# MYUNG-SIN SONG

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**Country of Citizenship:** Republic of Korea

US Permanent Resident

## EDUCATION

- Ph.D. in Mathematics, at The University of Iowa, July 2005.
  Dissertation Title: "*Wavelet Image Compression.*"
  Dissertation Advisor: Professor Palle E.T. Jorgensen.
- B.S. in Mathematics, minor in Computer Science with departmental honors at University of Kentucky, May 1999.

## RESEARCH INTERESTS

Functional and harmonic analysis of wavelets, the application of wavelet transform on image processing, using computer programming language, and connection of the engineering of image processing, using wavelet transform and mathematics of it. Mathematics behind the entropy encoding in wavelet image compression and also frame application in it. Fractal analysis and its application in image processing. Fractional Brownian motion, Karhunen-Loeve transform (principal component analysis) and spectral theory. Lifting scheme, sampling theory and quantization. Sampling theory and reproducing kernel Hilbert space.

## PUBLICATIONS

1. M.-S. Song, "*Wavelet Image Compression*" *Operator Theory, Operator Algebras, and Applications*, Contemp. Math., **414**: 41-73, AMS, Providence 2006.
2. P. E. T. Jorgensen and M.-S. Song, "*Entropy Encoding, Hilbert Space and Karhunen-Loeve Transforms*" J. Math. Phys., **48** 103503, 2007.
3. P. E. T. Jorgensen and M.-S. Song, "*Comparison of Discrete and Continuous Wavelet Transforms*" Springer *Encyclopedia of Complexity and Systems Science,* Springer, 2008.
4. M.-S. Song, "*Entropy Encoding in Wavelet Image Compression*" Representations, Wavelets and Frames A Celebration of the Mathematical Work of Lawrence Baggett (Editors Palle E.T. Jorgensen, Kathy D. Merrill and Judith A. Packer), 293—311, Springer, 2007.
5. K. Kim, K. H. Leem, G. Pelekanos and M.-S. Song, "*Algebraic Multigrid Preconditioner for a Finite Element Method in TM Electromagnetic Scattering"* J. Comput. Anal. and Appl., **11**, No 4:597-605, Eudoxus Press, 2009.
6. P. E. T. Jorgensen and M.-S. Song, "*Optimal Decompositions of Translations of* $L^2$ *- Functions*" Complex Anal. Oper. Theory, **3**, No 2: 449-478, Birkhauser, 2008.
7. P. E. T. Jorgensen and M.-S. Song, "*Analysis of Fractals, Image Compression, Entropy Encoding and Karhunen-Loeve Transforms*" Acta Applicandae Mathematicae, **108**, 5:498-508, Springer, 2009.
8. P. E. T. Jorgensen and M.-S. Song "*Spectral Theory of Discrete Processes*" Cent. Eur. J. Phys. **8**(3):340-363, Springer, 2010.
9. P. E. T. Jorgensen and M.-S. Song "*An Extension of Wiener Integration with the Use of Operator Theory*" J. Math. Phys. **50,** 103502, 2009.
10. P. E. T. Jorgensen and M.-S. Song "*Scaling, Image Compression and Encoding"* Analysis for Science, Engineering and Beyond, Springer, 2011.
11. P. E. T. Jorgensen and M.-S. Song, *"Matrix Factorization and Lifting,"* Sampling Theory in Signal and Image Processing, **9**: 167-197, Sampling Publishing, 2010.

12. P. E. T. Jorgensen, M.-S. Song, *"Compactification of Infinite Graphs and Sampling,"* Sampl. Theory Signal Image Process. **12** (2-3): 139-158, Sampling Publishing, 2013.
13. D. E. Dutkay, G. Picioroaga, M.-S. Song, *"Orthonomal Bases Generated by Cuntz Algebras,"* J. Math. Anal. Appl. **409** (2): 1128-1139, 2014.
14. P. E. T. Jorgensen, M.-S. Song, *"Filters and Matrix Factorization,"* submitted, 2014.
15. P. E. T. Jorgensen, M.-S. Song, *"Reproducing Kernel Hilbert Space vs. Frame Estimates,"* Mathematics3(3):615-625, MDPI, Jul 8, 2015.
16. P. E. T. Jorgensen, M.-S. Song, *"Infinite-dimentional Measure Spaces and Frame Analysis,"* submitted, 2015.
17. M.-S. Song, *"Image Compression with Cantor Filters,"* in preparation, 2015.

