# Daniel D. Lee

**Work address:**
University of Pennsylvania
200 S. 33rd St.
Philadelphia, PA 19104
*Telephone*: (215) 898-8112
*E-mail*: ddlee@seas.upenn.edu

**Home address:**
177 Reldyes Ave.
Leonia, NJ 07605
*Telephone*: (201) 461-4061

## Educational Background

1990-1995 *Massachusetts Institute of Technology* Cambridge, MA
Ph.D. in Condensed Matter Physics, June 1995. Dissertation title: "Interfacial Properties of Surfactant Monolayers in Microemulsion Systems."

1986-1990 *Harvard University* Cambridge, MA
A.B. *summa cum laude* in Physics, June 1990.

## Professional Appointments

2005-present Associate Professor, Graduate Chair, Departments of Electrical and Systems Engineering and Bioengineering, University of Pennsylvania, Philadelphia, PA.

2001-2005 Assistant Professor, Departments of Electrical and Systems Engineering and Bioengineering, University of Pennsylvania, Philadelphia, PA.

1997-2001 Member of Technical Staff, Department of Biological Computation, Bell Laboratories, Lucent Technologies, Murray Hill, NJ.

1995-1997 Postdoctoral Member of Technical Staff, Department of Theoretical Physics, Bell Laboratories, AT&T, Murray Hill, NJ.

1993 Summer Researcher, Exxon Research and Engineering, Annandale, NJ.

1989 Summer Researcher, MIT Materials Processing Center, Cambridge, MA.

1988 Summer Internship, Los Alamos National Laboratory, Los Alamos, NM.

1987 Summer Internship, Lawrence Berkeley Laboratory, Berkeley, CA.

## Awards and Honors

1. NSF CAREER Award (2004).
2. National Academy of Engineering Frontiers of Engineering (2002).
3. Materials Research Society Graduate Student Award (1995).
4. MIT Karl Taylor Compton Fellowship (1990-1995).
5. NSF Graduate Fellowship (1990-1995).

6. Phi Beta Kappa (one of twelve juniors elected at Harvard College) (1990).
7. Putnam Mathematical Competition (top 25) (1988-1990).
8. Harvard National Scholarship (1986-1990).
9. Westinghouse Science Talent Search Scholarship (1986).

## Teaching Experience

1. EAS101: Introduction to Engineering (Fall 2003-2004, EE subsection).
2. EE 531: Digital Signal Processing (Fall 2001-2002, instructor rating 3.7/4.0).
3. EE 400: Microcontroller Laboratory (Spring 2002-2003, instructor rating 4.0/4.0).
4. ESE 350: Embedded Systems Lab (Spring 2004-2005, instructor rating 3.4/4.0).
5. ESE 650: Learning in Robotics (Fall 2004, instructor rating 3.8/4.0).

## PhD Students

1. Jihun Ham (PhD expected 2007): "Graphs and kernels for correspondence learning"
2. Yuanqing Lin (PhD expected 2007): "Machine learning for acoustic and olfactory signals"
3. Ricky Der (PhD expected 2008).

## Service Activities

1. Univ. of Pennsylvania ESE colloquium organizer (2002-2005).
2. Univ. of Pennsylvania ESE graduate admissions committee (2001-2005).
3. Univ. of Pennsylvania ESE strategic planning committee (2004).

## Professional Activities

1. International Robocup competition organizing committee (2004).
2. University of Pennsylvania Robocup team advisor (2003-2004).
3. Canadian Institute of Advanced Research NCAP Associate (2004).
4. Korea Advanced Institute of Science and Technology affiliated faculty (2002-2004).
5. Microsoft Research Faculty Summit (2002-2004).
6. Franklin Institute PACTS Science Museum exhibit organizer (2002-2004).
7. Neural Information Processing Systems workshops chair (2004).
8. Neural Information Processing Systems conference program committee (2001-2003).
9. International Conference on Machine Learning program committee (2004).
10. American Association for Artificial Intelligence conference program committee (2004).
11. Bell Labs World of Science Lecturer (2000).
12. Lucent Global Scholars Program mentor and lecturer (1999-2001).
13. Bell Labs High School Science Grant Program for minority students (1998-2001).
14. FIRST High School Robotics competition organizer (1999-2001).
15. Member of IEEE (2003-2004).

