Revised Wednesday, December 15, 21

**Ramakrishna Janaswamy**

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## EDUCATION:

Ph.D.: University of Massachusetts, Amherst, Electrical Engineering, 1986.
M.Tech.: Indian Institute of Technology, Kharagpur, India, Electronics & Communication Engineering, 1983.
B.Tech.: Regional Engineering College, Warangal, India, Electronics & Communication Engineering, 1981.

## PROFESSIONAL HISTORY:

2001-Present: Professor, Department of Electrical & Computer Engineering, *University of Massachusetts, Amherst*; Graduate Program Director (July 2005-July 2008); Chair, College Personnel Committee (July 2006-July 2009, July 2010-July 2012).

1987-2001: Professor (July 00), Tenure (July 92), Associate Professor (July 91), Assistant Professor (August 87-June 91), Department of Electrical & Computer Engineering, *Naval Postgraduate School, Monterey, California*.

September 1997-June 1998: Visiting Researcher, Center for PersonKommunikation, *Aalborg University, Denmark*.

1986-1987: Assistant Professor of Electrical Engineering, School of Engineering & Physical Sciences, *Wilkes University, Wilkes-Barre, Pennsylvania*.

Summer 1994: *NASA Ames Research Center, Moffett Field, CA.*
Summer 1995: *SPAWARSYSCEN, San Diego, CA.*
Summer 1987: Dept. of ECE, University of Illinois, Urbana, IL.

## HONORS & AWARDS:

- *Certificate of Appreciation for Outstanding Contributions*, IEEE Standards Association, IEEE Std 211-2018, September 2018; IEEE Std 356-2020, October 2020.
- *Distinguished Alumni Professional Achievement Award*, National Institute of Technology, Warangal, India, October 2017.
- *College of Engineering Outstanding Teacher*, University of Massachusetts, Amherst, 2014.
- *Distinguished Foreign Scientist Award*, Council of Scientific and Industrial Research, India, August 2013.
- *Fellow of IEEE*, January 2003.
- *IEEE Third Millennium Medal*, January 2000, IEEE Santa Clara Valley Section.
- 1995 *R.W.P. King Best Paper* Award*, IEEE Transactions on Antennas and Propagation*.
- *Certificate of Recognition for Outstanding Research Contributions*, Office of Naval Research, 1995; Naval Postgraduate School, 1991.
- Secured *All India First Rank* in the Graduate Aptitude Technical Examination,1983.

- *Gold Medal* awarded for standing 1st in the aggregate 5-year undergraduate program, Regional Engineering College, Warangal, India, 1981. Name included in the ECE Roll of Honor List.

**RESEARCH ACTIVITIES:**

**Patent**:

**R. Janaswamy** and D. Gupta, "System and Method for Adaptive Correction to Phased Array Antenna Array Coefficients through Dithering and Near-field Sensing,'' **US 8,299,964 B2**.

*PUBLICATIONS:*

**Books:**

[RJ20a] R. Janaswamy, *Engineering Electrodynamics: A Collection of Theorems, Principles and Field Representations*, Bristol, UK: Institute of Physics, pp. 575, December 2020,
**ISBN** 978-0-7503-1716-0, I**SBN** 978-0-7503-1714-6.

[RJ00c] R. Janaswamy, *Radiowave Propagation and Smart Antennas for Wireless Communications*, Boston: Kluwer Academic Publishers, pp. 312, November 2000, **ISBN**-13: 978-0792372417, **ISBN**-10: 0792372417.

**Book Chapters:**

[RJ01b] R. Janaswamy, Spatial Diversity in Wireless Communications, *Handbook of Antennas in Wireless Communications*, L. Godara, Ed., CRC Press, August 2001.

[RJ05a] R. Janaswamy, *Signal Fading in Radio Communications*, Wiley Encyclopedia of RF and Microwave Engineering, K. Chang (Ed.), 2005.

**IEEE Standards**: (Joint Author)

IEEE Std 356-2020, IEEE Guide for Measurements of Electromagnetic Properties of Earth Media, September 2020.

IEEE Std 211-2018, IEEE Standard Definition of Terms for Radio Wave Propagation, October 2018.

**Refereed Journal Articles:**

<u>Wireless Networks:</u>

[RJ08a] V. Namboodiri, L. Gao and **R. Janaswamy**, "Power efficient topology control for static wireless networks with switched beam directional antennas,'' *Elsevier Ad Hoc Networks,* Vol. 6, No. 2, April 2008.