**TALKS**

1. *Compactification of Infinite Graphs and Sampling,* SIAM mini-symposium on Multivariate Signal Processing and Inverse Problems, Joint Mathematics Meetings, San Antonio, Texas, Jan 13, 2015.
2. *Orthonomal Bases Generated by Cuntz Algebras*, Computational Harmonic Analysis, Image and Signal Processing workshop, Foundations of Computational Mathematics, Montevideo, Uruguay, Dec 13, 2014.
3. *Compactification of Infinite Graphs and Sampling,* Operator Theory Seminar, Department of Mathematics, Seoul National University, Seoul, Korea, May 23, 2014.
4. *Haar Wavelet-like Analysis with MRA Method Extended to Fractals*, MAA General Contributed Paper Session: Research in Applied Mathematics, III, Joint Mathematics Meetings, San Diego, California, Jan 12, 2013.
5. *Haar Wavelet-like Analysis with MRA Method Extended to Fractals*, Colloquium, University of Central Florida, Orlando, Florida, Oct 18, 2012.
6. *Haar Wavelet-like Analysis with MRA Method Extended to Fractals*, Summer School "New Trends and Directions in Harmonic Analysis, Fractional Operator Theory, and Image Analysis," Inzell, Germany, Sept 18, 2012.
7. *Matrix Factorization and Lifting,* Operator Theory Seminar, Department of Mathematics, Seoul National University, Seoul, Korea, Jun 1, 2012.
8. *Matrix Factorization and Lifting*, AMS Special Session on Wavelets, Tilings, and Iterated Function Systems, Joint Mathematics Meetings, New Orleans, Louisiana, Jan 7, 2011.
9. *Matrix Factorization and Lifting,* Workshop on Harmonic Analysis and Integral Geometry, Louisiana State University, Baton Rouge, Louisiana, Jan 4, 2011.
10. *Scaling, Image Compression and Encoding*, From Banach Spaces to Frame Theory and Applications conference, Norbert Wiener Center, University of Maryland, College Park, Maryland, May 20, 2010.
11. *Analysis of Fractals, Image Compression and Entropy Encoding*, Workshop on Fractals and Tilings, Strobl, Austria, July 10, 2009.
12. *Spectral Theory of Discrete Processes*, Strobl09 Conference on Time-Frequency, Strobl, Austria, June 18, 2009.
13. *Analysis of Fractals, Image Compression and Entropy Encoding*, Fractal connections: wavelets, tilings, measures, and self-similar analysis workshop, the University of Iowa, Iowa City, Iowa, Jun 28, 2008.
14. *Analysis of Fractals, Image Compression and Entropy Encoding*, Illinois/Missouri Applied Harmonic Analysis Seminar, Illinois Wesleyan University, Bloomington, Illinois, Apr 19, 2008.
15. *Entropy Encoding using Karhunen Loeve Transform*, Functional Analysis II class, The University of Iowa, Iowa City, Iowa, Mar 10, 2008.
16. *The Mathematics in the Wavelet Image Compression*, GAUSS Seminar, The University of Iowa, Iowa City, Iowa, Mar 10, 2008.
17. *Wavelet Image Compression*, Pizza Seminar, Southern Illinois University Edwardsville, Feb 6, 2008.
18. *Entropy Encoding using Karhunen Loeve Transform in Wavelet Image Compression*, AMS Special Session on Wavelet Sets and Tilings on $R^n$, Joint Mathematics Meetings, San Diego, California, Jan 8, 2008.
19. *Entropy Encoding using Karhunen Loeve Transform*, Summer School "New Trends and Directions in Harmonic Analysis, Approximation Theory, and Image Analysis," Inzell, Germany, Sept 17, 2007.

