Seongjai Kim

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I. EDUCATION

B. S. Department of Mathematics, Seoul National University, February 1988

M. S. Department of Mathematics, Seoul National University, February 1990
M.S. Thesis: *Extension of Nagumo's Lemma and Its Applications*
Advisor: Professor Dohan Kim

Ph. D. Department of Mathematics, Purdue University, August 1995
Ph. D. Dissertation: *Domain Decomposition Methods for Contaminant Transport in 3D Fractured Porous Media*
Advisor: Professor Jim Douglas, Jr.

II. PROFESSIONAL EMPLOYMENTS

Aug. 1995 – Aug. 1997	:	Computational and Applied Mathematics Rice University, Research Associate Professor Supervisor: Professor William W. Symes
Aug. 1997 – Aug. 1998	:	Shell E&P Technology Co., Houston Research Scientist
Aug. 1998 – Aug. 2005	:	Department of Mathematics, University of Kentucky Assistant Professor
Aug. 2005 – May 2008	:	Department of Mathematics and Statistics Mississippi State University Associate Professor
May 2008 – Aug. 2009	:	M-Story Institute of Math Education Seoul, South Korea Co-owner
Aug. 2009 – Aug. 2014	:	Department of Mathematics and Statistics Mississippi State University Associate Professor
Aug. 2014 – Present	:	Department of Mathematics and Statistics Mississippi State University Professor

III. RESEARCH INTERESTS AND EXPERIENCES

- Thermal imaging & LiDAR data processing
- Image processing and analysis
- Wave propagation & computational seismology
- Mesh optimization

IV. GRANTS

Grants Awarded:

- **NSF, DMS-1228337**: *Real-time Processing Algorithms for LiDAR Point Cloud Data*. Seongjai Kim (PI). 09/01/12 - 08/31/16 (4 years). Total Budget: $205,459. Research institution: MSU.
- **NSF, DMS-0609815**: *PDE-based Image Restoration and Segmentation and Their Applications to Medical Imagery*. Seongjai Kim (PI). 07/01/06 - 06/30/10 (4 years). Total Budget: $135,042. Research institution: MSU.
- **NSF, DMS-0630798**: *PDE-based Image Restoration: Efficient Numerical Algorithms and Software Engineering*. Seongjai Kim (PI). 04/15/06 – 08/31/07 (16 months). Total Budget: $52,420. Research institution: MSU.
- **CetaTech, Inc.**: *PIMsolver*: The Development of Mathematical and Numerical Nano-powder Injection Molding Models. Seongjai Kim (PI). 07/01/06 – 06/30/07 Budget: $100,000. Research institution: MSU.
- **NSF, DMS-0312223**: *PDE-based Image Restoration: Efficient Numerical Algorithms and Software Engineering*. Seongjai Kim (PI) and Sung Ha Kang (Co-PI). 09/15/03 – 08/31/06 (3 years). Total Budget: $110,520. Research institution: University of Kentucky.
- **NSF, DMS-0107210**: *Computational methods for most-energetic traveltimes of seismic waves*. Seongjai Kim (PI). 09/01/01 – 08/31/04 (3 years). Total Budget: $38,590. Research institution: University of Kentucky.
- **KBRIN**: *Bioinformatics*. Charles Staben (PI: Biology, UK), Dave Westneat (Co-PI: Biology, UK), Arnold Stromberg and Kert Viele (Co-PIs: Statistics, UK), and Seongjai Kim (Co-PI). 09/01/02 – 06/30/04. Total Budget: $210,040. Research institution: University of Kentucky.
- **KBRIN, Undergraduate Research**: *A Hands-on Course in Neurophysiology and Neuroanatomy*. Robin Cooper (PI: Biology, UK), Kert Viele (Co-PI: Statistics, UK), and Seongjai Kim (Co-PI). 09/01/03 – 06/30/04. Total Budget: $39,386. Research institution: University of Kentucky.
- **E2Lab Inc.**: *Automatic segmentation and labeling in speech recognition*. Seongjai Kim (PI). 08/01/00 – 07/31/01. Total Budget: $25,000. Research institution: University of Kentucky.

