible Flow". *J. Comput. Phys.* **288** (2009) 1932–1946.

MANUSCRIPTS UNDER REVIEW & IN PREPARATION

A.G. Salinger, E. T. Phipps, R.A. Bartlett, G.A. Hansen, **I. Tezaur**, J.T. Ostien, W. Sun, Q. Chen, A. Mota, R.A. Muller, E. Nielsen, X. Gao. "Albany: Using Agile Components to Develop a Flexible, Generic Multiphysics Analysis Code", submitted to *Comput. Sci. Disc.*

M. Balajewicz, **I. Tezaur**, E. Dowell. "Minimal subspace rotation on the Stiefel manifold for stabilization and enhancement of projection-based reduced order models for the compressible Navier-Stokes equations", submitted to to *Comput. Meth. Appl. Mech. Engng.*, available at `http://arxiv.org/abs/1504.06661`.

R. Tuminaro, **I. Tezaur**, M. Perego, A. Salinger. "A Matrix-Dependent Multi-Grid/Algebraic Multi-Grid Approach for Extruded Meshes: Application to Ice Sheet Modeling", in preparation for submission to *SIAM J. Sci. Comput.*

A. Mota, **I. Tezaur**. "The alternating Schwarz method for concurrent multiscale coupling", in preparation for submission to *Comp. Mech.*

I. Demeshko, W. Spotz, **I. Tezaur**. "Towards Architecture Aware, Performance Portable Finite Element-based Albany Code", in preparation for submission to *J. HPC Appl.*

J. Fike, W. Spotz, **I. Tezaur**. "Embedded Uncertainty Quantification in Aeras, a Next-Generation Global Atmosphere Model", in preparation.

CONFERENCE PAPERS & TECHNICAL REPORTS

I. Kalashnikova, S. Arunajatesan, M.F. Barone, B. van Bloemen Waanders, J.A. Fike. "Reduced Order Modeling for Prediction and Control of Large-Scale Systems". *Sandia National Laboratories Report, SAND No. 2013-4693.* Sandia National Laboratories, Albuquerque, NM (2014).

E. Nielsen, X. Gao, **I. Kalashnikova**, R.P. Muller, A.G. Salinger, R.W. Young. "QCAD Simulation and Optimization of Semiconductor Double Quantum Dots". *Sandia National Laboratories Report, SAND No. 2013-10575.* Sandia National Laboratories, Albuquerque, NM (2013).

I. Kalashnikova, M.F. Barone, S. Arunajatesan, B.G. van Bloemen Waanders. "Construction of Energy-Stable Galerkin Reduced Order Models". *Sandia National Laboratories Report, SAND No. 2013-4063.* Sandia National Laboratories, Albuquerque, NM (2013).

I. Kalashnikova, S. Arunajatesan. "A Stable Galerkin Reduced Order Model (ROM) for Compressible Flow". *WCCM-2012-18407, 10th World Congress on Computational Mechanics (WCCM)*, Sao Paulo, Brazil (07/2012).

I. Kalashnikova, M.F. Barone. "Stable and Efficient Galerkin Reduced Order Model for Non-Linear Fluid Flow". *AIAA Paper No. 2011–3110, 6th AIAA Theoretical Fluid Mechanics Conference*, Honolulu, HI (06/2011).

M.F. Barone, **I. Kalashnikova**, M.R. Brake, D.J. Segalman. "Reduced Order Modeling of Fluid/Structure Interaction". *Sandia National Laboratories Report, SAND No. 2009-7189.* Sandia National Laboratories, Albuquerque, NM (2009).

M.F. Barone, D.J. Segalman, H. Thornquist, **I. Kalashnikova**. "Galerkin Reduced Order Models for Compressible Flow with Structural Interaction". *AIAA Paper No. 2008–0612 , 46th AIAA Aerospace Science Meeting and Exhibit*, Reno, NV (01/2008).

TALKS & PRESENTATIONS

I. Tezaur, M. Balajewicz. "A Minimal Subspace Rotation approach for stabilizing and fine-tuning projection-based reduced order models for fluid applications", West Coast ROM Day, Sandia National Laboratories, Livermore, CA, USA, November 19, 2015 (invited).