20. *Entropy Encoding using Karhunen Loeve Transform,* Operator Theory Seminar, Department of Mathematics, Seoul National University, Seoul, Korea, Jun 1, 2007.
21. *Entropy Encoding in Wavelet Image Compression,* Department of Mathematical Sciences, Division of Applied Mathematics, Korea Advanced Institute of Science & Technology, Daejeon, Korea, May 18, 2007.
22. *Entropy Encoding in Wavelet Image Compression,* Harmonic and Geometric Analysis Application workshop, Louisiana State University, Baton Rouge, Louisiana, Jan 4, 2007.
23. *Entropy Encoding in Wavelet Image Compression,* Operator methods in fractal analysis, wavelets and dynamical systems workshop, Banff International Research Station, Banff, Canada, Dec 6, 2006.
24. *Entropy Encoding in Wavelet Image Compression,* Wavelet Seminar, Department of Mathematics, Washington University, Saint Louis, Missouri, Nov 17, 2006.
25. *Wavelet Image Compression,* Analysis Seminar, Department of Mathematics, Saint Louis University, Saint Louis, Missouri, Oct 10, 2006.
26. *Hilbert Space Geometry in Wavelet Image Compression Algorithms,* Functional Analysis class, Department of Mathematics, The University of Iowa, Iowa City, Iowa, Sept 22, 2006.
27. *Hilbert Space Geometry in Wavelet Image Compression Algorithms,* International Conference Harmonic Analysis and Applications, San Luis, Argentina, Aug 4, 2006.
28. *The Mathematical Insights of Wavelet Image Compression* (Poster)*,* WavE 2006, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland, Jul 13, 2006.
29. *The Mathematical Insights of Wavelet Image Compression,* The 3rd International Workshop for Korean Women in Mathematics, Korea University, Seoul, Korea, Jun 26, 2006.
30. *The Connection between Wavelet Image Compression and Operator Theory,* Operator Theory Seminar, Department of Mathematics, Seoul National University, Seoul, Korea, Jun 2, 2006.
31. *Hilbert Space Geometry in Wavelet Algorithms,* Great Plaines Operator Theory Symposium, The University of Iowa, Iowa City, Iowa, May 24, 2006.
32. *Wavelet Image Compression,* Current Trends in Harmonic Analysis and Its Applications: Wavelets and Frames, University of Colorado at Boulder, Boulder, Colorado, May 20, 2006.
33. *Curvelets and Shearlets,* Topics in Applied Mathematics, Department of Mathematics, The University of Iowa, Iowa City, Iowa, Apr 21, 2006.
34. *Wavelet Transform,* Topics in Applied Mathematics, Department of Mathematics, The University of Iowa, Iowa City, Iowa, Mar 10, 2006.
35. *Mathematical Insights of Wavelet Image Compression,* Workshop on Harmonic Analysis and Fractal Geometry, Louisiana State University, Baton Rouge, Louisiana, Feb 24, 2006.
36. *Wavelets and Image Compression,* Topics in Applied Mathematics, Department of Mathematics, The University of Iowa, Iowa City, Iowa, Feb 3, 2006.
37. *Wavelets and Images*, GAUSS Seminar, Department of Mathematics, The University of Iowa, Iowa City, Iowa, Apr 20, 2005.
38. *Wavelets and Images*, Operator Theory Seminar, Department of Mathematics, The University of Iowa, Iowa City, Iowa, Apr 19, 2005.
39. *Mathematics Insight of Wavelet Image Processing*, Topics and Applied Mathematics, Department of Mathematics, The University of Iowa, Iowa City, Iowa, Mar 29, 2005.
40. *Wavelets and Images*, Industrial Engineering Seminar, Department of Industrial Engineering, The University of Iowa, Iowa City, Iowa, Mar 3, 2005.
41. *Wavelets and Images*, Topics and Applied Mathematics, Department of Mathematics, The University of Iowa, Iowa City, Iowa, Feb 22, 2005.
42. *Color Image Compression Using Wavelet Transform*, Advanced Image Processing, Department of Electrical and Computer Engineering, The University of Iowa, Iowa City, Iowa, Mar 30, 2004.
43. *Wavelets*, MSRI workshop in Mathematical Graphics, Reed College, Portland, Oregon, Jul 25, 2003
44. *Wavelets and Multiresolution Analysis,* Topics in Analysis, Department of Mathematics, The University of Iowa, Iowa City, Iowa, May 7, 2003.

