Curriculum Vitae

ARISTIDES A. G. REQUICHA

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PERSONAL DATA

Born March 18, 1939, in Monte Estoril, Portugal.
Married Shain Antónia Hakim in 1970; no children.
U.S. citizen.

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EDUCATION

Ph.D. in Electrical Engineering, University of Rochester, June 1970.

Engenheiro Electrotécnico, Instituto Superior Técnico, University of Lisbon, Portugal, 1962. (This was roughly equivalent to a M.S.E.E and was awarded after a six-year course.)

PROFESSIONAL EXPERIENCE

Gordon Marshall Chair in Engineering, 2003-present; Professor of Computer Science and Electrical Engineering, November 1986 – present; Director, Programmable Automation Laboratory, 1986 – 2003; Director, Laboratory for Molecular Robotics, 1994 – 2009, University of Southern California, Los Angeles, CA.

Associate Professor of Electrical Engineering, University of Rochester, July 1983 – October 1986.

Director, Production Automation Project, University of Rochester, July 1985 – October 1986.

Senior Scientist and Associate Director, Production Automation Project, University of Rochester, July 1975 – June 1985.

Postdoctoral Research Associate, Production Automation Project, University of Rochester, November 1973 – June 1975.

Research Scientist, SACLANT ASW Research Centre (NATO), La Spezia, Italy, October 1970 – October 1973. Worked on digital signal processing for underwater acoustical arrays, and on applications of Kalman filtering.

Summer work: Control systems engineer with Bausch & Lomb, Rochester, 1967; Logic designer with General Dynamics/Electronics Division, Rochester, 1966.

Lieutenant, Portuguese Air Force, 1963 – 1965. Taught radar and radio electronics at the Military School, Paço d'Arcos, Portugal.

Lecturer in general physics, Instituto Superior Técnico, University of Lisbon, Portugal, 1961– 63.

HONORS & SCHOLARSHIPS

Member of the National Academy of Engineering, USA, 2011.

Recognition Award for contributions to the IEEE Nanotechnology Council, on the Council's 10th anniversary, 2011.

Distinguished Service Award, IEEE Nanotechnology Council, 2010.

Distinguished Lecturer, IEEE Nanotechnology Council, 2010-2011.

Pioneer in Robotics and Automation Award, IEEE Robotics and Automation Society, 2008.

First-ever Pierre Bézier Award, Solid Modeling Association, received at the 2007 ACM Solid and Physical Modeling Symposium, Beijing, June 4-6, 2007.

Senior Research Award, Viterbi School of Engineering, USC, 2006, on the 100th School anniversary.

Listed in Thomson's ISI Web of Knowledge (2006) as a highly cited researcher for the years 1981-1999. (Out of a total of 282 in Computer Science, worldwide, and of 24 in the USC faculty in all disciplines.)

Best Paper Award, ASME Int'l Computers in Engineering Conference, 1995.

Best Paper Award, IEEE Computer Graphics and Applications, 1993.

Life Fellow of the IEEE, 1992; Fellow of the ACM, 2007; Fellow of the AAAS, 2008; member, Computer Graphics Pioneers, 2000; life member of Sigma Xi.

Graduate School (University of Rochester, except as noted): Fulbright travel grant, 1965 and 1970. Teaching Asst., 1965–67. Visiting Research Asst. at the Imperial College of Science and Technology, London, U.K., 1967-68. General Telephone & Electronics Fellow, 1968–69. Research Asst., 1969–70.

Undergraduate school (I.S.T., Lisbon): Bandeira de Melo Prize (Valedictorian), and the Marconi Prize for excellence in Telecommunications and Electronics, 1962. Gulbenkian Scholar, 1957–61.

High School (Liceu Pedro Nunes, Lisbon): National Awards of the Ministry of Education, 1954 and 1956. Valedictorian, 1956.

Listings: Who's Who in America, Who's Who in Technology, Who's Who in Science and Engineering, Men of Achievement, Who's Who in the West, American Men and Women of Science, Who's Who Directory of Computer Graphics, Dictionary of International Biography, International Directory of Distinguished Scholarship, International Who's Who on Information Technology, International Scientist of the Year (IBC, Cambridge), Who's Who in Engineering Education, Who's Who in Finance and Industry.

LANGUAGES

Fluent English, French, Italian, and Portuguese.

MEMBERSHIPS

Life Fellow of the IEEE (Institute of Electrical and Electronic Engineers); Fellow of the ACM (Association for Computing Machinery) and of the AAAS (American Association for the Advancement of Science); Senior Member of the SME (Society of Manufacturing Engineers); Member of the AAAI (American Association for Artificial Intelligence), AVS (American Vacuum Society), and Sigma Xi.

PUBLICATIONS

Books and chapters

——— , "Swarms of self-organized nanorobots", in A. Ferreira and D. Mavroidis, Eds., *NanoRobotics: Current Approaches and Techniques*. Berlin: Springer Verlag, 2011. (Invited submission to appear.)

——— , "Nanorobotics: A Perspective", in S. Kernbach, Ed., *Handbook of Collective Robotics*. Singapore: Pan Stanford Publishing, 2011. (Invited submission to appear.)

D. J. Arbuckle and ——— , "Issues in self-repairing robotic self-assembly", in R. Doursat, H. Sayama and O. Michel, Eds., *Morphogenetic Engineering: Toward Programmable Complex Systems*. Berlin: Springer Verlag, 2011. (Invited submission to appear.)

——— , "Nanomanipulation with the Atomic Force Microscope", in R. Waser, Ed., *Nanotechnology, Volume 3: Information Technology*. Weinheim, Germany: Wiley-VCH 2008, pp. 239-273.