<u>MIMO Communication Systems:</u>

[RJ09e] J. Xu, D. Goeckel and **R. Janaswamy**, "The capacity of MIMO systems with increasing SNR by electromagnetic analysis,'' *IEEE Trans. Wireless Commun.,* vol. 8(9), pp. 4752-4761, September 2009.

[RJ09d] J. Xu and **R. Janaswamy**, "Angular correlation properties with random multiple scattering,'' *IEEE Trans. Signal Proccessing, vol.* 57(7), pp. 2651-2659, July 2009.

[RJ09c] J. Xu and **R. Janaswamy**, "A double-angular propagation model with cluster scattering,'' *IEEE Trans. Antennas and Propagation,* vol. 57(4), pp. 1228-1240, April 2009.

[RJ06a] J. Xu and **R. Janaswamy**, "Electromagnetic degrees of freedom in 2-D scattering environments,'' *IEEE Trans. Antennas and Propagation,* vol. 54(12), pp. 3882-3894, December 2006.

[RJ05b] S-Q.Wei, D. Goeckel and **R. Janaswamy**, "On the asymptotic capacity of MIMO systems with antenna arrays of fixed length,'' *IEEE Trans. Wireless Commun*., vol. 4(4), pp. 1608-1621, May 2005.

[RJ05c] B. N. Getu and **R. Janaswamy**, "The effect of mutual coupling on the capacity of the MIMO cube,'' *IEEE Antennas and Wireless Propagation Letters,* vol. 4, pp. 240-244, 2005.

[RJ02d] **R. Janaswamy**, "Effect of element mutual coupling on the capacity of fixed length linear arrays, *IEEE Antennas and Wireless Propagation Letters*, vol. 1(8), pp. 157-160, August 2002.

Quantum Mechanical Methods:

[RJ09b] **R. Janaswamy**, "Transitional probabilities for the four-state random walk on a lattice in the presence of partially reflecting boundaries,'' *J. Mathematical Physics,* vol. 50(5), Pages: 053301 (11 pp), May 2009.

[RJ09a] **R. Janaswamy**, "Transparent boundary condition for the parabolic equation modeled by the 4RW,'' *IEEE Antennas and Wireless Propagation Letters,* vol. 8, pp. 23-26, 2009.

[RJ08c] **R. Janaswamy**, "Transitional probabilities for the 4-state random walk on a lattice,'' *J. Phys. A: Mathematical & Theoretical*, vol. 41, Pages: 155306 (11pp), April 2008.

Statistical Wave Propagation:

[RJ08b] J. Xu and **R. Janaswamy**, "On the diffusion of electromagnetic waves and applicability of diffusion equation to multipath random media,'' *IEEE Trans. Antennas and Propagation,* vol. 56(4), April 2008.

[RJ06b] **R. Janaswamy**, "An indoor pathloss model at 60 GHz based on transport theory,'' *IEEE Antennas and Wireless Propagation Letters*, vol. 5, pp. 58-60, 2006.

[RJ02c] **R. Janaswamy**, "Angle of arrival statistics for a 3D spheroid model,'' *IEEE Trans. Vehicular Tech.*, vol. 51(5), pp. 1242-1247, September 2002.

[RJ02b] **R. Janaswamy**, "Angle of arrival and time of arrival statistics for Gaussian scatter density model,'' *IEEE Trans. Wireless Commun*., vol. 1 (3), pp. 488-497, July 2002.

Deterministic Wave Propagation:

[RJ19b] L. Azpilicueta, F. Falcone, and **R. Janaswamy**, ``Hybrid computational techniques: electromagnetic propagation analysis in complex environments, *IEEE Antennas and Propagation Magazine*, vol. 61 (6), pp. 20-30, December 2019.

[RJ17b] L. Azpilicueta, F. Falcone, and **R. Janaswamy**, ``A hybrid ray launching-diffusion equation approach for propagation prediction in complex indoor environments,'' *IEEE Antennas Wir. Propagat. Lett*., vol. 16, pp. 214-217, 2017.

[RJ13b] **R. Janaswamy**, "Direct solution of current density induced on a rough surface by forward propagating waves," *IEEE Trans. Antennas and Propagation*, vol. 61(7), pp. 3728-3738, July 2013.