## TEACHING EXPERIENCE

**The University of Iowa**

Fall 1999 to Spring 2005: Worked as a graduate teaching assistant leading discussion sections, teaching my own class and tutoring at the math tutorial lab.

**Southern Illinois University Edwardsville**

Fall 2005
Math 125 Pre-calculus with Trigonometry
Math 355 Engineering Mathematics
Spring 2006
Math 305 Differential Equations
Fall 2006
Math 150 Calculus I
Math 462 Engineering Numerical Analysis
Spring 2007
Math 350 Introduction to Analysis
Math 321 Linear Algebra I - for six weeks
Math 451 Introduction to Complex Analysis - for six weeks
Fall 2007
Math 305 Differential Equations
Math 321 Linear Algebra I
Math 421 Linear Algebra II
Spring 2008
Math 150 Calculus I
Math 223 Logic and Mathematical Reasoning
Fall 2008
Math 152 Calculus II
Math 305 Differential Equations
Math 321 Linear Algebra I
Spring 2009
Math 120 College Algebra
Math 305 Differential Equations
Fall 2009
Math 150 Calculus I
Math 305 Differential Equations
Math 321 Linear Algebra I
Spring 2010
Math 125 Pre-calculus with Trigonometry
Math 223 Logic and Mathematical Reasoning
Fall 2010
Math 305 Differential Equations
Math 355 Engineering Mathematics
Spring 2011
Math 223 Logic and Mathematical Reasoning
Math 305 Differential Equations
Math 502 Advanced Calculus for Engineers
Fall 2011 (on leave)
Spring 2012
Math 120 College Algebra
Math 125 Pre-calculus with Trigonometry
Fall 2012 (on sabbatical leave)
Spring 2013
Math 355 Engineering Mathematics
Math 502 Advanced Calculus for Engineers
Fall 2013
Math 355 Engineering Mathematics
Math 450 Real Analysis
Spring 2014
Math 150 Calculus I
Math 555 Functional Analysis with Applications
Fall 2014
Math 305 Differential Equations
Math 355 Engineering Mathematics
Spring 2015
Math 150 Calculus I

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## AWARDS and GRANTS

- Fall 1999-Spring 2001, Fall 2001-Spring 2002, Fall 2002-Spring 2003, Fall 2003 and Fall 2004 Graduate Teaching Assistantship.
- Spring 2004 Graduate Research Assistantship.
- Summer 2003 and Summer 2004 Summer Research Fellowship.
- Travel Grant Award from WavE 2006 Wavelets and Applications Conference, Ecole Polytechnique Federale de Lausanne Bernoulli Center July 2006.
- NSF grant Collaborative Research: RUI: Analysis of Fractals, Image Compression, Entropy Encoding, Karhunen-Loeve Transforms and Applications, PIs: Myung-Sin Song and Palle E. T. Jorgensen – declined 2008.