## US Patents

1. "System and method for providing interactive dialogue and iterative search functions to find information," K. August, et. al., U. S. patent 6647383 (2003).
2. "Method of measuring and mapping dispersion variations along the length of an optical fiber," D. J. Thomson, P. P. Mitra, I. M. Brener, D. D. Lee, U. S. patent 6118523 (2000).
3. "Nonnegative linear coding, and apparatus comprising means for such coding," D. D. Lee and H. S. Seung, U. S. patent 6151414 (2000).

## Research Funding

1. "Learning Low-Dimensional Controllers For High-Speed Quadruped Locomotion," PI, DARPA IPTO, $1,750,000, 9/1/05-8/30/08.
2. "Learning Long Range Robot Perception and Navigation," PI, DARPA IPTO, $1,997,800, 10/1/04-9/30/07.
3. "Cellular Inspired Garbage Collection: Ubiquitin System and Memory Management," PI, National Science Foundation 0432025, $125,000, 8/15/04-8/14/06.
4. "MACNet: Mobile Ad-hoc Camera Networks," co-PI, National Science Foundation 0347132, $200,000, 8/01/04-7/31/05.
5. "CAREER: Biologically Inspired Learning Algorithms for Artificial Sensorimotor Systems," PI, National Science Foundation, $400,000, 7/01/04-6/30/09.
6. "Multimodal Olfactory Scene Analysis," PI, Army Research Office, $460,000, 7/21/03-6/20/06.
7. "Embedded Sensor-Actuator Networks," PI, Microsoft Research, $25,000, 7/1/03-6/30/04.
8. "Adaptive Flight Control for Unmanned Air Vehicles," co-PI, NASA, $30,000, 6/1/03-5/31/04.
9. "ANTIDOTE: Adaptive Network of Robots for Threat and Intrusion Detection and Emergency Response," co-PI, NSF 0205336, $400,000, 9/1/02-8/31/05.
10. "Distributed 3-D Mobile Sensor Network," PI, Univ. of Pennsylvania Research Foundation, $9,000, 7/1/02-6/30/03.

## Book Chapters

1. "Spectral methods for dimensionality reduction." L. K. Saul, K. Q. Weinberger, F. Sha, J. H. Ham, and D. D. Lee (2005). Spectral methods for dimensionality reduction. To appear in B. Schoelkopf, O. Chapelle, and A. Zien (eds.), Semisupervised Learning. MIT Press: Cambridge, MA.

