Donsub Rim

CONTACT INFORMATION

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RESEARCH INTERESTS

Numerical analysis of partial differential equations (PDEs)

- Nonlinear model reduction of parametrized nonlinear hyperbolic systems of conservation laws using reduced deep networks (RDNs)
- Approximate Discrete Radon transform (ADRT) and its applications, such as dimensional-splitting, sparse representations, dimensionality reduction, and absorbing layers for quasi-periodic hetergeneous media
- Uncertainty quantification (UQ) and inverse problems involving nonlinear hyperbolic PDEs
- Applications in aerospace engineering, geophysics and medical imaging: rocket combustion dynamics, probabilistic tsunami hazard assessment, storm surge prediction, coupled-physics imaging

EMPLOYMENT

Courant Institute, New York University

Postdoctoral Associate July 2019 - Present

Mentor: Benjamin Peherstorfer

Columbia University

Chu Assistant Professor July 2017 - June 2019

EDUCATION

University of Washington

Ph.D. in Applied Mathematics June 2017

Advisors: Randall J. LeVeque and Gunther Uhlmann

Yonsei University

M.Sc in Applied Mathematics August 2012

Advisors: Carsten Carstensen and Eun-Jae Park

B.Sc. in Mathematics, B.B.A. in Business Administration February 2011

PUBLICATIONS & PREPRINTS

1. C. Carstensen, J. Gedicke and D. Rim,
Explicit error estimates for Courant, Crouzeix-Raviart and Raviart-Thomas FEMs,
J. Comput. Math. **30** (2012), pp. 337-353. [urn:nbn:de:0296-matheon-9314]

2. R. J. LeVeque, K. Waagan, F. I. González, D. Rim, and G. Lin,
Generating random earthquake events for probabilistic tsunami hazard assessment (PTHA),
Pure Appl. Geophys. (2016), pp. 1-22. [arXiv:1605.02863]

3. D. Rim,
An elementary proof that symplectic matrices have determinant one,
Adv. Dyn. Syst. Appl. (2017) **12** (1) 15-20. [arXiv:1505.04240]

4. D. Rim, S. Moe, and R. J. LeVeque,
Transport reversal for model reduction of hyperbolic partial differential equations,
SIAM/ASA J. Uncertainty Quantification, (2018) **6** (1), 118-150. [arXiv:1701.07529]

5. L. M. Adams, R. J. LeVeque, D. Rim, and F. I. Gonzalez
Probabilistic Source Selection for the Cascadia Subduction Zone.
Results from a study supported by FEMA Region IX
Technical Report. (2017). [project-report]

6. F. Monard, D. Rim,
   Imaging of isotropic and anisotropic conductivities from power densities in three dimensions,
   Inverse Probl., (2018) **34** (7), 075005. [arXiv:1712.04028]

7. D. Rim, K.T. Mandli,
   Displacement interpolation using monotone rearrangement,
   SIAM/ASA J. Uncertainty Quantification, (2018) **6** (4), 1503-1531. [arXiv:1712.04028]

8. D. Rim,
   Dimensional splitting of hyperbolic PDEs using the Radon transform,
   SIAM J. Sci. Comput. (2018) **40** (6), A4184-A4207. [arXiv:1705.03609]

9. A. Williamson, D. Melgar, D. Rim,
   The Effects of Earthquake Kinematics on Tsunami Propagation
   J. Geophys. Res. Solid Earth (2019) **124** 11639-11650.

10. D. Rim,
    Exact and fast inversion of the approximate discrete Radon transform from partial data,
    Appl. Math. Lett. (2020) **102** 106159. [arXiv:1908.00887]

11. D. Rim, K.T. Mandli,
    Model reduction of a parametrized scalar hyperbolic conservation law using displacement interpolation,
    Preprint. [arXiv:1805.05938]

12. D. Rim, B. Peherstorfer, K.T. Mandli
    Manifold Approximations via Transported Subspaces: Model reduction for transport-dominated problems
    Preprint. [arXiv:1912.13024]

13. D. Rim, L. Venturi, J. Bruna, B. Peherstorfer
    Depth separation for reduced deep networks in nonlinear model reduction: Distilling shock waves in nonlinear hyperbolic problems
    Preprint. [arXiv:2007.13977]

14. A. Williamson, D. Rim, L. Adams, R. J. LeVeque, D. Melgar, F. I. Gonzalez
    A Source Clustering Approach for Efficient Inundation Modeling and Regional Scale PTHA
    Accepted to Frontiers in Earth Science. [EarthArXiv/yreqw]

15. W. Li, K. Ren, D. Rim
    A range characterization of single-quadrant ADRT
    Preprint. [arXiv:2010.05360]

MANUSCRIPTS IN PREPARATION

1. D. Rim, K.T. Mandli, K. Urban
   Displacement interpolation by pieces (DIP): Nonlinear interpolation for model reduction of nonlinear conservation laws
   In preparation.

2. Q. Du, D. Rim,
   Intertwined perfectly matched layers (iPML): Non-local absorbing layers
   In preparation.

3. K. Otness, D. Rim,
   `ADRT`: Approximate Discrete Radon Transform
   In preparation. [github.com/dsrim/adrtc]

4. D. Rim, G. Welper
   Lower bounds for the solution manifold the Kolmogorov N-width of the wave equation.
   In preparation.

