

Biographical sketch of Habib Ammari

Personal data Born June 28, 1969, in Eljem, Tunisia; married; one son; tunisian citizen

Educational Record

Bachelor of Science July 1992, Ecole Polytechnique, France

Master of Science June 1993 and Doctor of Philosophy May 1995, Applied Mathematics, Ecole Polytechnique, France

Habilitation Degree January 1999, Mathematics, University of Paris 6, France

Professional Experience

Director of Research at the French National Center for Scientific Research

Department of Mathematics and Applications

Ecole Normale Supérieure

45 Rue d'Ulm, Paris, France

&

Adjunct Professor in Applied Mathematics at Ecole Polytechnique

Department of Applied Mathematics

Ecole Polytechnique, Palaiseau, France

Visiting professorships: Mathematical Sciences Research Institute, Berkeley (2001), Institute of Pure and Applied Mathematics, UCLA (2003), Seoul National University (2006)

Research Interests

Asymptotic imaging, medical imaging, nondestructive testing

Books

- authored

1. (with H. Kang) Reconstruction of Small Inhomogeneities from Boundary Measurements. *Lecture Notes in Mathematics*, Volume **1846**, Springer-Verlag, Berlin, 2004.
2. (with H. Kang) Polarization and Moment Tensors: with Applications to Inverse Problems and Effective Medium Theory. *Applied Mathematical Sciences Series*, Volume **162**, Springer-Verlag, New York, 2007.
3. An Introduction to Mathematics of Emerging Biomedical Imaging. *Math & Applications*, Volume **62**, Springer-Verlag, Berlin, 2008.
4. (with H. Kang and H. Lee) Layer Potential Techniques in Spectral Analysis. *Mathematical Surveys and Monographs*, Volume **153**, American Mathematical Society, Providence, 2009.

- edited

1. (with H. Kang) Inverse Problems, Multi-Scale Analysis, and Homogenization. Proceedings of a Workshop in Seoul. *Contemporary Mathematics*, Volume **408**, American Mathematical Society, Providence, 2006.
2. Modeling and Computations in Electromagnetics: A Volume Dedicated to Jean-Claude Nédélec. *Lecture Notes in Computational Science and Engineering*, Volume **59**, Springer-Verlag, Berlin 2007.
3. (with H. Kang) Imaging Microstructures: Mathematical and Computational Challenges. *Contemporary Mathematics*, Volume **494**, American Mathematical Society, Providence, 2009.
4. Mathematical Modeling in Biomedical Imaging I: Electrical and Ultrasound Tomographies, Anomaly Detection, and Brain Imaging. *Lecture Notes in Mathematics: Mathematical Biosciences Subseries*, Volume **1983**, Springer-Verlag, Berlin, 2009.
5. Mathematics of Imaging and Inverse Problems: Proceedings of a Seminar Held at the *Institut Henri Poincaré*, 2007-2008, Paris. *ESAIM: Proceedings*, Volume **26**, French Applied and Industrial Mathematical Society, 2009.

Selected recent publications (from about 140 research papers)