## Journal Publications

2. "Correlation of pneumonia score with electronic nose signature: a prospective study," N.G. Hockstein, E.R. Thaler, Y. Lin, D.D. Lee, C.W. Hanson, *Annals of Otology, Rhinology, and Laryngology* **111**, 7 (2005).
3. "Bayesian regularization and nonnegative deconvolution (BRAND) for room impulse response estimation," Y. Lin and D. D. Lee, accepted to *IEEE Trans. Signal Processing* (2004).
4. "Short-term memory in orthogonal neural networks," O. L. White, D. D. Lee and H. Sompolinsky, *Phys. Rev. Lett.* **92**, 148102 (2004).
5. "Spontaneous eye movements in goldfish: oculomotor integrator performance, plasticity, and dependence on visual feedback," B. D. Mensh, E. Aksay, D. D. Lee, H. S. Seung and D. W. Tank, *Vision Research* **44**, 711-726 (2004).
6. "The diagonalization of quantum field Hamiltonians," D. J. Lee, N. Salwen, and D. D. Lee, *Phys. Lett.* **B503**, 223-235 (2001).
7. "Equilibrium properties of temporally asymmetric Hebbian plasticity," J. Rubin, D. D. Lee and H. Sompolinsky, *Phys. Rev. Lett.* **86**, 364-367 (2001).
8. "The manifold ways of perception," H. S. Seung and D. D. Lee, *Science* **290**, 2268-2269 (2000).
9. "Stability of the memory of eye position in a recurrent network of conductance-based model neurons," H. S. Seung, D. D. Lee, B. Y. Reis and D. W. Tank, *Neuron* **26**, 259-271 (2000).
10. "The autapse: A simple illustration of short-term analog memory storage by tuned synaptic feedback," H. S. Seung, D. D. Lee, B. Y. Reis and D. W. Tank, *J. Computational Neuroscience* **9**, 171-185 (2000).
11. "Learning the parts of objects with nonnegative matrix factorization," D. D. Lee and H. S. Seung, *Nature* **401**, 788-791 (1999).
12. "High-resolution zero-dispersion wavelength mapping in single-mode fiber," I. Brener, P. P. Mitra, D. D. Lee, D. J. Thomson, and D. L. Philen, *Opt. Lett.* **23**, 1520-1522 (1998).
13. "Morphological characterization of bicontinuous phase-separated polymer blends and one-phase microemulsions," H. Jinnai, T. Hashimoto, D. D. Lee, S. H. Chen, *Macromolecules* **30**, 130-136 (1997).
14. "Measurement of the Gaussian curvature of the surfactant film in an isometric bicontinuous one-phase microemulsion," S. H. Chen, D. D. Lee, K. Kimishima, H. Jinnai, T. Hashimoto, *Phys. Rev. E* **54**, 6526-6531 (1996).
15. "X-ray off-specular reflectivity studies of electrochemical pitting of Cu surface in sodium bicarbonate solution," Y. P. Feng, S. K. Sinha, C. A. Melendres, D. D. Lee, *Physica B* **221**, 251-256 (1996).

16. "Bulk and surface correlations in a microemulsion," D. D. Lee, S. H. Chen, C. F. Majkrzak, S. K. Satija, *Phys. Rev. E* **52**, R29-R33 (1995).
17. "X-ray diffuse scattering for the *in situ* study of electrochemically induced pitting on metal surfaces," C. A. Melendres, Y. P. Feng, D. D. Lee, S. K. Sinha, *J. Electrochem. Soc.* **142**, L19 (1995).
18. "Local geometry of surfactant monolayers in a ternary microemulsion system," D. D. Lee and S. H. Chen, *Phys. Rev. Lett.* **73**, 106-109 (1994).
19. "X-ray reflectivity study of an oil-water interface in equilibrium with a middle-phase microemulsion," B. R. McClain, D. D. Lee, B. L. Carvalho, S. G. J. Mochrie, S. H. Chen, J. D. Litster, *Phys. Rev. Lett.* **72**, 246-249 (1994).
20. "Visualization of 3D microstructure of bicontinuous microemulsions by combined SANS experiments and simulations," S. H. Chen, D. D. Lee, S. L. Chang, *J. Mol. Struct.* **296**, 259-264 (1993).
21. "Computer generation of binary and ternary phase diagrams via a convex hull method," D. D. Lee, J. H. Choy, J. K. Lee; *J. Phase Equil.* **13**, 365-372 (1992).