——— and S. N. Spitz, "Spatial modeling and reasoning for automatic dimensional inspection", in U. Cugini and M. Wozny, Eds., *From Geometric Modeling to Shape Modeling*. Boston, MA: Kluwer Academic Publishers, 2002, pp. 181-188. (Originally published in *Proc. 7th IFIP Workshop on Geometric Modeling, GEO-7*, Parma, Italy, pp. 233-238, October 2-4, 2000.)

J. R. Rossignac and ——— , "Solid Modeling", in J. G. Webster, Ed., *Encyclopedia of Electrical and Electronics Engineering*. New York, NY: Wiley, 1999, Vol. 19, pp. 658-672.

——— , "Nanorobotics", in S. Nof, Ed., *Handbook of Industrial Robotics*. New York, NY: Wiley, 2nd. ed., 1999, pp. 199-210.

J. H. Vandenbrande and ——— , "Geometric computation for the recognition of spatially interacting machining features", in J. J. Shah, D. Nau and M. Mäntylä, Eds., *Advances in Feature-Based Manufacturing*. Amsterdam: Elsevier/North Holland, 1994, pp. 83-106.

——— , "Reasoning about physical solids and processes", in B. Falcidieno and T. L. Kunii, Eds., *Modeling in Computer Graphics*. Berlin: Springer Verlag, 1993, pp. 411-422.

H. B. Voelcker and ——— , "Research in solid modeling at the University of Rochester: 1972–87", in L. Piegl, Ed., *Fundamental Developments of Computer-Aided Geometric Modeling*. New York: Academic Press, 1993, pp. 203-254.

L. M. Encarnação and ——— , "Direct graphic user interaction with modelers based on constructive solid geometry", in M. Göbel and J. C. Teixeira, Eds., *Graphics Modeling and Visualization in Science and Engineering*. Heidelberg: Springer Verlag, 1993, pp. 176-188.

A. J. Spyridi and ——— , "Accessibility analysis for polyhedral objects", in S. G. Tzafestas, Ed., *Engineering Systems with Intelligence: Concepts, Tools and Applications*. Dordrecht, Holland: Kluwer Academic Publishers, Inc., 1991, pp. 317-324. (Published

also as IRIS Rept. No. 280, Institute for Robotics and Intelligent Systems, University of Southern California, June 1991.)

——— and T. W. Whalen, "Representations for assemblies", in L. S. Homem de Mello and S. Lee, Eds., *Computer-Aided Mechanical Assembly Planning*. Boston: Kluwer, 1991, pp. 15-39. (Published also as IRIS Rept. No. 267, Institute for Robotics and Intelligent Systems, University of Southern California, March 1991.)

G. L. Lastra, J. L. Encarnação and ——— , Eds., *Applications of Computers to Engineering Design, Manufacturing and Management*. Amsterdam: North Holland, 1989.

——— , "Geometric modelling and programmable automation", in G. L. Lastra, J. L. Encarnação and ——— , Eds., *Applications of Computers to Engineering Design, Manufacturing and Management*. Amsterdam: North Holland, 1989, pp. 31-38. (Published also as IRIS Rept. No. 235, Institute for Robotics and Intelligent Systems, University of Southern California, April 1988.)

——— , "Solid modelling: a 1988 update", in B. Ravani, Ed., *CAD Based Programming for Sensory Robots*. New York: Springer Verlag, 1988, pp. 3-22. (Published also as IRIS Rept. No. 242, Institute for Robotics and Intelligent Systems, University of Southern California, August 1988.)

H. B. Voelcker, ——— and R. W. Conway, "Computer Applications in Manufacturing", in *Annual Review of Computer Science*, J. F. Traub, Ed. Palo Alto, CA: Annual Reviews, Inc., Vol. 3, pp. 349-387, 1988.

C. R. Liu, ——— , and S. Chandrasekar, Eds., *Intelligent Integrated Manufacturing: Analysis and Synthesis*. New York: American Society of Mechanical Engineers, 1987. (Proc. ASME Winter Annual Meeting, Boston, MA, December 14-18, 1987.)

——— and J. Vandenbrande, "Automated systems for process planning and part programming", in A. Kusiak, Ed., *Artificial Intelligence: Implications for CIM*. New York: Springer Verlag, 1988, pp. 299-326. (Published also as "Automatic process planning and part programming", IRIS Rept. No. 217, Institute for Robotics and Intelligent Systems, University of Southern California, April 1987.)

——— , Ed., *Eurographics '86*. Amsterdam: North--Holland Publishing Co., 1986.

——— , "Representation of tolerances in solid modelling: issues and alternative approaches", in M. S. Pickett and J. W. Boyse, Eds., *Solid Modeling by Computers: from Theory to Applications*. New York: Plenum Press, 1984, pp. 3-22. (Published also as Tech. Memo. No. 41, Production Automation Project, Univ. of Rochester, August 1983.)

——— and H. B. Voelcker, "An introduction to geometric modelling and its applications in mechanical design and manufacturing", in J. T. Tou, Ed., *Advances in Information Systems Science*, Vol. 8. New York: Plenum Press, 1981, pp. 293-328.

——— , "Representations of rigid solid objects", in J. Encarnação, Ed., *Computer Aided Design*, Lecture Notes in Computer Science No. 89. New York: Springer Verlag, 1980, pp. 2-78. (Published also as Tech. Memo. No. 29, Production Automation Project, Univ. of Rochester, June 1980.)