V. COURSES TAUGHT

Undergraduate level courses: Calculus. Probability. Differential Equations. Linear Algebra. Numerical Analysis and Computational Methods. Industrial Mathematics.

Graduate level courses: Numerical Analysis. Image Processing. Computational Fluid Dynamics. Partial Differential Equations. Industrial Mathematics.

VI. IMPACT SEMINAR

From Fall 2005, I am running the *IMage Processing And Computational Techniques* (IMPACT) seminar, meeting weekly for students and faculty to discuss/solve interesting problems in image processing and related real-world applications.

VII. MODELCODE LIBRARY

In Spring 1999, I began to build a modelcode library, called the *Graduate Research and Applications for Differential Equations* (GRADE), for an effective education of numerical methods for juniors to Ph.D. students. The modelcodes are written in multi-language (C++, C, and F77) and can be utilized for research-level realistic problems with minor modifications. One can easily revise, compile, and link these multi-language codes by using **cstart**, a main and driver routine generator, and **mkmk**, a makefile maker. Currently, more than 20 modelcodes along with the generators are available through internet access to `skim.math.msstate.edu/GRADE/`.

VIII. POST-DOCTORAL VISITORS AND STUDENTS

Post-doctoral Associates:

- Dr. Hakran Kim (9/16/2009-6/15/2010). She worked on image processing and computer graphics, resulting in two research articles.

Current Students

Name	Degree	Research area
Mr. Hwamog Kim	Ph.D., Mathematics	LiDAR data processing

Ex-Students:

Name	Degree	Current job
Mr. Joe Ferguson	Ph.D., Dec. 2016, Math	Assist. Prof., College of The Bahamas
Mr. Kishan Patel	Ms.D., Aug. 2015, Math	MSMS
Mr. Jamaris Moore	M.Sc. May 2013, Math	NASA
Dr. Aisha Alwehebi	Ph.D., Dec. 2009, Math	King Saud University
Dr. ChunFang Chen	Ph.D., Aug. 2005, Civil Eng	Assoc. Prof., U of Louisiana
Dr. Evans Chirwa	Ph.D., May. 2001, Civil Eng	Prof., University of Pretoria Republic of South Africa
Mr. Daniel Folie	M.Sc., Aug. 2000, Math	IBM

IX. PARTICIPATION, ORGANIZATION, AND SERVICES

- **NSF Grant Review Panel**:
  - Collaboration in Mathematical Geosciences (CMG), 2005.
- **International Conference Chair/Committee**:
  - *Conference Chair*: Image Processing and Computational Methods, University of Kentucky, Lexington, KY, USA, March 21-23, 2003.
  - *Associate Editor*: A special issue of "Electronic Journal of Differential Equations" for the Sixth MSU-UAB Conference on Differential Equations and Computational Simulations, Starkville, Mississippi, USA, May 13-14, 2005.
  - *Organization Committee*: The 12th WSEAS International Conference on Applied Mathematics, Cairo, Egypt, December 29-31, 2007.
- **Journal Review**: SIAM J. Sci. Comput., Mathematics of Computation, Applied Mathematics Letters, Geophysics, Geophysical Journal International, Geophysical Prospecting, Journal of Computational and Applied Mathematics, Journal of Computational Physics, IEEE Trans. Image Process., IEEE Trans. CSVT.
- **Membership**: IEEE.

X. PUBLICATION LIST

A. Articles in Journals/Books (refereed)

[1] B. Lee, M. Kang, and S. Kim, *An essentially non-oscillatory Crank-Nicolson procedure for the simulation of convection-dominated flows*. Journal of Scientific Computing 71, pp. 875–895 (2017).

[2] Philku Lee, Tai Wan Kim, and S. Kim, *Accurate and efficient numerical solutions for elliptic obstacle problems*. Journal of Inequalities and Applications 2017:34, pp. 1–25 (2017).

[3] Changsoo Shin and S. Kim, *Recursive Heaviside step functions and beginning of the universe*. New Astronomy 52C, pp. 108–111 (2017).

[4] S. Kim, *A Mathematician on the Road outside Time*, Figures and Books Publishing , 2017.