## Refereed Conference Proceedings

1. "Bayesian $L_1$-norm sparse learning," Y. Lin and D. D. Lee, submitted to *International Conference on Acoustics, Speech, and Signal Processing* (2005).
2. "Room impulse response estimation using sparse online prediction and absolute loss," K. Crammer and D. D. Lee, submitted to *International Conference on Acoustics, Speech, and Signal Processing* (2005).
3. "Rao-Blackwellized particle filtering for 6-DOF estimation of attitude and position via GPS and inertial sensors," P. Vernaza and D. D. Lee, to appear in *International Conference on Robotics and Automation* (2005).
4. "Bayesian regularization and nonnegative deconvolution (BRAND) for acoustic echo cancellation," Y. Lin and D. D. Lee, to appear in *IEEE Workshop on Applications of Signal Processing to Audio and Acoustics* (2005).
5. "Learning nonlinear appearance manifolds for robot localization," J. Ham, Y. Lin, and D. D. Lee, to appear in *International Conference on Intelligent Robots and Systems* (2005).
6. "Cooperative relative robot localization with audible acoustic sensing," Y. Lin, P. Vernaza, J. Ham, and D. D. Lee, to appear in *International Conference on Intelligent Robots and Systems* (2005).
7. "Semisupervised alignment of manifolds," J. Ham, D. D. Lee, and L. K. Saul, *Proceedings of the Tenth International Workshop on Artificial Intelligence and Statistics,* 120-127 (2005).
8. "Relevant deconvolution for acoustic source estimation," Y. Lin and D. D. Lee, to appear in *International Conference on Acoustics, Speech, and Signal Processing* (2004).

9. "Bayesian regularization and nonnegative deconvolution for time delay estimation," Y. Lin and D. D. Lee, to appear in *Advances in Neural and Information Processing Systems* (2004).
10. "Diagnosis of pneumonia using an electronic nose: a prospective study," N. G. Hockstein, E. R. Thaler, W. T. Miller, D. A. Torigian, D. D. Lee, C. W. Hanson, *Proceedings of the Triological Society* (2004).
11. "A kernel view of the dimensionality reduction of manifolds," J. H. Ham, D. D. Lee, and S. Mika, and B. Schoelkopf, *Proceedings of the International Conference on Machine Learning* (2004).
12. "Nonnegative deconvolution for time of arrival estimation," Y. Lin, D. D. Lee and L. K. Saul, *International Conference on Acoustics, Speech, and Signal Processing* (2004).
13. "The University of Pennsylvania Robocup 2003 Legged Soccer Team," D. Cohen, Y. H. Ooi, P. Vernaza, and D. D. Lee, *Robocup 2003: Robocup Soccer World Cup VII* (2003).
14. "Learning high dimensional correspondences with low dimensional manifolds," J. H. Ham, D. D. Lee, and L. K. Saul, *Proceedings of the ICML 2003 Workshop on The Continuum from Labeled to Unlabeled Data in Machine Learning and Data Mining,* 34-41 (2003).
15. "Statistical signal processing with nonnegativity constraints," L. K. Saul, F. Sha, and D. D. Lee, *Proceedings of the Eighth European Conference on Speech Communications* **2**, 1001-1004 (2003).
16. "Multiplicative updates for large margin classifiers," F. Sha, L. K. Saul, and D. D. Lee, *Proceedings of the Sixteenth Annual Conference on Computational Learning Theory,* 188-202 (2003).
17. "Real time voice processing with audiovisual feedback: toward autonomous agents with perfect pitch," L. K. Saul, D. D. Lee, C. L. Isbell and Y. Lecun, *Advances in Neural and Information Processing Systems* **15**, 1181-1188 (2003).
18. "Multiplicative updates for nonnegative quadratic programming in support vector machines," F. Sha, L. K. Saul and D. D. Lee, *Advances in Neural and Information Processing Systems* **15**, 1041-1048 (2003).
19. "Dimensionality reduction for sensorimotor learning in mobile robots," D. D. Lee, *Proceedings of the SPIE* **4479**, 4-11 (2002).
20. "Multiplicative updates for classification by mixture models," L. K. Saul and D. D. Lee, *Advances in Neural and Information Processing Systems* **14**, 897-904 (2002).
21. "Biologically inspired computation and learning in sensorimotor systems," D. D. Lee and H. S. Seung, *Proceedings of the SPIE* **4479**, 4-11 (2001).
22. "Algorithms for non-negative matrix factorization," D. D. Lee and H. S. Seung, *Advances in Neural and Information Processing Systems* **13**, 556-562 (2001).
23. "An information maximization approach to overcomplete and recurrent representations," O. Shriki, H. Sompolinsky, and D. D. Lee, *Advances in Neural and Information Processing Systems* **13**, 612-618 (2001).