Conferences & Workshops

1. KSIAM 2012 Spring Conference, Seoul, South Korea, May 2012
   The inf-sup test for a hybrid DG method (Poster, Best poster award)
2. Computational Methods in Applied Mathematics, Berlin, Germany, August 2012
3. Pacific Northwest Numerical Analysis Seminar, Portland, OR, October 2014
4. CLAWPACK Development Workshop, Salt Lake City, UT, March 2015
5. Pacific Northwest Numerical Analysis Seminar, Bellingham, WA, October 2015
   Inverse diffusion from power densities in dimension three (Poster)
6. SIAM Computational Science and Engineering, Salt Lake City, UT, March 2015
7. CSDMS Annual Meeting, Boulder, CO, May 2016
   Bayesian inversion for tsunami sources using DART buoy measurements (Poster)
8. SIAM Gene Golub Summer School 2016, Philadelphia, PA, July 2016
9. CLAWPACK Development Workshop, Seattle, WA, August 2016
10. WIAS Uncertainty Quantification Summer School, Berlin, Germany, July 2016
11. SIAM Mathematics of Planet Earth, Philadelphia, PA, September 2016
    Performing and communicating probabilistic tsunami hazard assessment (Minisymposium)
12. European Conference on Mathematics for Industry (ECMI), Budapest, Hungary, June 2018
    Model reduction of Burgers' equation using displacement interpolation (Minisymposium)
13. SIAM Annual Meeting, Portland, OR, July 2018
    Dimensionality reduction of wave-like phenomena using monotone rearrangement (Minisymposium)
    Dimensional splitting using the Radon transform (Minisymposium)
14. Approximation Theory and Machine Learning, Purdue University, IN, Sep 2018
    Dimensionality reduction of wave-like phenomena using monotone rearrangement (Poster)
15. Joint Mathematics Meetings, Baltimore, MD, Jan 2019
    Reconstruction of anisotropic conductivites from power densities in three dimensions (Minisymposium)
16. SIAM Conference on Computational Science and Engineering, Spokane, WA, Feb 2019
    Model Reduction of Multi-dimensional Hyperbolic Conservation Laws (Minisymposium)
17. ENUMATH 2019, Egmond Aan Zee, Netherlands, Sep 2019
    Model Reduction of Nonlinear Hyperbolic Problems Using Low-dimensional Transport Modes (Minisymposium)
18. ICERM Workshop 2020, Brown University, RI, Feb 2020
    Manifold Approximations via Transported Subspaces (Poster)

Seminar Talks

1. Inverse Problems Seminar, UW Math
   Approximate Riemann solvers for nonlinear hyperbolic PDEs November 2014
2. Seniors Seminar, PLU Math
   Numerical modeling of tsunamis and its applications October 2016
3. Numerical Analysis Research Club (NARC), UW Applied Math
   - *A brief review of a posteriori error estimators for FEMs* October 2013
   - *An efficient Neumann series algorithm for PAT/TAT with variable sound speed* April 2014
   - *Active subspaces* October 2015
   - *Discrete Radon Transform and its exact inverse* April 2016
   - *Hierarchical tensor decompositions* October 2016
4. Applied Mathematics Colloquium, Columbia University, February 2017

5. Applied Math Seminar, University of Washington, July 2018
6. APAM Math Research Conference, Columbia University, Oct 2018
7. Numerical Analysis Seminar, Universität Ulm, Jan 2019
8. Numerical Analysis and Scientific Computing seminar, Courant Institute, Feb 2019
9. Applied Mathematics Colloquium, Pittsburgh University, Oct 2020
10. Mathematics Colloquium, University of Central Florida, Feb 2020

TEACHING

Columbia University, New York, USA

Instructor

- APMA E3201: Applied Mathematics II: PDEs — Spring 2019
- APMA E4200: Partial Differential Equations — Fall 2018
- APMA E3201: Applied Mathematics II: PDEs — Spring 2018
- APMA E4200: Partial Differential Equations — Fall 2017

University of Washington, Seattle, USA

Teaching Assistant

- AMATH 301: Beginning Scientific Computing — Fall 2013,Winter 2014
- AMATH 577: Financial Software Development and Integration with C++ — Spring 2013
- AMATH 383: Introduction to Mathematical Modelling — Winter 2013
- MATH 125: Calculus and Analytic Geometry II — Autumn 2012

OTHER EXPERIENCES

University of Washington, Seattle, USA

Systems Administrator — Spring 2014 - June 2017

Provided comprehensive IT service for the Applied Mathematics department at UW.

- Successfully proposed and procured 2x20-core machine with 512GB RAM and high performance GPUs for the department through Student Technology Fee (STF).
- Maintained departmental computing resources: developed Python scripts for real-time monitoring of department computing cluster and printers.
- Maintained wordpress website for the department.

TREUM Co., Seoul, South Korea — April 2011 - August 2012

Researcher (part-time)

Morgan Stanley, Seoul, South Korea — October - December 2009

Intern, Investment Banking Division

District Office of Education, South Korea — July 2006 - September 2008

Civil Servant, Mandatory Civil Service

COMPUTER SKILLS

Python, C, C++, Fortran, MATLAB, knowledgeable in Linux environment.

LANGUAGES

Bilingual in Korean and English. Beginner in Spanish.