——— , "Broadband hydrophone arrays for use with explosive sound sources", in J. W. R. Griffiths, P. L. Stocklin and C. van Schooneveld, Eds., *Signal Processing*. London: Academic Press, 1973, pp. 525-543.

Journal papers

D. J. Arbuckle and ——— , "Self-assembly and self-repair of arbitrary shapes by a swarm of reactive robots: algorithms and simulations", *Autonomous Robots*, Vol. 28, No. 2, pp. 197-211, February 2010; published online on 7 November 2009. (Published also as Tech. Rept. AR-07, Laboratory for Molecular Robotics, University of Southern California, 2007.)

——— , D. J. Arbuckle, B. Mokaberi and J. Yun, "Algorithms and software for nanomanipulation with Atomic Force Microscopes", *Int'l J. Robotics Research*, Vol. 28, No. 4, pp. 512–522, April 2009.

A. S. Lee, S. F. Peteu, J. V. Ly, ——— , M. E. Thompson and C. Zhou, "Actuation of polypyrrole nanowires", *Nanotechnology*, Vol. 19, No. 16, 165501, 23 April 2008.

B. Mokaberi and ——— , "Compensation of scanner creep and hysteresis for AFM nanomanipulation", *IEEE Trans. on Automation Science & Engineering*, Vol. 5, No. 2, pp. 197-206, April 2008.

A. S. Lee, M. Mahapatro, D. A. Caron, ——— , B. A. Stauffer, M. E. Thompson and C. Zhou, "Whole-cell sensing for a harmful bloom-forming microscopic alga by measuring antibody-antigen forces", *IEEE Transactions on Nanobioscience*, Vol. 5, No. 3, pp. 149-156, September 2006.

B. Mokaberi and ——— , "Drift compensation for automatic nanomanipulation with scanning probe microscopes", *IEEE Trans. on Automation Science & Engineering*, Vol. 3, No. 3, pp. 199-207, July 2006.

——— and D. J. Arbuckle, "CAD/CAM for nanoscale self-assembly", *IEEE Computer Graphics and Applications*, Vol. 26, No. 2, pp. 88-91, March/April 2006.

D. J. Arbuckle and ——— , "Shape restoration by active self-assembly", *Applied Bionics and Biomechanics*, Vol. 2, No. 2, pp. 125-130, 2005. (An earlier version appeared in *Proc. Int'l Symp. on Robotics & Automation (ISRA '04)*, Querétaro, Mexico, pp. 173-177, August 25-27, 2004.)

E. Harel, S. E. Meltzer, ———, M. E. Thompson and B. E. Koel, "Fabrication of latex nanostructures by nanomanipulation and thermal processing", *Nanoletters*, Vol. 5, No. 12, pp. 2624-2629, December 2005.

X. Liu, J. Ly, S. Han, D. Zhang, ——— , M. E. Thompson and C. Zhou, "Synthesis and electronic properties of individual single-walled carbon nanotube/polypyrrole composite nanocables", *Advanced Materials*, Vol. 17, No. 22, pp. 2727-2732, November 2005.

——— , "Nanorobots, NEMS and Nanoassembly", *Proc. IEEE*, special issue on nanoelectronics and nanoscale processing, Vol. 91, No. 11, pp. 1922-1933, November 2003 (invited paper).

S. A. Maier, P. G. Kik, H. A. Atwater, S. Meltzer, E. Harel, B. E. Koel and ———, "Local detection of electromagnetic energy transport below the diffraction limit in metal nanoparticle plasmon waveguides", *Nature Materials*, Vol. 2, No. 4, pp. 229-232, April 2003 (cover article).

S. Hsieh, S. Meltzer, C. R. C. Wang, ——— , M. E. Thompson and B. E. Koel, "Imaging and manipulation of gold nanorods with an Atomic Force Microscope", *J. Physical Chemistry B*, Vol. 106, No. 2, pp. 231-234, January 17, 2002.

S. A. Maier, M. L. Brongersma, P. G. Kik, S. Meltzer, ——— , B. E. Koel and H. A. Atwater, "Plasmonics – A route to nanoscale optical devices", *Advanced Materials*, Vol. 13, No. 19, pp.1501-1505, October 2, 2001.

R. Resch, S. Meltzer, T. Vallant, H. Hoffmann, B. E. Koel, A. Madhukar, ——— and P. Will, "Immobilizing Au nanoparticles on SiO_2 surfaces using octadecylsiloxane monolayers", *Langmuir*, Vol. 17, No. 18, pp. 5666-5670, September 4, 2001.

S. Meltzer, R. Resch, B. E. Koel, M. E. Thompson, A. Madhukar, ——— and P. Will, "Fabrication of nanostructures by hydroxylamine-seeding of gold nanoparticle templates", *Langmuir*, Vol. 17, No. 5, pp. 1713-1718, March 6, 2001.

S. N. Spitz and ——— , "Accessibility analysis using computer graphics hardware", *IEEE Trans. Visualization & Computer Graphics*, Vol. 6, No. 3, pp. 208-219, July/September 2000.

R. Resch, D. Lewis, S. Meltzer, N. Montoya, B. E. Koel, A. Madhukar, ——— and P. Will, "Manipulation of gold nanoparticles in liquid environments using scanning force microscopy", *Ultramicroscopy*, Vol. 82, Nos. 1-4, pp. 135-139, February 2000.

——— , “Nanoparticle Patterns”, *J. Nanoparticle Research*, Vol. 1, No. 3, pp. 321-323, 1999 (invited perspective).

