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Principal Member of Technical Staff

Extreme-Scale Data Science Department

Sandia National Laboratories

Kevin Carlberg

My research combines computational mechanics, machine learning, numerical linear algebra, and high-performance computing. The objective is to discover structure in data to drastically reduce the cost of simulating nonlinear dynamical systems at extreme scale.

Research interests

Nonlinear model reduction • Computational mechanics • Machine learning • Numerical linear algebra • High-performance computing • Uncertainty quantification • Numerical optimization • Krylov-subspace methods • Time-parallel methods • Structure-preserving approximations

Positions

2014– **Principal Member of Technical Staff**, Sandia National Laboratories, Livermore, CA.

2011–2014 **Truman Fellow**, Sandia National Laboratories, Livermore, CA.

Education

2006–2011 **Stanford University**, *PhD, Aeronautics & Astronautics*.

PhD Minor: Computational and Mathematical Engineering

Adviser: Charbel Farhat

Thesis: “Model reduction of nonlinear mechanical systems via optimal projection and tensor approximation”

GPA: 4.15/4.0

2005–2006 **Stanford University**, *MS, Aeronautics & Astronautics*.

GPA: 4.21/4.0

Ranked 1st in Aeronautics & Astronautics

2001–2005 **Washington University in St. Louis**, *BS, Mechanical Engineering*.

GPA: 4.0/4.0, summa cum laude

Ranked 1st in School of Engineering & Applied Science

Summary

- 17 publications, including
 - *Featured article, June 2015*, SIAM Journal on Scientific Computing: [6]
 - *#1 most cited paper, 2013*, Journal of Computational Physics: [8]
 - *#2 most cited paper, 2011*, International Journal for Numerical Methods in Engineering: [10]
- 5 research grants funded as Principal Investigator (PI) for \$4.52M total.
- 3 research fellowships, including the Truman Fellowship at Sandia National Laboratories.
- Directly supervised 6 postdocs, 11 PhD candidates, 2 MS candidates, and 2 BS candidates.
- Model-reduction methods implemented in 3 massively parallel computational-mechanics codes.
- Ranked first in:
 - Stanford University Aeronautics & Astronautics MS Class of 2006.
 - Stanford University Aeronautics & Astronautics PhD qualifying exams, 2006.
 - Washington University School of Engineering & Applied Science BS Class of 2005.
- 1 keynote lecture, 21 invited talks, 22 conference talks.

Funding and proposals

- June 2016– **Bayesian inference for seismic wave propagation (PI)**, \$250K total: \$100K (2015), \$150K (2016), Funding source: National Nuclear Security Administration.
- Oct 2015– **Subsystem ROM and UQ for rapid, agile, extreme-scale simulation (PI)**, \$1.53M total: \$494K (2016), \$510K (2017), \$523K (2018), Funding source: Sandia National Laboratories' Laboratory-Directed Research & Development.
- Feb 2015 **Communication-reducing Krylov methods via basis splitting and data-driven inner products (co-PI with Eric DeSturler, Virginia Tech)**, *Successful pre-proposal (selection for full proposal)*, Funding source: Department of Energy Advanced Scientific Computing Research (ASCR) Exploratory Research for Extreme-Scale Science.
- Oct 2014– **Rigorous surrogates for quantifying margins of uncertainty (PI)** , \$780K total: \$230K (2015), \$275K (2016), \$275K (2017), Funding source: National Nuclear Security Administration, Advanced Scientific Computing (ASC), Verification & Validation Methods.
- Oct 2014– **Advanced ROM methods for thermomechanical responses (PI)**, \$1.15M total: \$400K (2015), \$425K (2016), \$325K (2017), Funding source: National Nuclear Security Administration, Advanced Scientific Computing (ASC), Verification & Validation Methods.
- April 2014 **Enabling data exploration and resilience at exascale: In situ distributed dimensionality reduction with next-generation programming models (PI)**, *Successful pre-proposal (selection for full proposal)*, Funding source: Sandia National Laboratories' Laboratory-Directed Research & Development.
- Oct 2011– **Real-time analysis and optimization of high-fidelity nonlinear models via model reduction (PI)**, \$810K total: \$260K (2012), \$290K (2013), \$260K (2014), Funding source: Sandia National Laboratories' Laboratory-Directed Research & Development.