[5] Hwamog Kim, J. Willers, and S. Kim, *Digital elevation modeling via curvature interpolation for LiDAR data*. Electronic Journal of Differential Equations, Conference Special Issue 23, pp. 47–57 (2016).

[6] Hwan Hee Park and S. Kim, *Iterative refinement and edge processing in PDE-based image restoration*. International Journal of Engineering and Innovative Technology 4, no. 7, pp. 1–10 (2015).

[7] Y. Y. Cha, G. Y. Lee, and S. Kim, *Image zooming by curvature interpolation and iterative refinement*. SIAM J. Imaging Sciences 7, no. 2, pp. 1284–1308 (2014).

[8] Y. Cha and S. Kim, *Equalized Net Diffusion (END) for the Preservation of Fine Structures in PDE-based Image Restoration*. Journal of Korea Information and Communications Society, Vol. 38A, no. 12, pp. 998–1012 (2013).

[9] H. Kim, V. R. Calvert, and S. Kim, *Preservation of fine structures in PDE-based image denoising*. Advances in Numerical Analysis, Vol. 2012, pp. 1–19 (2012).

[10] Y. Cha and S. Kim, *The method of nonflat time evolution (MONTE) in PDE-based image restoration*. Journal of Korea Information and Communications Society, Vol. 37, no. 11, pp. 961–971 (2012).

[11] I. Banicescu, H. Lim, R. Carino, and S. Kim, *A parameter study of a hybrid Laplacian mean-curvature flow denoising model*. Journal of Supercomputing, Vol. 57, no. 3, pp. 339–356 (2011).

[12] Hakran Kim, Y. Cha, and S. Kim, *Curvature interpolation method for image zooming*. IEEE Trans. Image Process., Vol. 20, no. 7, pp. 1895–1903 (2011).

[13] Y. Cha and S. Kim, *PDE-based image interpolators*. Journal of Korea Information and Communications Society, Vol. 35, no. 12, pp. 1010–1019 (2010).

[14] Y. Cha and S. Kim, *Parallel domain decomposition methods for high-order finite element solutions of the Helmholtz problem*. Lecture Notes in Computer Science, Vol. 6082 (2010), pp. 136–145.

[15] S.J. Park, S. Ahn, T. G. Kang, S.-T. Chung, Y.-S. Kwon, S.H. Chung, S.-G. Kim, S. Kim, S.V. Atre, S. Lee, and R.M. German, *A review of computer simulations in powder injection molding*. International Journal of Powder Metallurgy, Vol. 46 (2010), no. 3, pp. 37–46.

[16] S. Kim and H. Lim, *Fourth-order partial differential equations for effective image denoising*. Electronic Journal of Differential Equations, Conference Special Issue 17 (2009), pp. 107–121.

[17] C.-K. Cho and S. Kim, *An essentially non-oscillatory Crank-Nicolson procedure for incompressible Navier-Stokes equations*. International Journal for Numerical Methods in Fluids 56 (2008), pp. 1351-1357.

[18] S. Kim, *Map of Mathematics: For Students in a Maze of Mathematics*, Math Love Inc., 2008

[19] Y. Cha and S. Kim. *The Error-amended sharp edge (EASE) scheme for image zooming*. IEEE Trans. Image Process. 16 (2007), no. 6, pp. 1496-1505.

[20] S. Kim and H. Lim, *A non-convex diffusion model for simultaneous image denoising and edge enhancement*. Electronic Journal of Differential Equations, Conference Special Issue 15 (2007), pp. 175-192.

[21] S. Kim and H. Lim, *High-order schemes for acoustic waveform simulation*. Appl. Numer. Math. 57 (2007), pp. 402-414.

[22] D. N. Kim, J. Choi, and S. Kim, *The method of diffusion modulation for the restoration of image fine structures*. WSEAS Trans. on Mathematics 6 (2007), no. 2, pp. 361-368.

[23] H. Lim, S. Kim, and J. Douglas, Jr., *Numerical methods for viscous and nonviscous wave equations*. Appl. Numer. Math. 57 (2007), no. 2, pp. 194-212.