A. Bugacov, R. Resch, C. Baur, N. Montoya, K. Woronowicz, A. Papson, B. E. Koel, A. A. G. Requicha and P. Will, “Measuring the tip-sample separation in dynamic force microscopy”, *Probe Microscopy*, Vol. 1, pp. 345-354, 1999.

S. N. Spitz, A. J. Spyridi and ———, “Accessibility analysis for planning of dimensional inspection with coordinate measuring machines”, *IEEE Trans. Robotics & Automation*, Vol. 15, No. 4, pp. 714-727, August 1999.

R. Resch, C. Baur, A. Bugacov, B. E. Koel, P. M. Echternach, A. Madhukar, N. Montoya, ——— and P. Will, “Linking and manipulation of gold multi-nanoparticle structures using dithiols and scanning force microscopy”, *J. Physical Chemistry B*, Vol. 103, pp. 3647-3650, 1999.

———, “Massively parallel nanorobotics for lithography and data storage”, *Int’l J. Robotics Research* , Vol. 18, No. 3, pp. 344-350, March 1999.

C. Baur, A. Bugacov, B. E. Koel, A. Madhukar, N. Montoya, T. R. Ramachandran, ——, R. Resch, and P. Will, “Nanoparticle manipulation by mechanical pushing: underlying phenomena and real-time monitoring”, *Nanotechnology*, Vol. 9, No. 4, pp. 360-364, December 1998 (cover article).

R. Resch, C. Baur, A. Bugacov, B. E. Koel, A. Madhukar, ——— and P. Will, “Building and manipulating 3-D and linked 2-D structures of nanoparticles using scanning force microscopy”, *Langmuir*, Vol. 14, No. 23, pp. 6613-6616, November 10, 1998 (cover article).

T. R. Ramachandran, C. Baur, A. Bugacov, A. Madhukar, B. E. Koel, ——— , and C. Gazen, “Direct and controlled manipulation of nanometer-sized particles using the non-contact atomic force microscope”, *Nanotechnology*, Vol. 9, No. 3, pp. 237-245, September 1998.

R. Resch, A. Bugacov, C. Baur, B. E. Koel, A. Madhukar, ——— , and P. Will, “Manipulation of nanoparticles using dynamic force microscopy: simulation and experiments”, *Applied Physics A* , Vol. 67, No. 3, pp. 265-271, September 1998 (invited paper).

J.-H. Han and ——— , “Modeler-independent feature recognition in a distributed environment”, *Computer-Aided Design*, Vol. 30, No. 6, pp. 453-463, May 1998.

J.-H. Han and ——— , “Feature recognition from CAD models”, *IEEE Computer Graphics & Applications*, Vol. 18, No. 2, pp. 80-94, March/April, 1998.

C. Baur, B. C. Gazen, B. Koel, T. R. Ramachandran, ———, and L. Zini, "Robotic nanomanipulation with a scanning probe microscope in a networked computing environment", *J. Vacuum Science & Technology B*, Vol. 15, No. 4, pp. 1577-1580, July/August 1997. (Presented at the *4th Int'l Conf. on Nanometer-Scale Science & Technology*, Beijing, P. R. China, September 8-12, 1996.)

J.-H. Han and ——— , "Integration of feature based design and feature recognition", *Computer-Aided Design*, Vol. 29, No. 5, pp. 393-403, May 1997. (An earlier version appeared in *Proc. ASME Int'l Conf. on Computers in Engineering*, Boston, MA, pp. 569-578, September 17-21, 1995, and won a best paper award.)

——— , "Geometric reasoning for intelligent manufacturing", *Commun. ACM*, Special Issue on Computer Science in Manufacturing, Vol. 39, No. 2, pp. 71-76, February 1996.

A. Agrawal and ——— , "A paradigm for the robust design of algorithms for geometric modeling", *Computer Graphics Forum*, Vol. 13, No. 3, pp. 33-44, September 1994. (Proc. Eurographics '94.)

——— , "Mathematical definition of tolerance specifications", *ASME Manufacturing Review*, Vol. 6, No. 4, pp. 269-274, December 1993.

A. J. Spyridi and ——— , "Automatic planning for dimensional inspection", *ASME Manufacturing Review*, Vol. 6, No. 4, pp. 314-319, December 1993.

J. H. Vandenbrande and ——— , "Spatial reasoning for the automatic recognition of machinable features in solid models", *IEEE Trans. Pattern Analysis & Machine Intelligence*, Vol. 15, No. 10, pp. 1269-1285, December 1993.

——— and J. R. Rossignac, "Solid modeling and beyond", *IEEE Computer Graphics & Applications*, Vol. 12, No. 5, pp. 31-44, September 1992. (Best paper award.)

J. R. Rossignac and ——— , "Constructive non-regularized geometry", *Computer-Aided Design*, Vol. 23, No. 1, pp. 210-32, January/February 1991. (Published also as IBM Report RC 16183, IBM T. J. Watson Research Center, October 1990.)

J. R. Rossignac and ——— , "Piecewise-circular curves for geometric modeling", *IBM J. Research and Development*, Vol. 31, No. 3, pp. 296-313, May 1987.

——— and S. C. Chan, "Representation of geometric features, tolerances and attributes in solid modelers based on constructive geometry", *IEEE Journal of Robotics and Automation*, Vol. RA-2, No. 3, pp. 156-186, September 1986. (Published also as Tech. Memo. No. 48, Production Automation Project, Univ. of Rochester, October 1985.)

J. R. Rossignac and ——— , "Depth-buffering display techniques for constructive solid geometry", *IEEE Computer Graphics and Applications*, Vol. 6, No.9, pp. 29-39,

September 1986. (Published also as Tech. Memo. No. 31, Production Automation Project, Univ. of Rochester, September 1985.)