Honors and awards

- 2016 **Keynote speaker**, *Data-driven Model Order Reduction and Machine Learning (MORML 2016)*, March 30–April 1, 2016, University of Stuttgart, Germany.
- 2011–2014 **Truman Fellowship**, Sandia National Laboratories.
- 2008–2010 **National Science Foundation Graduate Research Fellowship**, Stanford University.
- 2008 **CEA-EDF-INRIA Numerical Analysis Summer School Scholarship**, Paris, France.
- 2007 **Nicholas J. Hoff Award**, *ranked 1st in graduating MS class of Aeronautics & Astronautics*, Stanford University.
- 2006 **Ranked 1st of 16 in Aeronautics & Astronautics PhD qualifying exams**, Stanford University.
- 2005–2008 **National Defense Science and Engineering Graduate Fellowship**, Stanford University.
- 2005 **Gustav Mesmer Prize**, *ranked 1st in graduating BS class of Mechanical Engineering*, Washington University in St. Louis.
- 2001–2005 **Calvin L. Woodward Fellowship**, Washington University in St. Louis.
- 2001–2005 **Danforth Scholarship**, Washington University in St. Louis.

Journal publications

Google Scholar citations: 677; h-index: 11; i-10 index: 11

In preparation

- K. Carlberg, M. Khalil, S. Guzzetti, K. Sargsyan. Uncertainty propagation in large-scale networks via domain decomposition, *in preparation*, 2016.
- K. Carlberg, Y. Choi, S. Sargsyan. Structure-preserving nonlinear model reduction for finite-volume models of conservation laws, *in preparation*, 2016.
- S. Trehan, K. Carlberg, L. Durlofsky. Error estimation for surrogate models of dynamical systems using machine learning, *in preparation*, 2016.

Preprints

- [1] K. Carlberg, L. Brencher, B. Haasdonk, and A. Barth. Data-driven time parallelism via forecasting. *arXiv e-print*, (1610.09049), 2016.

Published

- [2] K. Carlberg, M. Barone, and H. Antil. Galerkin v. least-squares Petrov–Galerkin projection in nonlinear model reduction. *Journal of Computational Physics*, accepted, 2016.
- [3] K. Carlberg, V. Forstall, and R. Tuminaro. Krylov-subspace recycling via the POD-augmented conjugate-gradient method. *SIAM Journal on Matrix Analysis and Applications*, 37(3):1304–1336, 2016.
- [4] K. Carlberg, J. Ray, and B. van Bloemen Waanders. Decreasing the temporal complexity for nonlinear, implicit reduced-order models by forecasting. *Computer Methods in Applied Mechanics and Engineering*, 289:79–103, 2015.
- [5] M. Drohmann and K. Carlberg. The ROMES method for statistical modeling of reduced-order-model error. *SIAM/ASA Journal on Uncertainty Quantification*, 3(1):116–145, 2015.
- [6] K. Carlberg, R. Tuminaro, and P. Boggs. Preserving Lagrangian structure in nonlinear model reduction with application to structural dynamics. *SIAM Journal on Scientific Computing*, 37(2):B153–B184, 2015.

Featured article, June 2015, SIAM Journal on Scientific Computing.

- [7] K. Carlberg. Adaptive h -refinement for reduced-order models. *International Journal for Numerical Methods in Engineering*, 102(5):1192–1210, 2015.
- [8] K. Carlberg, C. Farhat, J. Cortial, and D. Amsallem. The GNAT method for nonlinear model reduction: effective implementation and application to computational fluid dynamics and turbulent flows. *Journal of Computational Physics*, 242:623–647, 2013.
#1 most cited paper of 2013, Journal of Computational Physics.
- [9] K. Carlberg and C. Farhat. A low-cost, goal-oriented ‘compact proper orthogonal decomposition’ basis for model reduction of static systems. *International Journal for Numerical Methods in Engineering*, 86(3):381–402, April 2011.
- [10] K. Carlberg, C. Farhat, and C. Bou-Mosleh. Efficient non-linear model reduction via a least-squares Petrov–Galerkin projection and compressive tensor approximations. *International Journal for Numerical Methods in Engineering*, 86(2):155–181, April 2011.

#2 most cited paper of 2011, International Journal for Numerical Methods in Engineering.

- [11] D. Amsallem, J. Cortial, K. Carlberg, and C. Farhat. A method for interpolating on manifolds structural dynamics reduced-order models. *International Journal for Numerical Methods in Engineering*, 80(9):1241–1258, 2009.