[RJ10a] R. Martelly and **R. Janaswamy**, "Modeling radio transmission loss in curved, branched and rough-walled tunnels with the ADI-PE method,'' *IEEE Trans. Antennas and Propagation*, vol. 58(6), pp. 2037-2045, June 2010.

[RJ09f] R. Martelly and **R. Janaswamy**, "An ADI-PE approach for modeling radio transmission loss in tunnels,'' *IEEE Trans. Antennas and Propagation,* vol. 57(6), pp. 1759-1770, June 2009.

[RJ06c] Z. H. Lai and **R. Janaswamy**, "Specular propagation over rough surfaces: numerical assessment of Uscinski and Stanek's mean Green's function technique,'' *Waves in Random and Complex Media*, vol. 16(2), pp. 137-150, May 2006.

[RJ03a] **R. Janaswamy**, "Path loss predictions in the presence of buildings on flat terrain: A 3D parabolic equation approach,'' *IEEE Trans. Antennas and Propagation*, vol. 51(8), pp. 1716-1728, August 2003.

[RJ00b] **R. Janaswamy** and K. Rizk, "Addendum to path loss predictions in urban areas with irregular terrain topography,'' *Wireless Personal Communications*, vol. 14 (3), pp. 303-304, September 2000.

[RJ00a] **R. Janaswamy** and J. B. Andersen, "Path loss predictions in urban areas with irregular terrain topography," *Wireless Personal Communications*, vol. 12 (3), pp. 255-268, March 2000.

[RJ98] **R. Janaswamy**, "A curvilinear coordinate based, split-step parabolic equation method for propagation predictions over terrain," *IEEE Trans. Antennas and Propagation*, vol. 46 (7), pp. 1089-1097, July 1998.

[RJ94] **R. Janaswamy**, "A fast finite difference method for propagation predictions over irregular, inhomogeneous terrain," *IEEE Trans. Antennas and Propagation*, vol. 42 (9), pp. 1257--1267, September 1994.

[RJ92c] **R. Janaswamy**, "A Fredholm integral equation approach to propagation predictions over small terrain irregularities," *IEEE Trans. Antennas and Propagation*, vol. 40 (11), pp. 1416--1422, November 1992.

Computational Electromagnetics:

[RJ17a] **R. Janaswamy**, ``Field determination near plasmonic structures by the Feynman-Kac stochastic representation,'' *IEEE Antennas Wir. Propagat. Lett.*, vol. 16, pp. 1643-1646, 2017.

[RJ 2014] S. Ozbayat, S and **R. Janaswamy**, "Assessment of adaptive sparse grid collocation methods in wave propagation environments with uncertainty,'' *IEEE Trans. Antennas and Propagation,* vol. 62(12), pp. 6354-6364, December 2014.

[RJ11a] S. Ozbayat and **R. Janaswamy**, "Effective local absorbing boundary conditions for a finite-difference implementation of the parabolic equation,'' *IEEE Trans. Antennas and Propagation,* vol. 59 (5), pp. 1616-1625, May 2011.

[RJ02a] J. R. Kuttler and **R. Janaswamy**, "Improved Fourier transform methods for solving the parabolic equation,'' *Radio Science*, vol. 37 (2), pp. 5.1—5.11, March-April 2002.

[RJ97] **R. Janaswamy** and Y. Liu, "An unstaggered, colocated finite difference method for solving time domain Maxwell's equations in curvilinear coordinates," *IEEE Trans. Antennas and Propagation*, vol. 45 (11), pp. 1584-1591, November 1997.

[RJ95] P. Dutta, Y. Joshi and **R. Janaswamy**, "Thermal modeling of tungsten arc-welding process with non-axi-symmetric boundary conditions,'' *Numer. Heat Tr. A-Appl*., vol. 27 (5), pp. 499-518, May 1995.

[RJ92b] **R. Janaswamy**, "2-D radiation boundary conditions on an arbitrary outer boundary," *Microwave and Optical Technology Letters*, vol. 5 (8), pp. 393--395, July 1992.

[RJ91] **R. Janaswamy**, "On the applicability of OSRC technique to homogeneous scatterers," *IEEE Trans. Antennas and Propagation*, vol. 39 (6), pp. 862--867, June 1991.

[RJ87b] **R. Janaswamy**, "A simplified expression for the self/mutual impedance between two coplanar and parallel surface monopoles," *IEEE Trans. Antennas and Propagation*, vol. 35 (10), pp. 1174--1176, October 1987.