1. (with M. Vogelius and D. Volkov) Asymptotic formulas for perturbations in the electromagnetic fields due to the presence of inhomogeneities of small diameter II. The full Maxwell equations, *Journal de Mathématiques Pures et Appliquées* **80** (2001), no. 8, 769–814.
2. (with H. Kang, G. Nakamura, and K. Tanuma) Complete asymptotic expansions of solutions of the system of elastostatics in the presence of inhomogeneities of small diameter, *Journal of Elasticity* **67** (2002), 97–129.
3. An inverse initial boundary value problem for the wave equation in the presence of imperfections of small volume, *SIAM Journal on Control and Optimization* **41** (2002), 1194–1211.
4. (with A. Khelifi) Electromagnetic scattering by small dielectric inhomogeneities, *Journal de Mathématiques Pures et Appliquées* **82** (2003), 749–842.
5. (with S. Moskow and M. Vogelius) Identification of small inhomogeneities from boundary measurements, *ESAIM: Control, Optimization and Calculus of Variations* **9** (2003), 49–66.
6. (with H. Kang) Complete asymptotic expansions of solutions of the system of elastostatics in the presence of inhomogeneities of small diameter, *SIAM Journal on Mathematical Analysis* **34** (2003), no.5, 1152–1166.
7. (with J.K. Seo) Accurate formula for the reconstruction of conductivity inhomogeneities, *Advances in Applied Mathematics* **30** (2003), 679–705.
8. (with F. Santosa) Guided waves in photonic bandgap structure with line defect, *SIAM Journal on Applied Mathematics* **64** (2004), no. 6, 2018–2033.
9. (with G. Uhlmann) Reconstruction of the Potential from Partial Cauchy Data for the Schrödinger Equation, *Indiana University Mathematics Journal* **53** (2004), no. 1, 168–184.
10. (with F. Triki) Splitting of resonant and scattering frequencies under shape deformation, *Journal of Differential Equations* **202** (2004), 231–255.
11. (with H. Kang and K. Kim) Polarization tensors and effective properties of anisotropic composite materials, *Journal of Differential Equations* **215** (2005), 401–428.
12. (with H. Kang, E. Kim, and M. Lim) Reconstruction of closely spaced small inclusions, *SIAM Journal on Numerical Analysis* **42** (2005), no. 6, 2408–2428.
13. (with H. Kang and M. Lim) Gradient estimates for solutions to the conductivity problem, *Mathematische Annalen* **332** (2005), 277–286.
14. (with O. Kwon, J.K. Seo, and E.J. Woo) T-scan electrical impedance imaging system for anomaly detection, *SIAM Journal on Applied Mathematics* **65** (2005), 252–266.
15. (with E. Iakovleva and H. Kang) Reconstruction of a small inclusion in a two-dimensional open waveguide, *SIAM Journal on Applied Mathematics* **65** (2005), no. 6, 2107–2127.
16. (with E. Iakovleva, H. Kang and K. Kim) Direct algorithms for thermal imaging of small inclusions, *Multiscale Modeling and Simulation: A SIAM Interdisciplinary Journal* **4** (2005), 1116–1136.
17. (with H. Kang and F. Santosa) Scattering of electromagnetic waves by thin dielectric structures, *SIAM Journal on Mathematical Analysis* **38** (2006), 1329–1342.
18. (with H. Kang, H. Lee, J. Lee and M. Lim) Optimal estimates for the electric field in two-dimensions, *Journal de Mathématiques Pures et Appliquées* **88** (2007), 307–324.
19. (with R. Griesmaier and M. Hanke) Identification of small inhomogeneities: asymptotic factorization, *Mathematics of Computation* **76** (2007), 1425–1448.
20. (with E. Iakovleva, D. Lesselier and G. Perrusson) A MUSIC-type electromagnetic imaging of a collection of small three-dimensional inclusions, *SIAM Journal on Scientific Computing* **29** (2007), 674–709.
21. (with H. Kang and H. Lee) Asymptotic expansions for eigenvalues of Lamé system in domains with small inclusions, *Communications in Partial Differential Equations* **32** (2007), 1715–1736.
22. (with E. Bonnetier, Y. Capdeboscq, M. Fink, and M. Tanter) Electrical impedance tomography by elastic deformation, *SIAM Journal on Applied Mathematics* **68** (2008), 1557–1573.
23. (with P. Garapon, H. Kang, and H. Lee) A method of biological tissues elasticity reconstruction using magnetic resonance elastography measurements, *Quarterly of Applied Mathematics* **66** (2008), 139–

24. (with H. Kang, E. Kim, K. Louati and M. Vogelius) A MUSIC-type algorithm for detecting internal corrosion from electrostatic boundary measurements, *Numerische Mathematik* **108** (2008), 501–528.
25. (with P. Calmon and E. Iakovleva) Direct elastic imaging of a small inclusion, *SIAM Journal on Imaging Sciences* **1** (2008), 169–187.
26. (with H. Kang, E. Kim, H. Lee, and K. Louati) Vibration testing for detecting internal corrosion, *Studies in Applied Mathematics* **122** (2009), 85–104.
27. (with Y. Capdeboscq, H. Kang, and A. Kozhemyak) Mathematical models and reconstruction methods in magneto-acoustic imaging, *European Journal of Applied Mathematics* **20** (2009), 303–317.
28. (with H. Kang) The method of small-volume expansions for medical imaging, *Lecture Notes in Mathematics*, Volume **1983** (2009), 99–132, Springer-Verlag, Berlin.
29. (with H. Kang and H. Lee) Asymptotic analysis of high-contrast phononic crystals, *Archive for Rational Mechanics and Analysis*, **193** (2009), 679–714.
30. (with H. Kang, M. Lim and H. Zribi) Layer potential techniques in spectral analysis. Part I: complete asymptotic expansions for eigenvalues of the Laplacian in domains with small inclusions, *Transactions of the American Mathematical Society*, to appear.
31. (with H. Kang, M. Lim and H. Zribi) Conductivity interface problems. Part I: small perturbations of an interface, *Transactions of the American Mathematical Society*, **362** (2010), 2435–2449.
32. (with E. Beretta, E. Francini, H. Kang, and M. Lim) Identification of small changes of an interface by vibration analysis, *Mathematics of Computation*, to appear.
33. (with P. Garapon, L. Guadarrama Bustos, and H. Kang) Transient anomaly imaging by the acoustic radiation force, *Journal of Differential Equations*, to appear.
34. (with H. Kang, H. Lee, M. Lim, and H. Zribi) Decomposition theorems and fine estimates for electrical fields in the presence of closely located circular inclusions, *Journal of Differential Equations*, **247** (2009), 2897–2912.
35. (with E. Bonnetier and Y. Capdeboscq) Enhanced resolution in structured media, *SIAM Journal on Applied Mathematics*, **70** (2009), 1428–1452.
36. (with H. Kang, H. Lee, and W.K. Park) Asymptotic imaging of perfectly conducting cracks, *SIAM Journal on Scientific Computing*, to appear.
37. (with E. Bossy, V. Jugnon, and H. Kang) Mathematical models in photo-acoustic imaging of small absorbers, *SIAM Review*, to appear.
38. (with H. Kang) Multi-Scale and Multi-Physics Biomedical Imaging Modalities, *Handbook of Mathematical Methods in Imaging*, Springer, New York, to appear.
39. (with E. Beretta, E. Francini, H. Kang, and M. Lim) Reconstruction of small interface changes of an inclusion from modal measurements II: The elastic case, *Journal de Mathématiques Pures et Appliquées*, to appear.
40. (with Y. Capdeboscq, H. Kang, H. Lee, G. Milton, and H. Zribi) Progress on the strong Eshelby's Conjecture and Extremal Structures for the Elastic Moment Tensor, *Journal de Mathématiques Pures et Appliquées*, to appear.