Conference proceedings (refereed)

- [12] J. Tencer, K. Carlberg, R. Hogan, and M. Larsen. Reduced order modeling applied to the discrete ordinates method for radiation heat transfer in participating media. *HT 2016-7010, ASME 2016 Summer Heat Transfer Conference, Washington, DC*, July 10–14, 2016.
- [13] K. Carlberg, R. Tuminaro, and P. Boggs. Efficient structure-preserving model reduction for nonlinear mechanical systems with application to structural dynamics. *AIAA Paper 2012-1969, 53rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, Honolulu, HI*, April 23–26, 2012.
- [14] K. Carlberg, J. Cortial, D. Amsallem, M. Zahr, and C. Farhat. The GNAT nonlinear model reduction method and its application to fluid dynamics problems. *AIAA Paper 2011-3112, 6th AIAA Theoretical Fluid Mechanics Conference, Honolulu, HI*, June 27–30, 2011.
- [15] R. Stephan and K. Carlberg. Gappy data reconstruction and applications in archaeology. In *Proceedings of the XXXVIII Annual Conference on Computer Applications and Quantitative Methods in Archaeology, Granada, Spain*, April 6–9, 2010.
- [16] K. Carlberg and C. Farhat. An adaptive POD-Krylov reduced-order model for structural optimization. *8th World Congress on Structural and Multidisciplinary Optimization, Lisbon, Portugal*, June 1–5, 2009.
- [17] K. Carlberg and C. Farhat. A compact proper orthogonal decomposition basis for optimization-oriented reduced-order models. *AIAA Paper 2008-5964, 12th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference, Victoria, Canada*, September 10–12, 2008.

Research codes

My nonlinear model-reduction techniques are implemented in the following massively parallel computational-mechanics codes:

- **AERO-F**, *Computational fluid dynamics*, Stanford University, *Model-reduction implementation*: K. Carlberg (lead), J. Cortial, C. Bou-Mosleh, D. Amsallem.
bitbucket.org/frg/aero-f
- **Albany**, *Multiphysics finite-element analysis*, Sandia National Laboratories, *Model-reduction implementation*: J. Cortial (lead), K. Carlberg.
github.com/gahansen/Albany
- **SPARC**, *Computational fluid dynamics*, Sandia National Laboratories, *Model-reduction implementation*: J. Fike (lead), M. Howard, K. Carlberg, M. Barone, I. Tezaur.

Research advising

Postdoctoral researchers

- May 2016– **Liqian Peng**, *Postdoctoral researcher*, Sandia National Laboratories.
Project: Model reduction for large-scale linear dynamical systems
- Feb 2016– **Chi Hoang**, *Postdoctoral researcher*, Sandia National Laboratories.
Project: Subsystem model reduction
- Dec 2015– **Youngsoo Choi**, *Postdoctoral researcher*, Sandia National Laboratories.
Project: Optimization-based model reduction
- Sept 2014– **Jeffrey Fike**, *Postdoctoral researcher*, Sandia National Laboratories.
 Sept 2016 *Project: Model reduction for thermomechanical responses*
- Oct 2012– **Martin Drohmann**, *Postdoctoral researcher*, Sandia National Laboratories.
 Sept 2014 *Project: Uncertainty quantification for reduced-order models*
- Feb 2012– **Julien Cortial**, *Postdoctoral researcher*, Sandia National Laboratories.
 Nov 2013 *Project: A Trilinos-based module for nonlinear model reduction*

PhD candidates

- June 2016– **Zhe Bai**, *University of Washington*.
Project: Non-intrusive nonlinear model reduction
- June 2016– **Jiahua Jiang**, *University of Massachusetts, Dartmouth*.
Project: Anderson acceleration for domain decomposition methods in uncertainty quantification
- June–Sept 2016 **Hasan Cagan Ozen**, *Columbia University*.
Project: Bayesian inference in large-scale networks
- May 2016– **Kookjin Lee**, *University of Maryland*.
Project: Optimal intrusive uncertainty quantification
- May 2016– **Sofia Guzzetti**, *Emory University*.
Project: Multigrid for accelerating domain decomposition methods in uncertainty quantification
- May 2016– **Wayne Uy**, *Cornell University*.
Project: Bayesian inference with reduced-order-model error surrogates
- June 2015– **Syuzanna Sargsyan**, *University of Washington*.
Project: Reduced-order models for nonlinear compressible fluid dynamics
- May–Aug 2015 **Katarzyna Swirydowicz**, *Virginia Tech*.
Project: Generalized Krylov-subspace methods for extreme-scale architectures
- March 2015– **Matthew Zahr**, *Stanford University*.
Project: Optimization under uncertainty with reduced-order models
- Feb 2015– **Sumeet Trehan**, *Stanford University*.
Project: Automated construction error surrogates via statistical learning
- May 2014– **Virginia Forstall**, *University of Maryland*.
 Sept 2015 *Project: Applying model reduction to Krylov-subspace iterative methods via recycling*