Electromagnetic Scattering:

[RJ11b] **R. Janaswamy**, "On the EM degrees of freedom in scattering environments,'' *IEEE Trans. Antennas and Propagation*, vol. 59 (10), pp. 3872-3881, October 2011.

[RJ92a] **R. Janaswamy**, "Oblique scattering from lossy periodic surfaces with application to anechoic chamber absorbers," *IEEE Trans. Antennas and Propagation*, vol. 40 (2), pp. 162--169, February 1992.

[RJ88] **R. Janaswamy** and S. W. Lee, "Scattering from dipoles loaded with diodes," *IEEE Trans. Antennas and Propagation*, vol. 36 (11), pp. 1649--1651, November 1988.

Electromagnetic Theory:

[RJ17f] **R. Janaswamy**, ``Consistency requirements for integral representations of Green's functions, Pt II: An erroneous representation,'' IEEE Transactions Antennas and Propagation, vol. 66(8), pp. 4069-4076, August 2018.

[RJ17e] **R. Janaswamy**, ``Consistency requirements for integral representations of Green's functions, Pt I'', IEEE Transactions Antennas and Propagation, vol. 66(8), pp. 4060-4068, August 2018.

[RJ13c] **R. Janaswamy**, ``Comments on "A Physics Based Green's Function for Analysis of Vertical Electrical Dipole Radiation Over an Imperfect Ground Plane"'', *IEEE Trans. Antennas and Propagation*, October 2013.

[RJ13a] **R. Janaswamy**, "On random time and on the relation between wave and telegraph equations," *IEEE Trans. Antennas and Propagation*, vol. 61(5), pp. 2735-2744, May 2013.

[RJ03b] **R. Janaswamy**, "A note on the TE/TM decomposition of electromagnetic fields in three-dimensional homogeneous space,'' *IEEE Trans. Antennas and Propagation*, vol. 52(9), pp. 2474-2477, September 2004.

[RJ01a] **R. Janaswamy**, "Radio wave propagation over a non-constant immittance plane,'' *Radio Science*, vol. 36(3), pp. 387-405, May-June 2001.

[RJ90b] **R. Janaswamy**, "Wiener-Hopf analysis of the asymmetric slotline," *Radio Science*, vol. 25 (5), pp. 699--706, September-October 1990.

Signal Processing/ System Modeling:

[RJ19a] H. Bai, M. F. Duarte, and **R. Janaswamy**, ``Direction of Arrival Estimation for Complex Sources Through ℓ1 Norm Sparse Bayesian Learning,'' IEEE Signal Processing Letters, vol. 26(5), pp. 765-769.

[RJ18a] **R. Janaswamy**, P. Loring, and J. McLaren, ``A state space technique for wildlife position estimation using non-simultaneous signal strength measurements,'' arXiv preprint arXiv:1805.11171, May 2018.

Antenna Analysis & Design:

[RJ22a] **R. Janaswamy**, ``Input admittance, directivity and quality factor of biconical antenna of arbitrary cone angle,'' *IEEE Trans. Antennas and Propagation*, to appear in 2022.

[RJ17c] J. A. Maloney, D.H. Kwon, S. D. Keller, and **R. Janaswamy**, ``Realistic GPS coverage prediction for dual-polarized controlled reception pattern antennas,'' *IEEE Antennas Wir. Propagat., Lett.*, vol. 16, pp. 1907-1910, 2017.

[RJ17d] K. Selvan and **R. Janaswamy**, ``Fraunhoffer and Fresnel Distances: Unified derivation for aperture antennas,'' *IEEE Antennas & Propagation Magazine*, August 2017.

[RJ10b] **R. Janaswamy**, D. Gupta, and D. H. Schaubert, "Adaptive correction to array coefficients through dithering and near-field sensing,'' *IEEE Trans. Antennas and Propagation*, vol. 58(11), pp. 3558-3567, November 2010.

[RJ89] **R. Janaswamy**, "An accurate moment method model for the tapered slot antenna," *IEEE Trans. Antennas and Propagation*, vol. 37 (12), pp. 1523--1528, December 1989.

[RJ87a] **R. Janaswamy** and D. H. Schaubert, "Analysis of the tapered slot antenna," *IEEE Trans. Antennas and Propagation*, vol. 35 (9), pp. 1058--1065, September 1987.