I. Tezaur. "Computational Methods in Ice Sheet Modeling for Next-Generation Climate Simulations", Civil & Environmental Engineering Seminar, Duke University, Durham, NC, USA, November 16, 2015 (invited).

I. Tezaur, A. Salinger, M. Perego, J. Jakeman, M. Eldred, I. Demeshko, R. Tuminaro, S. Price. "Albany/FELIX: A Robust and Scalable Trilinos-Based Finite-Element Ice Flow Dycore Built for Advanced Architectures and Analysis", International Congress on Industrial and Applied Mathematics (ICIAM) 2015, Beijing, China, August 10–14, 2015 (invited).

M. Balajewicz, **I. Tezaur**. "Stabilization and fine-tuning of projection-based reduced order models for compressible flow via minimal subspace rotation on the Stiefel manifold", International Congress on Industrial and Applied Mathematics (ICIAM) 2015, Beijing, China, August 10–14, 2015 (invited).

I. Tezaur, R. Tuminaro, M. Perego, A. Salinger, S. Price. "On the Scalability of the Albany/FELIX First-Order Stokes Approximation Ice Sheet Solver for Large-Scale Simulations of the Greenland and Antarctic Ice Sheets", International Conference on Computational Science (ICCS) 2015, Reykjavik, Iceland, June 1–3, 2015 (invited).

I. Tezaur, B. van Bloemen Waanders, S. Arunajatesan, M. Barone, J. Fike. "Stabilization of Projection-Based Reduced Order Models via Optimization-Based Eigenvalue Reassignment", 1st Pan-American Congress on Computational Mechanics (PANACM) 2015, Buenos Aires, Argentina, April 27–29, 2015 (invited).

I. Tezaur, A. Salinger, M. Perego, R. Tuminaro. "On the Development and Performance of a First Order Stokes Finite Element Ice Sheet Dycore Built Using Trilinos Software Components", SIAM Conference on Computational Science & Engineering (CS&E) , Salt Lake City, Utah, March 13–18, 2015 (invited).

I. Kalashnikova, M. Perego, A. Salinger, R. Tuminaro, S. Price. "Update on the Albany/FELIX First Order Stokes Solver and the CISM-Albany and MPAS-Albany Dycores", CESM Land Ice Working Group Meeting, National Center for Atmospheric Research (NCAR) - Mesa Lab, Boulder, CO, February 2–3, 2015.

I. Kalashnikova, J.A. Fike, M.F. Barone, S. Arunajatesan, B. van Bloemen Waanders. "Approaches for building stable projection-based reduced order models", Reduced-Order Modeling Workshop, Sandia National Laboratories, Livermore, CA, 8/7/2014 (invited).

I. Kalashnikova, J.A. Fike, M.F. Barone, S. Arunajatesan, B. van Bloemen Waanders. "Energy-stable Galerkin reduced order models for nonlinear compressible flow", World Congress on Computational Mechanics (WCCM XI), Barcelona, Spain, 7/20/2014–7/25/2014 (invited).

I. Kalashnikova. "Albany/FELIX: A New Parallel, Scalable and Robust First-Order Stokes Ice Sheet Simulation Code", Technical Seminar, Sandia National Laboratories, Livermore, CA, 7/3/2014.

I. Kalashnikova, A. Salinger, M. Perego, R. Tuminaro, S. Price. "An Update on the Albany/FELIX First Order Stokes Finite Element Solver and Its Coupling to Land Ice Dycores", CESM Annual Workshop, Breckenridge, CO, 6/16/2014–6/19/2014.

I. Kalashnikova, B.G. van Bloemen Waanders, S. Arunajatesan, M.F. Barone. "Stabilized Projection-Based Reduced Order Models for Uncertainty Quantification". SIAM Conference on Uncertainty Quantification (SIAM UQ14), Savannah, GA, 3/30/2014–4/3/2014.

I. Kalashnikova, A. Salinger, M. Perego, R. Tuminaro, S. Price. "The Albany/FELIX First-Order Stokes Dycore". *CESM Land Ice Working Group Meeting*, National Center for Atmospheric Research (NCAR) – Mesa Lab, Boulder, CO, 1/30/2014–1/31/2014.