[24] Y. Cha and S. Kim, *Edge-forming methods for image zooming*. J. Math. Imaging and Vis. 25 (2006), no. 3, pp. 353-364.

[25] S. Kim and S.-H. Kwon, *Explicit nonflat time evolution for PDE-based image restoration*. Lecture Notes in Computer Science 4338 (2006), pp. 35-44.

[26] S. Kim, *Image denoising via diffusion modulation*. International Journal of Pure and Applied Mathematics 30 (2006), no. 1, pp. 71-92.

[27] S. Kim and H. Lim, *A traveltime-based absorbing boundary condition and fourth-order implicit procedures for the simulation of acoustics*. WSEAS Trans. on Mathematics 5 (2006), no. 5, pp. 451-458.

[28] Y. Cha and S. Kim, *Edge-forming methods for color image zooming*. IEEE Trans. Image Process. 15 (2006) no.8, pp. 2315-2323.

[29] S. Kim, *PDE-based image restoration: A hybrid model and color image denoising*. IEEE. Trans. Image Process. 15 (2006) no.5, 1163-1170.

[30] S. Kim, C.-S. Shin, and J.B. Keller, *High-frequency asymptotics for the numerical solution of the Helmholtz equation*. Appl. Math. Letters 18 (2005) 797-804.

[31] J. Douglas, Jr., S. Kim, and H. Lim, *An improved alternating-direction method for a viscous wave equation*. Contemporary Mathematics 329 (2003) 99-104.

[32] S. Kim, *Compact schemes for acoustics in the frequency domain*. Mathematical and Computer Modeling 37 (2003) 1335-1341.

[33] S. Kim and Soohyun Kim, *Multigrid simulation for high-frequency solutions of the Helmholtz problem in heterogeneous media*. SIAM J. Sci. Comput. 24 (2002) 684-701.

[34] S. Kim, *3D eikonal solvers: First-arrival traveltimes*. Geophysics 67 (2002) 1225-1231.

[35] J. Douglas, Jr. and S. Kim, *Improved accuracy for locally one-dimensional methods for parabolic equations*. Mathematical Models and Methods in Applied Sciences 11 (2001) 1563-1579.

[36] S. Kim, *An $\mathcal{O}(N)$ level set method for eikonal equations*, SIAM J. Sci. Comput. 22 (2001) 2178-2193.

[37] S. Kim, *The Most-Energetic Traveltime of Seismic Waves*. Appl. Math. Letters 14 (2001) 313-319.

[38] S. Kim, *Artificial damping in multigrid methods*. Appl. Math. Letters 14 (2001) 359-364.

[39] S. Kim, *Wavefronts of linear elastic waves: local convexity and modeling*. Wave Motion 32 (2000) 203-216.

[40] S. Kim, R.L. Cooper, and H.L. Atwood, *Assessing accurate sizes of synaptic vesicles in nerve terminals*, Brain Research 877 (2000) 209-217.

[41] S. Kim and R. Cook, *3D traveltime computation using second-order ENO scheme*. Geophysics 64 (1999) 1867-1876.

[42] S. Kim, *Domain decomposition iterative procedures for solving scalar waves in the frequency domain*. Numerische Mathematik 79 (1998) 231-259.

[43] S. Kim, *On the use of rational iterations and domain decomposition methods for solving the Helmholtz problem*. Numerische Mathematik 79 (1998) 529-552.

[44] S. Kim and W.W. Symes, *Smooth detectors of linear phase*. Inverse Problems 14 (1998) 101-112.

[45] S. Kim and W.W. Symes, *Multigrid domain decomposition methods for the Helmholtz problem*. In: Mathematical and Numerical Aspects of Wave Propagation. SIAM, Philadelphia, 1998, pp. 617-619.

[46] S. Kim, W.W. Symes, and M. A. El-Mageed, *Superconvergent difference formulas for traveltimes and amplitudes*. In: Mathematical and Numerical Aspects of Wave Propagation. SIAM, Philadelphia, 1998, pp. 591-593.

[47] S. Kim and W.W. Symes, *Multifrequency simulation for acoustics*. Appl. Math. Let. 10 (1997) 47-52.