24. "Algorithms for independent components analysis and higher order statistics," D. D. Lee, U. Rokni, and H. Sompolinsky, *Advances in Neural and Information Processing Systems* **12**, 491-497 (2000).
25. "The nonnegative Boltzmann machine," O. B. Downs, D. J. C. MacKay, and D. D. Lee, *Advances in Neural and Information Processing Systems* **12**, 428-434 (2000).
26. "Learning in intelligent embedded systems," D. D. Lee and H. S. Seung, *Usenix Proceedings*, Workshop on Embedded Systems (1999).
27. "Learning a continuous hidden variable model for binary data," D. D. Lee and H. Sompolinsky, *Advances in Neural and Information Processing Systems* **11**, 515-521 (1999).
28. "A new technique for zero-dispersion wavelength mapping in single mode fiber with high spatial resolution," I. Brener, D. D. Lee, P. P. Mitra, D. L. Philen, and D. J. Thomson, *European Conf. Opt. Comm. Proc.* (1998).
29. "A neural network based head tracking system," D. D. Lee and H. S. Seung, *Advances in Neural and Information Processing Systems* **10**, 908-914 (1998).
30. "The rectified Gaussian distribution," N. D. Socci, D. D. Lee and H. S. Seung, *Advances in Neural and Information Processing Systems* **10**, 350-356 (1998).
31. "Unsupervised learning by convex and conic coding," D. D. Lee and H. S. Seung, *Advances in Neural and Information Processing Systems* **9**, 515-521 (1997).
32. "Nonlinear network models of the oculomotor integrator," D. D. Lee, B. Y. Reis, H. S. Seung, D. W. Tank, *Computational Neuroscience* **5**, 371 (1997).
33. "Off-specular x-ray scattering studies of the morphology of thin films," S. K. Sinha, Y. P. Feng, C. A. Melendres, D. D. Lee, T. P. Russell, S. K. Satija, E. B. Sirota, M. K. Sanyal, *Physica A* **231**, 99 (1996).
34. "Interfacial scattering from surfactant monolayers in microemulsions," D. D. Lee, B. R. McClain, B. L. Carvalho, S. G. J. Mochrie, J. D. Litster, S. H. Chen, C. F. Majkrzak, S. K. Satija, *Physica B* **221**, 296-300 (1996).
35. "Bulk and surface structure of a ternary microemulsion," D. D. Lee, S. H. Chen, S. K. Satija, C. F. Majkrzak, *Mat. Res. Soc. Proc.* **376**, 241 (1995).
36. "Geometry of bicontinuous microemulsions as revealed by SANS and simulations," D. D. Lee and S. H. Chen, *Il Nuovo Cimento* **16D**, 1357-1366 (1994).
37. "Absolute calibration of small angle neutron scattering data using strong coherent scattering," D. D. Lee, J. Barker, S. H. Chen, *J. Phys. (Paris)* IV **C8**, 431-434 (1993).

## Invited Presentations (2002-present)

1. "Sensorimotor learning in robotics," Robotics Institute, Carnegie Mellon University, Pittsburgh, PA, March 2005.