[RJ86b] **R. Janaswamy**, D. H. Schaubert and D. M. Pozar, "Analysis of the TEM mode tapered slot antenna," *Radio Science*, vol. 21 (5), pp. 797--804, September-October 1986.

Microwave Circuits:

[RJ2015a] **R. Janaswamy**, "General Properties for Determining Power Loss and Efficiency of Passive Multi-Port Microwave Networks,'' *IETE Technical Review*, 20 July 2015, DOI:10.1080/02564602.2015.1064330,

[RJ90a] **R. Janaswamy**, "Even mode characteristics of the bilateral slotline," *IEEE Trans. Microwave Theory Tech*., vol. 38 (6), pp. 760--765, June 1990.

[RJ86a] **R. Janaswamy** and D. H. Schaubert, "Characteristic impedance of a wide slotline on a low permittivity substrate," *IEEE Trans. Microwave Theory Tech*., vol. 33 (8), pp. 900--902, August 1986.

[RJ85] **R. Janaswamy** and D. H. Schaubert, "Dispersion characteristics of wide slotlines on low permittivity substrates," *IEEE Trans. Microwave Theory Tech*., vol. 32 (8), pp. 723--726, August 1985.

[RJ84] B. N. Das, **J. Ramakrishna**, and B. K. Sarap, "Resonant conductance of inclined slots on the narrow wall of a rectangular waveguide,'' *IEEE Trans. Antennas and Propagation*, vol. 32(7), pp. 759-761, July 1984.

Radar Systems:

[RJ06d] Y. Hao, D. Goeckel, **R. Janaswamy**, and S. Frasier, "Surface Refractive Index (RI) field estimation from multiple radars,'' *Radio Science*, vol. 41, pp. RS3002, 1-18, 2006.

[RJ06e] Z. Culcouglu, S. Frasier and **R. Janaswamy**, "Considerations for bistatic probing of clear-air winds at short radio wavelength," *Radio Science*, vol. 41, pp. RS3003, 1-11, 2006.

**TEACHING ACTIVITIES:**

*GRADUATE COURSES TAUGHT:*

Nonlinear Dynamics and Engineering Applications (*course developed*), Modern Methods in EM Analysis (*course developed*), Linear Systems Theory, Microwave and RF Design of Wireless Systems, Wireless Propagation and Smart Antennas (*course developed*), Communications Engineering, Fiber Optic System Fundamentals, Optoelectronic Engineering, Advanced Electromagnetic Theory, Introduction to Radar Systems, Antenna Theory and Design, Microwave Active Devices, Electromagnetic Radiation, Scattering & Propagation, and Radiowave Propagation (*course developed*).

*UNDERGRADUATE COURSES TAUGHT:*

Analytical Tools for ECE, Microwave Engineering II, Probabilistic Analysis of Signals and Systems, Fourier Analysis of Signals and Systems, Analog and Digital Communication

Systems, Circuit Analysis-I, Introduction to MATLAB, Introduction to Fields and Waves, Electromagnetic Engineering, Microwaves & Antenna Systems, Microwave & Communications Lab, Fiber Optic Communications.

*GRADUATE MENTORING:*

Supervised the completion of 25 Master's theses, 1 Engineer's degree, 5 PhD dissertations, and 3 post-doctoral research fellowships. Mentees are all well settled in Industry/Academia.

*PROFESSIONAL SHORT COURSES TAUGHT:*

Antenna Theory and Radiowave Propagation, Sprint PCS, Overland Park, March 2004.
Wireless Propagation and Smart Antennas, Sprint PCS, Lenexa, KS, November 2003.
Radiowave Propagation and Antennas, Sprint PCS, Overland Park, Kansas, May 2003.
Wireless Propagation & Smart Antennas, IEEE AP-S International Symposium/URSI Meeting, San Antonio, June 2002.
Wireless Propagation & Smart Antennas, IEEE AP-S International Symposium/URSI Meeting, Boston, July 2001.
Array Antennas for Wireless Communications, IEEE Symposium on Phased Array Systems and Technology, Dana Point, California, May 2000.
Radiowave Propagation and Adaptive Antennas, Swedish Defense College, Stockholm, Sweden, March 1999.