[48] S. Kim and M. Lee, *Artificial damping techniques for scalar waves in the frequency domain*. Computers Math. Applic. 31 (1996) 1-12.

[49] S. Kim, *Parallel multidomain iterative algorithms for the Helmholtz wave equation*. Appl. Numer. Math. 17 (1995) 411-429.

[50] S. Kim, *A parallelizable iterative procedure for the Helmholtz problem*. Appl. Numer. Math. 14 (1994) 435-449.

[51] S. Kim, *Numerical Treatments for the Helmholtz Problem by Domain Decomposition Techniques*. Contemp. Math. 180 (1994) 245-250.

B. Articles in Proceedings (refereed/invited)

[52] H. Kim and S. Kim *Impulse-mowing anisotropic diffusion filter for image denoising*. In: Proceedings of The 2014 IEEE International Conference on Image Processing, Paris, France, October 27-30, 2014, pp. 2923–2927.

[53] J. Moore and Y. Um and S. Kim, *Efficient edge-forming procedures for real-time image interpolation*. In: Proceedings of The 2013 International Conference on Image Processing, Computer Vision, and Pattern Recognition, Las Vegas, Nevada, USA, July 22 - 15, 2013, pp. 186–192.

[54] A. Gautam and Jihee Kim and D. Kwak and S. Kim, *Iterative refinement by smooth curvature correction for PDE-based image restoration*. In: Proceedings of The 2013 International Conference on Image Processing, Computer Vision, and Pattern Recognition, Las Vegas, Nevada, USA, July 22 - 15, 2013, pp. 518–523.

[55] W. Cordell and Hakran Kim and J. Willers and S. Kim, *Image reconstruction for arbitrarily spaced data using curvature interpolation*, In: Proceedings of The 2013 International Conference on Image Processing, Computer Vision, and Pattern Recognition, Las Vegas, Nevada, USA, July 22 - 15, 2013, pp. 506–512.

[56] Jiho Kim and Hwamog Kim and S. Kim, *Computing education and research for high school students through subject modularization and basic software*. In: Proceedings of The 2013 International Conference on Frontiers in Education: Computer Science and Computer Engineering, Las Vegas, Nevada, USA, July 22 - 15, 2013, pp. 409–415.

[57] H. Kim, V. R. Calvert, J. H. Hwang, and S. Kim, *Curvature Interpolation Method for the Recovery of Scattered Image Data*. In: Proceedings of the IASTED International Conference on Signal and Image Processing, Dallas, TX, USA, December 14-16, 2011, pp. 201–207.

[58] A. Alwehebi, H. Kim, and S. Kim, *Random noise in Rician MRI data*. In: Proceedings of the IASTED International Conference on Computer Graphics and Imaging, Innsbruck, Austria, February 17–19, 2010.

[59] Y. Cha and S. Kim, *PDE-based interpolation methods for image super resolution*. In: Proceedings of the 2007 International Conference on Future Generation Communication and Networking, IEEE Computer Society, 2007, pp. 213-218.

[60] H. Choi and S. Kim, *Novel numerical methods for efficient and reliable segmentation*. In: Proceedings of the 2007 International Conference on Future Generation Communication and Networking, IEEE Computer Society, 2007, pp. 224-229.

[61] S. Kim, S.J. Park, S.V. Atre, and R.M. German, *Simulation of binder-powder separation in powder injection molding*. In: Proceedings of the 2007 International Conference on Powder Metallurgy & Particlate Materials (PowderMet 2007). Metal Powder Industries Federation and APMI International, Princeton, NJ, USA, 2007, Part 1, pp. 8-14.

[62] D. N. Kim, J. Choi, and S. Kim, *Speckle-mowing anisotropic diffusion*. In: Proceedings of the 2007 International Conference on Image Processing, Computer Vision, and Pattern Recognition, 2007, pp. 282-288.

[63] R. Carino, I. Banicescu, H. Lim, N. Williams, and S. Kim, *Simulation of a hybrid model for image denoising*. In: Proceedings of the Seventh Workshop on Parallel and Distributed Scientific and Engineering Computing, 2006, in CD-Rom

[64] S. Kim, *Equalized net diffusion (END) in image denoising*. In: Proceedings of The 10th WSEAS International Conference on Applied Mathematics, 2006.