2. “Sensorimotor learning in robotics,” Broad Area Colloquium for AI, Geometry, Graphics, Robotics, and Computer Vision, Stanford University, Stanford, CA, March 2005.
3. “Machine learning for sensorimotor processing,” Kavli Institute for Theoretical Physics, UCSB, Santa Barbara, CA, September 2004.
4. “Cellular garbage collection: the ubiquitin system,” AEARU International Symposium on Biosystems, Daejeon, Korea, August 2004.
5. “Machine learning for sensorimotor processing,” KSEA/UKC Robotics Symposium, Durham, NC, August 2004.
6. “Nonnegative matrices in machine learning,” Hamilton Institute Workshop, NUI Maynooth, Ireland, July 2004.
7. “Learning in sensorimotor systems,” DARPA/Defense Sciences Research Council Workshop on Hardware Fabric of Intelligent Machines, Monterrey, CA, March 2004.
8. “Learning in sensorimotor systems,” USA-Korea Joint Symposium on MEMS and Biosystems Technology, Berkeley, CA, March 2004.
9. “Motor learning algorithms in robotics,” Hebrew University Workshop on Motor Control, Jerusalem, Israel, December 2003.
10. “Learning in sensorimotor systems”, Neural Information Processing Systems conference tutorial, Vancouver, Canada, December 2003.
11. “Learning with correspondences,” Canadian Institute for Advanced Research workshop, Vancouver, Canada, December 2003.
12. “Learning in artificial sensorimotor systems,” Department of Mathematical Sciences, New Jersey Institute of Technology, Newark, NJ, October 2003.
13. “Biologically inspired learning algorithms,” International Joint Conference on Neural Networks panel discussion, Portland, OR, July 2003.
14. “Learning algorithms for olfaction,” Mathematical Biosciences Institute, Ohio State University, Columbus, OH, April 2003.
15. “Sensorimotor learning in olfactory systems,” Monell Chemical Senses Center, Philadelphia, PA, March 2003.
16. “Making a robot dog see and hear,” Statistics Department, Rutgers University, New Brunswick, NJ, November 2002.
17. “Making a robot dog see and hear,” Mathematical Biology Department, Rockefeller University, New York, NY, April 2002.
18. “Making a robot dog see and hear,” Institute for Research in Cognitive Sciences, Univ. of Pennsylvania, Philadelphia, PA, February 2002.

## Undergraduate Mentoring

1. "Speech-based air traffic controller," Sith Chaisurote, Toon Tantimekabut, 2004.
2. "Virtual keyboard interface," Jared Miller, Sudhir Shaunak, 2004.
3. "Virtual reality glove," Yao Hua Ooi, Bryan Chao, 2004.
4. "Bluetooth smart remote," Michael Lyons, Sumati Mathur, 2004.
5. "Ultrasonic position tracking," Giridhar Nandipati, Aunim Hossain, 2004.
6. "Coordinated chemical sensing," Ray Ciarcia, Brian Corwin, Paul Vernaza, 2004.
7. "Binaural auditory localization," Emery Ku, Summer 2003.
8. "Cable-suspended sensor node," Greg Kuperman, Summer 2003.
9. "Perl-based robot monitor," Brian Corwin, Summer 2003.
10. "Reverse engineering Sony OPEN-R," Gabriel Jinich, Eduardo Viera de Fonseca, 2003.
11. "GUI for robotic remote control," Catherine Gooi, Candace Lin, 2003.
12. "IR communications for handheld devices," Steve Battle, Jacob Rank, 2003.
13. "Modulator/demodulator for ultrasonic communications," Ryan Hinkle, Michael Nigro, Asif Rahman, 2003.
14. "Software architecture for multi-robot control," Yen Chu Cheng, Kian Neng Lim, 2003.
15. "Embedded controller for cable-suspended locomotion," Yao Hua Ooi, Summer 2002.
16. "Portable EEG instrumentation," Sona Desai, Sara Pomerantz, Allison Schlaff, 2002.
17. "Bluetooth speaker system," Jai Gupta, Scott Stinson, Azmat Yusuf, 2002.
18. "Solar car telemetry," Michael Ching, David Ha, Adithya Mathai, 2002.
19. "FPGA circuit evolution," Henry Chan, Frank Hsu, Tom Olsen, 2002.
20. "Multicast IP robot control," Alemayehu Addis, Matthew Lo, 2002.

## Personal Data

Born in Redwood City, California, on December 22, 1969; United States citizen; Married to Lisa Park, 1995; son Jordan Lee, born 2001; daughter Jessica Lee, born 2003.