I. Kalashnikova, A. Salinger, M. Perego, R. Tuminaro, J. Jakeman, M. Eldred. "FELIX: the Albany Ice Sheet Modeling Code". *Albany User Group Meeting*, Sandia National Laboratories, Albuquerque, NM, 1/15/2014.

I. Kalashnikova, B. van Bloemen Waanders, S. Arunajatesan, M.F. Barone, "Stabilization of Galerkin Reduced Order Models (ROMs) for LTI Systems Using Controllers". *SIAM Conference on Control and Its Applications (CT13)*, San Diego, CA, 7/9/2013.

I. Kalashnikova, S. Arunajatesan, B. van Bloemen Waanders. "Energy-Stable Galerkin Reduced Order Models for Prediction and Control of Fluid Systems". *SIAM Conference on Computational Science and Engineering (CSE13)*, Boston, MA, 2/26/2013 (invited).

I. Kalashnikova, A. Salinger, R. Tuminaro. "A new unstructured variable-resolution finite element ice sheet stress-velocity solver within the MPAS/Trilinos FELIX dycore of PISCEES". *CESM Land Ice Working Group Meeting*, National Center for Atmospheric Research (NCAR) - Mesa Lab, Boulder, CO, 2/14/2013.

I. Kalashnikova, S. Arunajatesan. "Towards Feedback Control of Compressible Flows Using Galerkin Reduced Order Models". *Second International Workshop on Model Reduction for Parametrized Systems (MoRePaS II)*, Schloss Reisensburg, Gunzburg, Germany, 10/4/2012.

I. Kalashnikova, S. Arunajatesan. "A Stable Galerkin Reduced Order Model (ROM) for Compressible Flow". *10th World Congress on Computational Mechanics (WCCM)*, Sao Paulo, Brazil, 07/13/2012 (invited).

I. Kalashnikova, R. Tezaur, C. Farhat. "The Discontinuous Enrichment Method for Multi-Scale Fluid Problems". *7th International Congress on Industrial and Applied Mathematics (ICIAM 2011)*, Vancouver, BC, Canada, 07/22/2011.

I. Kalashnikova, M.F. Barone. "Stable and Efficient Galerkin Reduced Order Models for Non-Linear Fluid Flow". *6th AIAA Theoretical Fluid Mechanics Conference"*, Honolulu, HI, 06/27/2011.

I. Kalashnikova, R. Tezaur, C. Farhat. "The Discontinuous Enrichment Method for Advection-Dominated Transport Phenomena in Computational Fluid Dynamics". *10th Bay Area Scientific Computing Day (BASCD 2011)*, Institute for Computational & Mathematical Engineering, Stanford University, Stanford, CA, 05/08/2011 (invited).

I. Kalashnikova, R. Tezaur, C. Farhat. "Recent Extensions of the Discontinuous Enrichment Method to Variable-Coefficient Advection-Diffusion Problems in the High Péclet Regime". *16th International Conference on Finite Elements in Flow Problems (FEF 2011)*, Munich, Germany, 03/23–25/2011.

I. Kalashnikova. "A Discontinuous Enrichment Method (DEM) for Advection-Dominated Fluid Problems". *Aerosciences Department Seminar*, Sandia National Laboratories, Albuquerque, NM, 08/23/2010.

I. Kalashnikova, C. Farhat, R. Tezaur. "Recent extensions of the discontinuous enrichment method (DEM) to advection-dominated fluid mechanics problems" (Poster and Presentation). *10th U.S. National Congress on Computational Mechanics (USNCCM-X)*, Ohio State University, Columbus, OH, 07/16/2009.

I. Kalashnikova. "A Discontinuous Enrichment Method for the Solution of the Advection-Diffusion Equation". *Robert J. Melosh Medal Competition for the Best Student Paper on Finite Element Analysis*, Department of Civil and Environmental Engineering, Duke University, Durham, NC, 04/25/2008.

POSTER PRESENTATIONS

I. Tezaur, M. Perego, R. Tuminaro, A. Salinger, J. Jakeman, M. Eldred, L. Ju, T. Zhang, M. Gunzburger, S. Price. "Progress on the PISCEES FELIX Ice Sheet Dynamical Cores". *SciDAC Principal Investigator Meeting*, Hyatt Regency Bethesda, Bethesda, MD (July 2015).