J. R. Rossignac and ——— , "Offsetting operations in solid modelling", *Computer Aided Geometric Design*, Vol. 3, No. 2, pp. 129--148, August 1986. (Published also as Tech. Memo. No. 53, Production Automation Project, Univ. of Rochester, June 1985.)

——— and H. B. Voelcker, "Boolean operations in solid modelling: boundary evaluation and merging algorithms", *Proc. IEEE*, Vol. 73, No. 1, pp. 30-44, January 1985. (Published also as Tech. Memo. No. 26, Production Automation Project, Univ. of Rochester, January 1984.)

R. B. Tilove, ——— and M. R. Hopkins, "Efficient editing of solid models by exploiting structural and spatial locality", *Computer Aided Geometric Design*, Vol. 1, No. 3, pp. 227-239, December 1984. (Published also as Tech. Memo. No. 46, Production Automation Project, Univ. of Rochester, May 1984.)

J. R. Rossignac and ——— , "Constant-radius blending in solid modelling", *ASME Computers in Mechanical Engineering*, Vol. 2, No. 7, pp. 65-73, July 1984.

——— and H. B. Voelcker, "Solid Modelling: un riepilogo storico e una valutazione", *Pixel*, the official publication of the Italian Association for Computer Graphics, Vol. 5, No. 1, pp. 21-26, and No. 2, pp. 27-36, 1984; in Italian, translation of the original paper which appeared in the *IEEE Computer Graphics and Applications,* March 1982.

——— , "Computação geométrica tridimensional e automatização programável", *Revista de Informática*, the official publication of the Portuguese Computer Society, Vol. 5, No. 2, pp. 49-55, March/April 1984; invited paper, in Portuguese.

——— , "Toward a theory of geometric tolerancing", *Int. J. of Robotics Research*, Vol. 2, No. 2, pp. 45-60, Winter 1983. (Revised version of Tech. Memo. No. 40, Production Automation Project, Univ. of Rochester, March 1983.)

——— and H. B. Voelcker, "Solid modelling: current status and research directions", *IEEE Computer Graphics and Applications*, Vol. 3, No. 7, pp. 25-37, October 1983.

Y. T. Lee and ——— , "Algorithms for computing the volume and other integral properties of solids: I --- Known methods and open issues", *Commun. of the ACM*, Vol. 25, No. 9, pp. 635-641, September 1982.

Y. T. Lee and ——— , "Algorithms for computing the volume and other integral properties of solids: II --- A family of algorithms based on representation conversion and cellular approximation", *Commun. of the ACM*, Vol. 25, No. 9, pp. 642-650, September 1982.

——— and H. B. Voelcker, "Solid modelling: a historical summary and contemporary assessment", *IEEE Computer Graphics and Applications,* Vol. 2, No. 2, pp. 9-24, March 1982.

——— , "Representations for rigid solids: theory, methods, and systems", *ACM Computing Surveys*, Vol. 12, No. 4, pp. 437-464, December 1980.

R. B. Tilove and ——— , "Closure of Boolean operations on geometric entities", *Computer Aided Design*, Vol. 12, No. 5, pp. 219-220, September 1980.

——— , "The zeros of entire functions: theory and engineering applications", *Proc. IEEE*, Vol. 68, No. 3, pp. 308-328, March 1980 (invited paper).

H. B. Voelcker, ——— *et al*., "The PADL-1.0/2 system for defining and displaying solid objects", *ACM Computer Graphics*, Vol. 12, No. 3, pp. 257-263, August 1978. (Proc. of SIGGRAPH '78.)

H. B. Voelcker and ——— , "Geometric modelling of mechanical parts and processes", *IEEE Computer,* Vol. 10, No. 12, pp. 48-57, December 1977. (Published also as Tech. Memo. No. 23, Production Automation Project, Univ. of Rochester, October 1977.)

H. B. Voelcker and ——— , "Band-limited random-real-zero signals", *IEEE Trans. on Comm.*, Vol. COM-21, No. 8, pp. 933-936, August 1973.

H. B. Voelcker and ——— , "Clipping and signal determinism: two algorithms requiring validation", *IEEE Trans. on Comm.*, Vol. COM-21, No. 6, pp. 738-744, June 1973.

——— , "Expected values of functions of quantized random variables", *IEEE Trans. on Comm.*, Vol. COM-21, No. 7, pp. 850-854, July 1973.

——— and H. B. Voelcker, "Design of nonrecursive filters by specification of frequency domain zeros", *IEEE Trans. on Audio and Electroacoustics*, Vol. AU-18, No. 4, pp. 464-470, December 1970.

——— , "Direct computation of distribution functions from characteristic functions using the fast Fourier transform", *Proc. IEEE*, Vol. 58, No. 7, pp. 1154-1155, July 1970.

Conference papers

T. Tangchoopong and ——— , "An empirical study of the performance of active self-assembly", *Proc. IEEE/RSJ Int'l Conf. on Intelligent Robots and Systems* (*IROS '09*), St. Louis, MO, pp. 1838-1842, October 11-15, 2009. (Published also as Tech. Rept. TR-09, Laboratory for Molecular Robotics, University of Southern California, 2009.)

——— , "Fifteen years of nanorobotics", *Proc. IEEE Int'l Conf. on Nanotechnology*, Genoa, Italy, July 27-30, 2009 (extended summary for a keynote talk).