MS candidates

- Fall 2010 **Wade Spurlock**, *Stanford University*.
Project: Visualizing nonlinear model reduction methods for Formula One car design
- Fall 2009 **Paul Covington**, *Stanford University*.
Project: Implementing shape sensitivity analysis in a massively parallel fluid code

BS candidates

- April–Oct 2015 **Lukas Brencher**, *University of Stuttgart*, Germany.
Project: Enabling data-driven time parallelism for reduced-order models
- Summer 2010 **Matthew Zahr**, *University of California, Berkeley*.
Project: Comparing model reduction methods on linear and nonlinear electrical, mechanical, and biological systems. Won “best project” at AHPARC 2010 Summer Institute.

Teaching

- Summer 2009–10 **Instructor and Curriculum Developer**, *Introduction to Engineering Optimization (short course)*, Army High-Performance Computing Research Center Summer Institute, Stanford, CA.
- Spring 2010 **Teaching Assistant**, *Large-Scale Numerical Optimization (CME 338)*, Stanford University, Prof Michael Saunders.
- Spring 2005 **Teaching Assistant**, *Mechanics of Deformable Bodies (ME 241)*, Washington University in St. Louis, Prof Barna Szabó.
- Fall 2004 **Teaching Assistant**, *Mechanics of Deformable Bodies (ME 241)*, Washington University in St. Louis, Prof Barna Szabó.

Service

- 2015– **Conference organizing committee.**
- SIAM Annual Meeting, Boston, MA, July 11–15, 2016.
 - International Conference on Advances in Computational Tools for Engineering Applications, Louaize, Lebanon, July 11–13, 2016.
- 2014– **Workshop organizer.**
- West Coast ROM Workshop, Sandia National Laboratories, Livermore, CA, Nov 19, 2015. *Organizers:* K. Carlberg, D. Amsallem.
 - Bay Area ROM Workshop, Sandia National Laboratories, Livermore, CA, Aug 7, 2014. *Organizer:* K. Carlberg.
- 2012– **Minisymposium organizer.**
- K. Carlberg and M. Yano, “Model reduction in computational fluid dynamics,” 14th U.S. National Congress on Computational Mechanics, Montréal, Canada, July 17–20, 2017.
 - K. Carlberg, F. Lu, and M. Morzfeld, “Numerical methods for uncertainty quantification, surrogate models, and Bayesian inference,” 2017 SIAM Conf on Comp Sci & Eng, Atlanta, GA, February 27–March 3, 2017.
 - K. Carlberg and K. Duraisamy, “Data and Dynamical-System Models,” 2016 SIAM Annual Meeting, Boston, MA, July 11–15, 2016.
 - K. Carlberg and A. Manzoni, “Reduced-Order Modeling in Uncertainty Quantification,” 2016 SIAM Conf on Uncertainty Quantification, Lausanne, Switzerland, April 5–8, 2016.
 - K. Carlberg and G. Rozza, “Recent Advances in Model Reduction,” 2015 SIAM Conf on Comp Sci & Eng, Salt Lake City, UT, March 14–18, 2015.
 - K. Carlberg and D. Kouri, “Model-Reduction Techniques for Quantifying and Controlling Uncertainty,” 2014 SIAM Conf on Uncertainty Quantification, Savannah, GA, March 31–April 3, 2014.
 - K. Carlberg and M. Drohmann, “Error analysis in model reduction,” 2013 SIAM Conf on Comp Sci & Eng, Boston, MA, February 25–March 1, 2013.
 - K. Carlberg, D. Amsallem, and C. Farhat, “Model Order Reductions,” 10th World Congress on Computational Mechanics, São Paulo, Brazil, July 8–13, 2012.
 - K. Carlberg and P. Constantine, “Model reduction for nonlinear dynamical systems,” 2012 SIAM Conf on Uncertainty Quantification, Raleigh, NC, April 2–5, 2012.