Recent preprints

1. (with Garnier, H. Kang, W.K. Park, and K. Solna) Imaging schemes for cracks and inclusions, submitted to *SIAM Journal on Applied Mathematics*.
2. (with P. Garapon, F. Jouve, and H. Kang) A new optimal control approach toward reconstruction of acoustic and elastic inclusions, preprint.
3. (with J. Garnier, H. Kang, M. Lim, and K. Solna) Multistatic imaging of extended targets, preprint.
4. (with K. Kalimeris, H. Kang, and H. Lee) Layer potential techniques for the narrow escape problem, submitted to *Journal of Functional Analysis*.
5. (with E. Bossy, V. Jugnon, and H. Kang) Quantitative photo-acoustic imaging of small absorbers, submitted to *SIAM Journal on Applied Mathematics*.
6. (with M. Asch, V. Jugnon, L. Guadarrama Bustos, and H. Kang) Transient wave imaging with limited-

view data, submitted to *SIAM Journal on Imaging Sciences*.

7. (with H. Kang, M. Lim, and H. Zribi) Recovery of fine shape details using the generalized polarization tensors, submitted to *Numerische Mathematik*.
8. (with L. Guadarrama Bustos, H. Kang, and H. Lee) Transient elasticity imaging and time-reversal, submitted to *Proceedings of the Royal Society of Edinburgh: Section A*.
9. (with H. Kang, E. Kim, M. Lim, and K. Louati) A direct algorithm for ultrasound imaging of internal corrosion, submitted to *SIAM Journal on Numerical Analysis*.
10. (with E. Bonnetier, F. Triki, and M. Vogelius) Elliptic estimates in composite media with smooth inclusions: an integral equation approach, preprint.

List of recent invitations to international conferences (from about 45 invitations)

1. Geometric Methods in Inverse Problems and PDE Control, IMA, Minneapolis, July 2001.
2. International Workshop on Photonic and Electromagnetic Crystal Structures, Institute of Pure and Applied Mathematics, Los Angeles CA, October 2002.
3. Computational Methods for Inverse Problems and Applications, Institute of Pure and Applied Mathematics, Los Angeles CA, November 2003.
4. The Second International Conference on Inverse Problems-Recent Development in Theories and Numerics, Shanghai, June 2004.
5. Inverse Problems in Applied Sciences -towards breakthrough, Sapporo, Japan, July 2006.
6. Recent Mathematical and Computational Developments of Maxwell's Equations: Challenges and Frontiers, Weihai, China, July 2006.
7. Calderon Conference, Rio de Janeiro, Brazil, January 2007.
8. The International Conference on Inverse Problems and its Applications, Shanghai, China, October 2008.
9. Korean Mathematical Society: Annual Meeting, October 2008.
10. Conference of Mathematics and Mathematical Physics, Fez, Morocco, October 2008.
11. The First International Conference on Frontiers in Computational Mathematics, Guilin, China, December 2008.
12. Conference on Applied Inverse Problems 2009, Vienna, July 2009.
13. The International Conference on Nanophotonics 2009, Harbin, China, May 2009.
14. Miniworkshop on Recent Analytic Developments in Applied Inverse Problems, Linz, Austria, May 2009.
15. 10th International Conference on Biomedical Applications of Electrical Impedance Tomography (EIT 2009), Manchester, June 2009.
16. Conference on Applied Inverse Problems 2009, Vienna, July 2009.
17. International Conference on Inverse Problems and Applications, Daejeon, Korea, August, 2009.
18. Modern Mathematical Methods in Science and Technology 2009 (M3ST '09), Greece, September 2009.
19. Mathematical Methods in Emerging Modalities of Medical Imaging, Banff International Research Station, Canada, October 2009.
20. WIPA 2010 Workshop on Inverse Problems and Applications, Valparaiso, Chile, January 2010.
21. Some mathematical problems of material science: effects of multiple scales and extreme aspect ratios, Banff International Research Station, Canada, 2010.
22. International Conference on Inverse Problems, Wuhan, China, April 2010.

