

# Donsub Rim

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## CONTACT INFORMATION

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New York University  
New York, NY, 10012, USA

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Webpage: [dsrim.github.io](https://dsrim.github.io)

## 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 heterogeneous 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](https://nbn-resolving.org/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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, <i>The inf-sup test for a hybrid DG method</i> (Poster, Best poster award)	Seoul, South Korea, May 2012
	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, <i>Inverse diffusion from power densities in dimension three</i> (Poster)	Bellingham, WA, October 2015
	6. SIAM Computational Science and Engineering,	Salt Lake City, UT, March 2015
	7. CSDMS Annual Meeting, <i>Bayesian inversion for tsunami sources using DART buoy measurements</i> (Poster)	Boulder, CO, May 2016
	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, <i>Performing and communicating probabilistic tsunami hazard assessment</i> (Minisymposium)	Philadelphia, PA, September 2016
	12. European Conference on Mathematics for Industry (ECMI), <i>Model reduction of Burgers' equation using displacement interpolation</i> (Minisymposium)	Budapest, Hungary, June 2018
	13. SIAM Annual Meeting, <i>Dimensionality reduction of wave-like phenomena using monotone rearrangement</i> (Minisymposium) <i>Dimensional splitting using the Radon transform</i> (Minisymposium)	Portland, OR, July 2018
	14. Approximation Theory and Machine Learning, <i>Dimensionality reduction of wave-like phenomena using monotone rearrangement</i> (Poster)	Purdue University, IN, Sep 2018
	15. Joint Mathematics Meetings, <i>Reconstruction of anisotropic conductivities from power densities in three dimensions</i> (Minisymposium)	Baltimore, MD, Jan 2019
	16. SIAM Conference on Computational Science and Engineering, <i>Model Reduction of Multi-dimensional Hyperbolic Conservation Laws</i> (Minisymposium)	Spokane, WA, Feb 2019
	17. ENUMATH 2019, <i>Model Reduction of Nonlinear Hyperbolic Problems Using Low-dimensional Transport Modes</i> (Minisymposium)	Egmond Aan Zee, Netherlands, Sep 2019
	18. ICERM Workshop 2020, <i>Manifold Approximations via Transported Subspaces</i> (Poster)	Brown University, RI, Feb 2020
	19. SIAM Conference on Mathematics of Data Science 2020, <i>Low-rank transport for 2D waves: a dimensional splitting approach</i>	Virtual, May 2020
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

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| 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                    |

#### TEACHING

**Columbia University**, New York, USA

*Instructor*

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|--|-------------|
| ◦ 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*

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|--|------------------------|
| ◦ 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.

**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.