2009– **Journal referee.**

- *Computer Methods in Applied Mechanics and Engineering*
- *Computers and Fluids*
- *ESAIM: Mathematical Modelling and Numerical Analysis*
- *International Journal for Numerical Methods in Engineering*
- *International Journal for Numerical Methods in Fluids*
- *Journal of Computational and Applied Mechanics*
- *Journal of Scientific Computing*
- *SIAM Journal on Optimization*
- *SIAM Journal on Scientific Computing*

2015– **Book-proposal reviewer**, *Society for Industrial and Applied Mathematics*.

2015– **Proposal reviewer**, *Air Force Office of Scientific Research*.

2012– **Recruiter**, *Sandia National Laboratories*, Livermore, CA.

2011 **External examiner for postgraduate courses**, *University of Pretoria*, South Africa.

2009–2010 **Student search-committee member**, *Faculty Search Committee*, Stanford University Aeronautics & Astronautics.

Talks (* indicates travel support)

Keynote

- * “Nonlinear model reduction: discrete optimality, h -adaptivity, and error surrogates,” Data-Driven Model Order Reduction and Machine Learning, University of Stuttgart, Stuttgart, Germany, March 30–April 1, 2016.

Invited

1. “Model reduction for nonlinear dynamical systems: discrete optimality and time parallelism,” Mathematical Modelling and Numerical Simulations of Biological Flows Group Seminar, INRIA, Paris, France, November 15, 2016.
2. * “Nonlinear model reduction: discrete optimality, time parallelism, and error surrogates,” Seminar in Applied Mathematics and Statistics, University of California, Santa Cruz, Santa Cruz, California, October 31, 2016.
3. * “Breaking computational barriers via nonlinear model reduction,” National Labs Day, University of California, Merced, Merced, California, October 21, 2016.
4. * “Model reduction for nonlinear dynamical systems: discrete optimality and time parallelism,” Applied and Computational Mathematics Seminar, University of South Carolina, Columbia, South Carolina, October 17, 2016.
5. * “Nonlinear model reduction: discrete optimality and time parallelism,” Absolventen-Seminar, Numerische Mathematik, Technische Universität Berlin, Berlin, Germany, July 27, 2016.
6. * “Recent advances in nonlinear model reduction,” Applied Mathematics Seminar, University of Washington, Seattle, WA, Apr 20, 2016.
7. “Nonlinear model reduction: discrete optimality and time parallelism,” Linear Algebra and Optimization Seminar, Stanford University, Stanford, CA, Nov 12, 2015.
8. “Integrating reduced-order models with uncertainty quantification: modeling and controlling error,” FRG Group Seminar, Stanford University, Stanford, CA, June 9, 2015.
9. * “Statistical modeling and adaptive control of reduced-order-model error in uncertainty quantification,” Numerical Analysis Seminar, University of Maryland, College Park, MD, March 3, 2015.

10. “Modeling and controlling reduced-order-modeling uncertainty in data assimilation,” School of Earth Sciences Seminar, Stanford University, Stanford, CA, Nov 19, 2014.
11. * “Reduced-order modeling in uncertainty quantification: modeling and controlling error,” Applied and Computational Math Seminar, George Mason University, Fairfax, VA, Apr 25, 2014.
12. “The ROMES method for reduced-order-model uncertainty quantification: application to data assimilation,” Workshop on Model Order Reduction and Data, Paris, France, Jan 6, 2014.
13. “The GNAT method for nonlinear model reduction,” Bay Area Scientific Computing Day, Lawrence Berkeley National Lab, Dec 11, 2013.
14. * “Discrete optimality and structure preservation in nonlinear model reduction,” Applied Mathematics Seminar, University of Washington, Seattle, WA, Nov 21, 2013.
15. * “Model reduction for nonlinear fluid dynamics and structural dynamics: discrete optimality and structure preservation,” Mechanical & Aerospace Engineering Colloquium, Cornell University, Ithaca, NY, Oct 8, 2013.
16. “The GNAT method for model reduction of nonlinear dynamical systems,” Applied Mathematics Seminar, University of California, Berkeley, Berkeley, CA, Oct 2, 2013.
17. * “The GNAT method for nonlinear model reduction: discrete optimality, practical implementation, and application to CFD,” Department of Mathematics Colloquium, Virginia Tech, Blacksburg, VA, Apr 19, 2013.
18. “Discrete-optimal nonlinear model reduction by the GNAT method,” ACDL Seminar, Massachusetts Institute of Technology, Boston, MA, Apr 17, 2013.
19. “The GNAT method for nonlinear model reduction: overview and perspectives on UQ application,” Uncertainty Quantification Laboratory Seminar, Stanford University, Stanford, CA, May 3, 2012.
20. “The Gauss–Newton with approximated tensors (GNAT) method for nonlinear model reduction,” SUPRI-B Group Seminar, Stanford University, Stanford, CA, June 1, 2011.
21. “Model reduction-based iterative methods for real-time simulation and repeated analyses of mathematical models,” Linear Algebra and Optimization Seminar, Stanford University, Stanford, CA, Oct 28, 2010.