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## OTHER ACTIVITIES

- **Conferences and Workshops Attended/Hosted**
    1. Illinois/Missouri Applied Harmonic Analysis Seminar, University of Illinois, Urbana-Champaign, Illinois, Oct 16, 2010.
    2. Illinois/Missouri Applied Harmonic Analysis Seminar, Northern Illinois University, Dekalb, Illinois, Apr 24, 2010.
    3. Illinois/Missouri Applied Harmonic Analysis Seminar, Saint Louis University Saint Louis, Missouri, Nov 14, 2009
    4. Illinois/Missouri Applied Harmonic Analysis Seminar, University of Illinois, Urbana-Champaign, Illinois, Mar 27, 2009.
    5. Hosted Illinois/Missouri Applied Harmonic Analysis Seminar, Southern Illinois University Edwardsville, Sept 27 2008.
    6. February Fourier Talks, The Norbert Wiener Center for Harmonic Analysis and Applications, University of Maryland, College Park, MD, Feb 21-22, 2008.
    7. Illinois/Missouri Applied Harmonic Analysis Seminar, Washington University, Saint Louis, Missouri, Apr 28, 2007.
    8. Illinois/Missouri Applied Harmonic Analysis Seminar, University of Illinois, Urbana-Champaign, Illinois, Dec 2, 2006.
    9. Mini-workshop on Wavelets, Frames and Operator Theory, Vanderbilt University, Nashville, Tennessee, Apr 28-30, 2006.
    10. AMS-MAA Joint National Meeting, Atlanta, Georgia, January 2005.
    11. Wavelet Workshop, Washington University, Saint Louis, Missouri, Apr 3-7, 2006
    12. Hosted Korean Science Teachers Workshop in Wavelets with Prof. Palle Jorgensen at the University of Iowa, Iowa, Jun 27-Jul 14, 2005.
    13. MSRI Workshop for Women in Mathematics: Introduction to Image Analysis at MSRI, Berkeley, California, Jan 21-22, 2005.
    14. MSRI Workshop in Mathematical Graphics (PostScript and Java) at Reed College, Portland, Oregon, Jul 14-25, 2003.
- Associate editor for Sunway Academic Journal, Volume 3 (2006).
- Referee for Iranian Journal of Electrical and Computer Engineering (2007, 2008).
- Referee for Acta Applicandae Mathematicae, Springer Verlag (2007-).
- Referee for Journal of Mathematical Physics, American Institute of Physics (2008-).
- Reviewer for Mathematical Reviews (MR), American Mathematical Society (2009-).
- Referee for Complex Analysis and Operator Theory, Birkhauser (2009-).
- Reviewer for Central European Journal of Mathematics, Versita/Springer Verlag (2009-).
- Reviewer for 53$^{rd}$ the Institute of Electrical and Electronics Engineers (IEEE) International Midwest Symposium on Circuits and Systems (2010).
- Reviewer for Journal of Applied Mathematics and Computing, Springer (2010).
- Reviewer for International Journal of Modelling and Simulation, Acta Press (2010-).
- Reviewer for Institute of Electrical and Electronics Engineers (IEEE) Transactions on Information Theory (2012-).
- Reviewer for Journal of Mathematical Analysis and Applications, Elsevier (2012-).
- Reviewer for Journal of Functional Analysis, Elsevier (2014-).

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## TECHNOLOGIES

**Platforms:** Windows, LINUX, UNIX, Solaris, Mac OS.
**Programming Language:** C/C++, Java, Pascal, PostScript.
**Markup Language:** HTML, LaTeX.

**Others:** MATLAB, Mathematica, Maple, Lindo, Microsoft Office Power Point, Excel, Word, Dreamweaver MX, Adobe Photoshop, Adobe Illustrator.

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## PROFESSIONAL MEMBERSHIPS

American Mathematical Society (AMS): 2000 – current.
Society for Industrial and Applied Mathematics (SIAM)-Imaging Science: 2003 – current.
Institute of Electrical and Electronics Engineers (IEEE.)
– Signal Processing Society (2005 – 2008, 2011 – current.)
– Information Theory Society (2006 – 2008, 2011 – current.)
– Communications Society (2007 – 2008.)
Women in Information Theory Society (2010 – current.)

## SERVICE

**University Committee:**

- Honorary Degree Committee (Fall 2009 – Spring 2012.)
- Program Review Committee for Graduate Program in Arts and Design (Fall 2009 – Spring 2010.)
- Advisor for Korean Student Association (Spring 2007 – present.)
- Graduate Council Programs Committee (Fall 2013 – Spring 2014.)
- Program Review Committee for Graduate Program in Electrical and Computer Engineering (Fall 2013 – Spring 2014.)
- Department Representative to the College of Arts and Sciences Congress Curriculum Committee.

**Departmental Committee:**

- Peer Review Committee (Spring 2011 – Fall 2011.)
- Instructor Search Committee (Spring 2011.)
- Colloquium Committee (Spring 2010 – present.)
- Graduate Program Committee (Spring 2008 – Fall 2009, Spring 2012.)
- Math125 Proficiency Exam (Spring 2007– present.)
- Textbook Selection Committee (2006– present.)
- Applied Math Search Committee (Fall 2012 – Spring 2013)
- Graduate Program Director (July 2012 – Sept 2015.)
- Peer Review Committee (Spring 2014 - Fall 2014).

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## LANGUAGES

- Korean – Native
- English – Fluent
- Chinese (Mandarin) – Fluent
- Malay – Basic
- German (Reading) – Basic

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## REFERENCES

Palle E.T. Jorgensen
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