I. Kalashnikova, D. Martin, S. Price. "Ice sheet dynamical core development for PISCEES". *SciDAC Principal Investigator Meeting*, Hilton Executive Meeting Center, Rockville, MD (July 2013).

A.G. Salinger, **I. Kalashnikova**, M. Perego, R.S. Tuminaro, M.S. Eldred, J.D. Jakeman. "Rapid development of an ice sheet climate application using the component-based approach". *CIS External Review*, Sandia National Laboratories, Albuquerque, NM (May 2013).

I. Kalashnikova, C Farhat, R. Tezaur. "Recent extensions of the discontinuous enrichment method (DEM) to advection-dominated fluid mechanics problems". *10th U.S. National Congress on Computational Mechanics (USACM)*, Ohio State University, Columbus, OH (July 2009).

RESEARCH ADVISING & MENTORING

Syuzanna Sargsyan, Graduate Technical Intern, Quantitative Modeling & Analysis Department, Sandia National Laboratories, Livermore, CA, USA (06–09/2015).

Oksana Guba, Contractor and Postdoctoral Fellow, Optimization & UQ Department, Sandia National Laboratories, Albuquerque, NM, USA (01/2015–present).

Irina Demeshko, Postdoctoral Fellow, Scalable Algorithms Department, Sandia National Laboratories, Albuquerque, NM, USA (08/2013–present).

Jeffrey A. Fike, Graduate Technical Intern and Postdoctoral Fellow, Component Science and Mechanics Department, Sandia National Laboratories, Albuquerque, NM, USA (06/2013–08/2013, 04/2014–present).

COMPUTER SOFTWARE & LANGUAGES: C++, Fortran, MPI, Trilinos, Python, MATLAB, Maple, LaTeX, Unix, HTML, *Albany 2.0*[1], *Community Ice Sheet Model (CISM 2.0)*[2].

PROFESSIONAL MEMBERSHIPS: Society for Industrial & Applied Mathematics (SIAM), Sigma Xi Scientific Research Society, Society of Women Engineers (SWE), American Institute of Aeronautics & Astronautics (AIAA), American Geophysical Union (AGU).

SERVICE

Reviewer for the following journals: *Finite Elements in Analysis and Design*, *International Journal for Numerical Methods in Fluids*, *International Journal for Numerical Methods in Engineering*, *Journal of Computational Physics*, *Numerical Algorithms*, *World Journal of Modeling and Simulation*, *Journal of Computational & Applied Mathematics*, *Computer Methods in Applied Mechanics and Engineering*, *AIAA Journal*.

Coordinator of the 2010 Stanford University Linear Algebra & Optimization Seminar.

Webmaster, Board Member and Financial Office of the Stanford University's chapter of the Society for Industrial and Applied Mathematics (2009–2011)

Organizer of 2013 Sandia National Laboratories' Computer Science Research Institute (CSRI) summer intern seminar series.

2014 National Defense Science and Engineering Graduate (NDSEG) Fellowship Review Panelist.

Program committee member for workshop entitled "Numerical and computational developments to advance multi-scale Earth System Models" at the *International Conference on Computational Science (ICCS 2015)* conference in Reykjavik, Iceland, June 1–3, 2015.

Organizer of minisymposia at SIAM CS&E 2015, ICCS 2015, ICIAM 2015, SIAM UQ 2016.

UNIVERSITY TEACHING

[1] An open-source multiphysics analysis package based on the Trilinos multiphysics framework and the SCOREC Parallel Unstructured Mesh Infrastructure (PUMI) [https://github.com/gahansen/Albany].

[2] A next-generation ice sheet model that will be used for predicting ice sheet retreat and sea level rise in a warming climate, freely available to the glaciology and climate modeling communities and serves as the ice dynamics component of the Community Earth System Model (CESM) [https://github.com/cism/cism].

Course Reader & Grader, Mathematics Department, Stanford University, Stanford, CA, USA (Fall 2007).

Recitation Instructor, Mathematics Department, University of Pennsylvania, Philadelphia, PA, USA (Fall 2005, Spring 2006).

REFERENCES: Available upon request.