Conference (excluding proceedings)

1. “Structure-preserving model reduction for finite-volume discretizations of conservation laws,” Recent developments in numerical methods for model reduction, Institut Henri Poincaré, Paris, France, November 7–10, 2016.
2. “Adaptive h -refinement in nonlinear model reduction: capturing moving discontinuities,” 7th European Congress of Mathematics, Berlin, Germany, July 18–22, 2016.
3. “Krylov-subspace recycling via the POD-augmented conjugate gradient method,” SIAM Annual Meeting, Boston, MA, July 11–15, 2016.
4. “Data-driven time parallelism and model reduction,” SIAM Conf on Uncertainty Quantification, Lausanne, Switzerland, April 5–8, 2016.
5. “Applying model reduction to Krylov-subspace recycling: the POD-augmented conjugate-gradient method,” 14th Copper Mountain Conf on Iterative Methods, Copper Mountain, CO, March 20–25, 2016.

6. “Discrete-optimal projection in nonlinear model reduction,” 3rd International Workshop on Reduced Basis, POD and PGD Model Reduction Techniques, Cachan, France, November 4–6, 2015.
7. “Time-parallel reduced-order models via forecasting,” MoRePaS III, Trieste, Italy, October 13–16, 2015.
8. “The ROMES method for statistically quantifying reduced-order model error,” 13th US National Congress on Computational Mechanics, San Diego, CA, July 26–30, 2015.
9. “Discrete optimality in nonlinear model reduction: analysis and application to computational fluid dynamics,” 1st Pan-American Congress on Computational Mechanics, Buenos Aires, Argentina, April 27–29, 2015.
10. “Adaptive h -refinement for reduced-order models via basis splitting,” 2015 SIAM Conf on Comp Sci & Eng, Salt Lake City, UT, March 14–18, 2015.
11. “Bayesian Inference with Reduced-order Models and Statistical Error Estimates,” SIAM Annual Meeting, Chicago, IL, July 7–11, 2014.
12. “Adaptive h -refinement for reduced-order models with application to uncertainty control,” SIAM Conf on Uncertainty Quantification, Savannah, GA, March 31–April 3, 2014.
13. “The GNAT nonlinear model-reduction method with application to large-scale turbulent flows,” Fourth International Workshop on Model Reduction in Reacting Flows (IWMRRF), San Francisco, CA, June 19–21, 2013.
14. “Preserving Lagrangian Structure in Nonlinear Model Reduction,” 2013 SIAM Conf on Comp Sci & Eng, Boston, MA, February 25–March 1, 2013.
15. “A forecasting method for decreasing the temporal complexity in implicit, nonlinear model reduction,” MoRePaS II, Gunzburg, Germany, October 2–5, 2012.
16. “The GNAT method for nonlinear model reduction: recent developments and application to large-scale models,” 10th World Congress on Computational Mechanics, São Paulo, Brazil, July 8–13, 2012.
17. “Decreasing the temporal complexity in nonlinear model reduction,” 2012 SIAM Conf on Uncertainty Quantification, Raleigh, NC, April 2–5, 2012.
18. “Efficient Model Reduction of Large-Scale Nonlinear Systems in Fluid Dynamics,” 2011 SIAM Conf on Comp Sci & Eng, Reno, NV, February 28–March 4, 2011.
19. “Nonlinear model reduction using Petrov–Galerkin projection and data reconstruction,” 2010 SIAM Annual Meeting, Pittsburgh, PA, July 13, 2010.
20. “A proper orthogonal decomposition-based augmented conjugate gradient algorithm for nearby problems,” 2009 SIAM Annual Meeting, Denver, CO, July 7, 2009.
21. “An adaptive POD-Krylov reduced-order modeling framework for repeated analyses problems,” 2009 Joint ASCE–ASME–SES Conf on Mechanics and Materials, Blacksburg, VA, June 27, 2009.
22. “A POD-based iterative solver for fast structural optimization,” Seoul National University–Stanford University Student Joint Workshop, Stanford University, Stanford, CA, June 18, 2009.