# 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)
19. SIAM Conference on Mathematics of Data Science 2020, Virtual, May 2020
    *Low-rank transport for 2D waves: a dimensional splitting approach*

## Seminar Talks

1. Inverse Problems Seminar — University of Washington, Nov 2014
2. Seniors Seminar — Pacific Lutheran University, Oct 2016
3. Numerical Analysis Research Club (NARC) — University of Washington, Oct 2016
4. Applied Mathematics Colloquium — Columbia University, Feb 2017
5. Applied Mathematics 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 — University of Pittsburgh, Oct 2020
10. Mathematics Colloquium — University of Central Florida, Feb 2020
11. Numerical Analysis and Machine Learning seminar — Courant Institute, Sep 2020
12. Data-Driven Physical Simulation Seminar — Lawrence Livermore National Laboratory, Nov 2020
13. Research group seminar — Stanford University, Nov 2020