D. J. Arbuckle and ——— , "Global-to-local rule generation for self-assembly and self-repair by robot swarms", *Proc. 4th Conf. on Foundations of Nanoscience (FNANO '07)*, Snowbird, UT, pp. 251-255, April 18-21, 2007.

B. Mokaberi, J. Yun, M. Wang and ——— , "Automated nanomanipulation with atomic force microscopes", *Proc. IEEE Int'l Conf. on Robotics & Automation (ICRA '07)*, Rome, Italy, pp. 1406-1412, April 10-14, 2007.

D. J. Arbuckle, J. Kelly and ——— , "A high-level nanomanipulation control framework", International Advanced Robotics Programme (IARP) Workshop on Micro and Nano Robotics, Paris, France, October 23-24, 2006.

A. S. Lee, J. V. Ly, S. F. Peteu, M. E. Thompson, C. Zhou and ———, "Electroactive polymer actuation at the nanoscale", *Proc. IEEE Int'l Conf. on Nanotechnology*, Cincinnati, OH, July 16-20, 2006.

——— , B. Koel and M. Thompson, "Advances in Nanorobotics", *Proc. NSF Design, Service, Manufacture and Industrial Innovation Conf.*, St. Louis, MO, July 24-27, 2006.

D. J. Arbuckle and ——— , "Self-repairing self-assembled structures", *Proc. IEEE Int'l Conf. on Robotics & Automation (ICRA '06)*, Orlando, FL, pp. 4288-4290, May 15-19, 2006.

A. Dhariwal, B. Zhang, B. Stauffer, C. Oberg, G. S. Sukhatme, D. A. Caron, and A. A. G. Requicha, "Networked aquatic microbial observing system", *Proc. IEEE Int'l Conf. on Robotics & Automation (ICRA '06)*, Orlando, FL, pp. 4285-4287, May 15-19, 2006.

A. S. Lee, M. Mahapatro, ——— , M. E. Thompson and C. Zhou, "Force sensing for the identification of single-cell microorganisms", *Proc. IEEE Int'l Conf. on Biomedical Robotics and Biomechatronics (BioRob '06)*, Pisa, Italy, February 20-22, 2006.

——— , B. Koel and M. Thompson, "Nanorobotics research", *Proc. NSF Design, Service, Manufacture and Industrial Innovation Conf.*, Scottsdale, AZ, January 3-6, 2005.

B. Zhang, G. S. Sukhatme and ——— , "Adaptive sampling for marine microorganism monitoring", *Proc. IEEE/RSJ Int'l Conf. on Intelligent Robots and Systems*, (*IROS '04*), Sendai, Japan, pp. 1115-1122, September 28-October 2, 2004.

V. Bokser, C. Oberg, G. S. Sukhatme and ——— , "A small submarine robot for experiments in underwater sensor networks", *Proc. Symp. on Intelligent Autonomous Vehicles (IAV '04)*, Lisbon, Portugal, July 5-7, 2004.

D. J. Arbuckle and ——— , "Active self-assembly", *Proc. IEEE Int'l Conf. on Robotics & Automation (ICRA '04)*, New Orleans, LA, pp. 896-901, April 25-30, 2004.

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Ph. D. dissertation: "Contributions to a zero-based theory of bandlimited signals", University of Rochester, June 1970.

GRANTS & CONTRACTS

Project Director, IEEE, "Transactions on Nanotechnology", January 1, 2007- December 31, 2010, $82,443.

Principal Investigator, Okawa Foundation Research Grant, "Building nanostructures by robotic self-assembly", September 1, 2004 – August 31, 2005, $10,000.

Fellow, USC Center for Interdisciplinary Research, "BioNEMS", July 1, 2003-June 30, 2004, $50,000.

Principal Investigator and Project Director, Grant DMI-02-09678, National Science Foundation, Design, Manufacturing and Industrial Innovation (plus others), "NIRT: Nanorobotics", September 1, 2002 – August 31, 2007, $1,010,000. Co-PIs: Bruce Koel and Mark Thompson (both Chemistry).

USC Principal Investigator, Cooperative Agreement CCR-01-20778, National Science Foundation, Experimental and Integrative Activities, "Center for Embedded Networked Sensing (CENS)", August 1, 2002 – July 31, 2007, $4,000,000 (USC part). CENS Director: Deborah Estrin, Computer Science, UCLA. USC Co-PIs: David Caron (Biology), Ramesh Govindan and Gaurav Sukhatme (both Computer Science), and Chongwu Zhou (Electrical Engineering-Electrophysics). (Resigned December 31, 2005.)

Principal Investigator and Project Director, Grant EIA-01-21141, National Science Foundation, Experimental and Integrative Activities, "ITR/SI+AP: Active Sensor Networks with Applications in Marine Microorganism Monitoring", September 15, 2001 – August 31, 2005, $1,570,000. Co-PIs: David Caron (Biology), Deborah Estrin (Computer Science, UCLA), Maja Mataric and Gaurav Sukhatme (both Computer Science).

Co-Principal Investigator, Sea Grant Program, "*In-situ* Identification of Aquatic Microorganisms Using Scanning Probe Microscopy and Monoclonal Antibodies", March 1, 2001 - February 28, 2003, $148,719. PI: David Caron (Biology).

Principal Investigator, Contract, Samsung Electronic Company, "Layered Nanofabrication and Multi-Tip SPM Arrays", December 5, 2000 - December 4, 2001, $70,013.

Principal Investigator, Grant IIS-99-87977, National Science Foundation, Information and Intelligent Systems, "Massively Parallel Nanorobotics with Multi-Tip Scanning Probe Microscopes", July 1, 2000 – June 30, 2004, $333,508.