List of students advised

I advised 14 PhD students: N. Béreux (PhD 1998, currently researcher at EDF), C. Latiri-Grouz (PhD 1999), A. Khelifi (PhD 2002, assistant professor at University of Tunis), F. Triki (PhD 2002, assistant professor at University of Grenoble), K. Touibi (PhD 2004, teacher at high-school), S. Soussi (PhD 2004, lecture at Limerick), E. Iakovleva (PhD 2004, researcher at CEA), H. Zribi (PhD 2005, researcher at KAIST, Korea), K. Laouti (PhD 2006, engineer), A. Dossevi (PhD 2007, teacher at Classes préparatoires), A. Kozhemyak (PhD 2008, engineer), W.K. Park (PhD 2009, assistant professor at Kookmin University, Korea), P. Garapon

(PhD 2009, Szegő assistant professor at Stanford), and S. Khan (postdoc at Harvard Medical School), and 7 postdocs: M. Lim (assistant professor at Korean Advanced Institute of Science and Technology, Korea), E. Kim (researcher at University of Seoul, Korea), H. Lee (assistant professor at Inha University, Korea), A. Rozanova, C. Poinard (researcher at INRIA, Bordeaux), G. Ciruolo (assistant professor at University of Florence), and J.P. Groby (researcher at CNRS). I am currently advising 4 PhD students: V. Jugnon, L. Guadarrama Bustos, J.B. Bellet, and A. Wahab and 3 post-docs: E. Bretin, K. Kalimeris, and S. Gdoura.

Editorial boards

Journal of Computational Mathematics, Mathematical Methods in the Applied Sciences, and Numerical Mathematics: Theory, Methods and Applications.

Organization of conferences, workshops, and seminars

1. Weekly Seminar on Mathematics of Imaging, Institut Henri Poincaré, Paris (2006-); Proceedings published in ESAIM-Proc by the French Applied and Industrial Math. Soc.
2. Minicourse on Mathematics of Emerging Biomedical Imaging III, February 4-6, 2009, Institut Henri Poincaré, Paris.
3. (with H. Kang) Workshop on Imaging Microstructures: Mathematical and Computational Challenges, June 18-20, 2008, Institut Henri Poincaré, Paris; Proceedings published in Contemporary Mathematics by the American Math. Soc.
4. (with H. Kang) Franco-Korean Days of Mathematical Analysis and Its Applications, February 14-15, 2008, Institut Henri Poincaré, Paris.
5. Minicourse on Mathematics of Emerging Biomedical Imaging II, February 11-13, 2008, Institut Henri Poincaré, Paris.
6. Minicourse on Mathematics of Emerging Biomedical Imaging I, March 21-23, 2007, Institut Henri Poincaré, Paris.
7. (with H. Kang) Workshop on Inverse Problems, Multi-Scale Analysis and Homogenization, Seoul, 22-24 June, 2005; Proceedings published in Contemporary Mathematics by the American Math. Soc.
8. Future Directions in Applied Mathematics, 18-21 June 2003, Institut Henri Poincaré, Paris.

Industrial grants and collaborations

CEA-LIST, THALES, L'OREAL, and SCHLUMBERGER.

Agency funds

Agence Nationale de la Recherche (ANR), Direction Générale de l'Armement, Digiteo, Région Ile de France.

Grants for International Collaboration

PHC STAR (South Korea), PHC AMADEUS (Austria), Alliance (Columbia University).

Patent

(with E. Bonnetier, Y. Capdeboscq, M. Tanter, and M. Fink) Electrical Impedance Tomography by Elastic Deformation, WO 2008/037929 A2.