**OUTREACH & PROFESSIONAL ACTIVITIES:**

- **Vice Chair**, IEEE P2816, *Recommended Practice for Computational Electromagnetics Applied to Modeling and Simulation of Antennas,* 2020-present.
- **Voting Member***, IEEE Antennas and Propagation Standards Committee*, 2013-present.
- **IEEE Fellows Evaluating Committee**, IEEE Antennas and Propagation Society, 2018-2019.
- **Associate Editor**, *IET Electronics Letters*, July 2015-July 2017.
- Technical Program Committee Chair, 2017 Applied Electromagnetics Conference, Dec., 19-21, Aurangabad, India.
- **Associate Editor**, *IEEE Transactions on Antennas & Propagation*, August 2010-July 2016.
- 2010 US Faculty Leader, *Indo-US Collaboration for Engineering Education*, K. L. University, Vijayawada, India, June 21-25, 2010.
- **Associate Editor**, *IETE Technical Review*, August 2009-July 2013.
- **Associate Editor**, *IEEE Transactions on Vehicular Technology*, August 2003-July 2006.
- **Associate Editor**, *Radio Science* (of American Geophysical Union), January 1999-2003.
- International Program Committee Member, IASTED Int'l Conference on Antennas, Radar and Wave Propagation, 2007, 2010.
- Session Organizer and Chair, 2007 North American Radio Science Meeting, Ottawa, CN.
- Member of Technical Program Committee, EuCAP 2015, IEEE GLOBECOM 2006.
- Member of Technical Program Committee, 2003 IEEE Symposium on Phased Array Systems and Technology, Waltham, MA, October 2003.
- Judge, UMass Amherst Regional Science Fair, March 25, 2003.

- Chaired technical sessions at the 2008, 2005, 2004, 2003, 2002, 1999 and 1995 Joint IEEE AP-S International Symposium/URSI Meeting, San Diego, CA, Washington, DC, Monterey, CA, Columbus, OH, San Antonio, TX, Orlando, FL and Newport Beach, CA.
- ***Chairman***, IEEE Monterey Bay Subsection, July 1998-July 2001.
- Member of Technical Programs Committee, Joint IEEE AP-S International Symposium/URSI Meeting, Double Tree Hotel, Salt Lake City, Utah, July 2000, Renaissance Resort, Orlando, FL, July 1999.
- Research Adviser in the National Research Council Postdoctoral Research Associateship Programs.
- Elected member of *U.S. National Committee of URSI*, Commissions B (1995) and F (1998).
- *Editor, Perspectives in CEM*, Applied Computational Electromagnetics Society Newsletter, January-December 1996.
- External examiner for Ph.D. candidates at Universite Toulouse, France;
  University of Toronto, Canada; Campus Arrosadia, UPNA Pamplona, Navarra, Spain; University of Pretoria, South Africa; Aalborg University, Denmark; University of Technology, Sydney, Australia; KL University, Vijayawada, India, BHU-IT, Varanasi, India.
- Technical Session Chairman (Design) for the 9th Annual MIC Meeting, Organized by Arlon Corporation, San Diego, 1990.
- Invited speaker at IEEE Antennas & Propagation Boston Chapter, May 2014; Department of Electrical & Computer Engineering, University of Pisa, Pisa, Italy, September 2009; Raytheon Corporation, Sudbury, MA, July 2007; Department of Electrical Engineering, Ohio State University, January 2007; Indian Space Research Organization, Bangalore, India, July 2000; Physics Department Colloquium, Naval Postgraduate School, Monterey, CA, August, 1996; Electrical Engineering Department, University of Nebraska at Lincoln, November 1992; Electronics and Radar Development Establishment, Bangalore, India, May 1989; Advanced Technology Seminar Series, organized by the Ben Franklin Technical Center, Lehigh University, Bethlehem, PA, March 1987.

- Consultant for

  Project Decibel, Boston, MA
  Town of Pelham, MA
  Wesfield Gas & Electric, Wesfield, MA
  Newlans, Inc., Chelmsford, MA
  Octoscope, MA
  Motorola Corp., Shaumburg, IL
  Comcast Cable Communications, Inc., PA
  Ball Corporation, Boulder, CO
  TRW Corporation, Los Angeles, CA
  Northrop Corporation, Chicago, IL
  Ericsson, Copenhagen, Denmark
  CSELT, Italy
  American Radio Relay League, Washington DC
  Ministry of Defense, Singapore
  Sprint PCS, Kansas

**HOBBIES**:

*Wildlife Photography*, https://www.flickr.com/photos/ramajanaswamy/