Principal Investigator, Grant CTS-99-86348, National Science Foundation, Chemical and Transport Systems (plus others), "NANOSCALE: DNA Robotics", January 15, 2000 – January 31, 2003, $99,855.

Principal Investigator and Project Director, Caltech President's Fund, "Room-Temperature Single-Electron Transistors: Fabrication by Nanomanipulation and Application in Chemical Sensing", October 1, 1999 – September 30, 2001, $49,900. Co-PIs: Bruce Koel (Chemistry), Roland Resch (Chemistry) and Pierre Echternach (JPL).

Principal Investigator and Project Director, Grant EIA-98-71775, National Science Foundation, Experimental and Integrative Activities (plus others), "Robotic Assembly of Functional Nanostructures", September 15, 1998 – August 31, 2002, $708,726. Co-PIs: Bruce Koel (Chemistry), Anupam Madhukar (Materials Science) and Peter Will (ISI).

Principal Investigator, Grant IIS-98-13563, National Science Foundation, Information and Intelligent Systems (plus EIA), "SGER: Massively Parallel Nanorobotics", September 1, 1998 – August 31, 1999, $50,000.

Principal Investigator, Grant DMI-96-34727, National Science Foundation, Design and Integration Engineering, "Integration of Computer Aided Design and Dimensional Inspection through Automatic Process Planning and Probe Path Generation", September 16, 1996 - August 31, 2000, $271,343.

Principal Investigator, Contract No. 062G350248S, Allied Signal Kansas City Plant, "Coordinate Metrology Planning Algorithm", October 1, 1995 - January 2, 1997, $88,728.

Principal Investigator and Project Director, Z. A. Kaprielian Technology Innovation Fund, "Molecular Robotics", September 15, 1994 - March 31, 1999, $1,683,256. Co-PIs: Bruce Koel (Chemistry), Anupam Madhukar (Materials Science) and Peter Will (ISI).

Co-Principal Investigator, CAM-I, Inc., "Research and development in process planning and feature recognition", May 1, 1994 - April 30, 1995, $153,978. Co-PIs: George Bekey and Behrokh Khoshnevis (Industrial Engineering).

Investigator, TRP, "Southern California Coalition for Education in Manufacturing Engineering (SCCEME)", multi-institution grant, April 1, 1994 - March 31, 1996, totalling about $4M. USC PI: George Bekey.

Principal Investigator, Grant B1993-65, Alfred P. Sloan Foundation, "A Computer Science Perspective on Nanosystems: Molecular Robotics", April 1, 1994 - June 30, 1995, $20,000.

Principal Investigator, Grant DDM-92-14996, National Science Foundation, Computer-Integrated Engineering, "Geometric Modeling and Artificial Intelligence for Design and Manufacturing Automation", January 1, 1993 - August 31, 1996, $195,060 .

Principal Investigator and Project Director, Grant DDM-92-15362, National Science Foundation, Strategic Manufacturing Initiative, "Automatic Design and Assembly of Fixtures using Modular Components", September 15, 1992 - August 31, 1996, $607,012. Co-PIs: George Bekey, Ken Goldberg and Lucy King (GMI Engineering and Management Institute).

Fraunhofer Gesellschaft, Institut für Graphische Datenverarbeitung, Darmstadt, Germany, 1992: $52,980.

Co-Principal Investigator, NSF, Robotics and Machine Intelligence, "Workshop on geometric uncertainty in motion planning", Grant IRI-92-08161, January 1, 1992 - December 31, 1992, $15,000. Co-Pis: Ken Goldberg and Matt Mason (CMU).

Principal Investigator, Grant DDM-87-15404, National Science Foundation, "Solid modeling and its applications", February 15, 1988 - January 31, 1993, $612,023. (Includes a two-year extension for special creativity, awarded in 1990.)

Principal Investigator, Institute for Manufacturing Automation Research (IMAR), "Geometric modeling and its applications in design and manufacturing automation", September 1, 1987 - August 31, 1992, $369,456. (Includes $123,913 from NSF Grant ECD-87-17322.)

McDonnell-Douglas (now Unigraphics/EDS): $36,000 plus 30 licenses for campus and ISI use of the Unigraphics and Parasolids CAD/CAM systems, including future upgrades (software listed at over $2M).

Principal Investigator, AT&T Contract, July 1, 1988 - June 30, 1990, $169,874.

Co-principal investigator, Grant DMC-84-19220 (renumbered DMC-87-96192), National Science Foundation, May 1985 - July 1988, $756,111. Co-PI: Herbert Voelcker.

Co-principal investigator, Grant ECS-84-03882 (renumbered DCI-84-03882), National Science Foundation, July 1984 - June 1987, $515,533. Co-PI: Herbert Voelcker.

Co-principal investigator, Research Equipment Grant ECS-84-04771, National Science Foundation, federal funding $144,000, May 1984 - April 1985. PI: Herbert Voelcker.

Co-principal investigator, Grant MEA-82-11424, National Science Foundation, March 1983 - February 1985, $228,200. PI: Herbert Voelcker.

Co-principal investigator, Grant ECS-81-04646, National Science Foundation, July 1981-June 1984, $465,185. PI: Herbert Voelcker.

Co-principal investigator, Grant DAR-78-17064, National Science Foundation, July 1978 -June 1982, $899,800. PI: Herbert Voelcker.

PATENTS

"Layered Nanofabrication", U. S. Patent No. 6,508,979, issued January 21, 2003 (jointly with B. E. Koel, D. Y. Lewis, R. Resch and M. E. Thompson).