[65] Y. Cha and S. Kim, *Error-amended sharp edge (EASE) schemes for image interpolation*. In: Proceedings of 2006 IEEE International Conference on Image Processing, 2006, pp. 701-704.

[66] S. Kim, *Image denoising by fourth-order PDEs*. In: Proceedings of the Eighth IASTED International Conference on Signal and Image Processing, 2006, pp. 249-254.

[67] S. Kim and H. Lim, *Method of background subtraction for medical image segmentation*. In: Proceedings of The 3rd International Conference on Cybernetics and Information Technologies, Systems and Applications, 2006, pp. 87–91.

[68] S. Kim, *A 4th-order implicit procedure for the simulation of acoustics*. In: Proceedings of The 9th WSEAS International Conference on Applied Mathematics, 2006, pp. 599-604.

[69] S. Kim and H. Lim, *A hybrid level set segmentation for medical imagery*. In: Proceedings of 2005 IEEE Nuclear Science Symposium & Medical Imaging Conference, pp. 1790-1794.

[70] S. Kim, *A hybrid level set approach for efficient and reliable image segmentation*. Proceedings of 2005 IEEE ISSPIT (Wyndham El Conquistador Resort, Puerto Rico, Oct. 23 - 29, 2005) 743-748.

[71] S. Kim, H. Lim, D.N. Kim, and M. Tynan, *Subject modularization and research projects with high school students on mathematical image processing*. Proceedings of the IASTED International Conference on Education and Technology (Hyatt Regency Hotel, Calgary, Alberta, Canada, July 4-6, 2005) 247-252.

[72] S. Kim, *Loss and recovery of fine structures in PDE-based image denoising* (invited). Proceedings of The Fifth Conference on Mathematics and Image Analysis 2004. Paris, France, September 6-9, 2004.

[73] C. Chen, S.C. Yost, and S. Kim, *Pade-ENO-CN scheme for one-dimensional open channel flow*. Proceedings of the 175h ASCE Engineering Mechanics Conference, University of Delaware, Newark, DE, June 13-16, 2004. Paper number 113.

[74] S. Kim and K. Joo, *Efficient and reliable procedures for PDE-based denoising*. Proceedings of Hawaii International Conference on Statistics, Mathematics and Related Fields (2004) 1126-1141.

[75] S. Kim, *Fourth-order compact schemes for the Helmholtz equation*. Society of Exploration Geophysicists 72 (2002) 1907-1910.

[76] S. Kim, *Implicit fourth-order schemes for acoustic waveform simulation*. Society of Exploration Geophysicists 72 (2002) 1919-1922.

[77] S. Kim, *On accuracy of finite difference amplitudes and interpolated traveltimes*. Society of Exploration Geophysicists 71 (2001) 1175-1178.

[78] S. Kim, *Multigrid domain decomposition techniques for the high-frequency numerical solution of scalar waves in heterogeneous media*. Society of Exploration Geophysicists 71 (2001) 1179-1182.

[79] S. Kim, *On most-energetic traveltimes*. Society of Exploration Geophysicists 70 (2000) 946-949.

[80] S. Kim and D. Folie, *The group marching method: An $\mathcal{O}(N)$ level set eikonal solver*. Society of Exploration Geophysicists 70 (2000) 2297-2230.

[81] S. Kim, *ENO-DNO-PS: a stable, second-order accuracy eikonal solver*. Society of Exploration Geophysicists 69 (1999) 1747-1750.

[82] S. Kim, *On eikonal solvers for anisotropic traveltimes*. Society of Exploration Geophysicists 69 (1999) 1875-1878.

C. Lecture Notes

[1] S. Kim, *Numerical Methods for Differential Equations*. The lecture note is available through internet access to `skim.math.msstate.edu/LectureNotes/` or by asking Dr. S. Kim (`skim@math.msstate.edu`).

[2] S. Kim, *Numerical Analysis Using Maple and Matlab*.