CONSULTING

National Science Foundation: Review panels on Nanomanufacturing, CAREER, Rapid Protyping Initiative, Engineering Research Centers, and Research Initiation grants; site visitor for the program on Coordinated Experimental Research of the Computer Division.

General Motors Research Laboratories, Computer Science Department, Warren, MI.

Intergraph Corp., Huntsville, AL

General Electric Research and Development Center, Schenectady, NY.

ARIES Technology, Lowell, MA.

Cydrome, Inc., Milpitas, CA.

Los Alamos National Laboratory, Los Alamos, NM

Hewlett-Packard Research Laboratories, Palo Alto, CA.

Morgan Kaufmann Publishers, Inc., S. Francisco, CA.

KEYNOTE ADDRESSES, PLENARY INVITED TALKS, AND DISTINGUISHED LECTURER SERIES

"Nanotechnology, robotics and swarm intelligence", keynote address, National Engineering Congress, Medellin, Colombia, May 29-31, 2012.

"Nanorobotics: manipulation, autonomy and programming", Distinguished Lecturer Series, ETH Zürich, October 7, 2011.

"Seventeen years of nanorobotics", invited plenary talk, Foresight Institute 25th Anniversary Conference at Google, Mountain View, CA, June 25-26, 2011.

"Nanorobotics", IEEE Nanotechnology Council Distinguished Lecturer talk, Portuguese Chapter of the IEEE Robotics and Automation Society, Coimbra, Portugal, April 14, 2010.

"Advances in nanorobotics and swarm intelligence", keynote address, Nanotechnology and Artificial Intelligence Forum, Bogotá, Colombia, September 4, 2009.

"Fifteen years of nanorobotics", invited plenary talk, IEEE Int'l Conf. on Nanotechnology, Genova, Italy, July 27-30, 2009.

"Robotics at the molecular scale", Distinguished Lecture in the series "Technology: Beyond our Limits" of the Fundació La Caixa of Barcelona, Spain; Lleida, Barcelona, Palma de Mallorca and Madrid, May 25, 27, 29, and June 2, 2009.

"Towards computer aided design and manufacturing at the nanoscale", invited plenary talk, CAD 2007, Honolulu, HI, June 25-29, 2007.

"Robotics at the molecular scale", Distinguished Robotics, Mechatronics and Automation Lecture, Singapore, January 18, 2007.

"Nanorobots and nanoassembly", keynote address, 19th IFIP World Computer Congress, Santiago de Chile, August 20-25, 2006.

"Assembly at the nanoscale", Distinguished Lecturer Series, Mechanical Engineering Department, University of Maryland, April 15, 2006.

"Nanorobotics", Distinguished Lecturer Series, Santo Tomás University, Bogotá, Colombia, November 11, 2005.

"Nanorobotics", Distinguished Lecturer Series, Nueva Granada University, Bogotá, Colombia, November 10, 2005.

"Robotic nanoassembly", invited plenary talk, Nanotechnology International Workshop, University of Western Australia, Perth, WA, Australia, July 17-20, 2005.

"Nanoassembly and nanorobots", invited plenary talk, 1st Conf. on Advanced Nanotechnology: Research, Applications and Policy, Washington, DC, October 21-24, 2004.

"Building shapes by self-assembly", keynote address to a joint session of ACM Symp. on Solid Modeling and Applications, and Shape Modeling Int'l Conf., Genova, Italy, June 7-11, 2004.

"Nanorobotics", keynote address, Informatics Week, Instituto Superior Técnico, Lisbon Portugal, March 11, 2004.

"Nanorobotics and sensor networks", keynote address, Eurosensors 2003, Guimarães, Portugal, September 22, 2003.

"Nanorobotics", Distinguished Lecturer Series, Computing Science Department, University of Alberta, Canada, March 25, 2002.

"Robotics and rapid prototyping at the nanoscale", keynote address, NSF-EC Nanomanufacturing and Processing Workshop, San Juan, Puerto Rico, January 5-7, 2002.

"Nanorobotics", keynote address, IBM Centre for Advanced Studies Annual Conference (CASCON), Toronto, Canada, November 7, 2001.

"Nanorobotics", keynote address, 11th Annual Canadian Conference on Intelligent Systems, Ottawa, Canada, June 5, 2001.

"Nanostructure fabrication by combining manipulation with self assembly", invited plenary talk, *ELBA-Max Planck Forum on Nanoscale Science & Technology*, Rome, Italy, September 28, 2000.

"Robotics at the nanometer scale", keynote address, *Int'l Conf. on Mechatronics Technology*, Pusan, Korea, October 21-23, 1999.

"Nanorobotics", Distinguished Lecturer Series, Mechanical Engineering Department, Massachussets Institute of Technology, March 5, 1999.

"Research in spatial reasoning for CAD/CAM integration", keynote address, CAD '98 – Tele-CAD, Darmstadt, Germany, March 5, 1998

"Nanoassembly", invited plenary talk, IEEE Symp. on Assembly & Task Planning, Marina del Rey, CA, August 7, 1997.

"Geometric reasoning for intelligent manufacturing", keynote address, Jornadas Internacionales de Mecánica Computacional y CAD/CAM, Concepción, Chile, November 22, 1995.

"Reasoning about physical solids and processes", keynote address, IFIP Conference on Modeling in Computer Graphics, Genoa, Italy, June 29, 1993.

"Twenty years of solid modeling: a personal view", keynote address, 2nd ACM Symposium on Solid Modeling and Applications, Montreal, Canada, May 19, 1993.

"Computational geometry and artificial intelligence for computer-aided design and manufacture", keynote address, Compugraphics '92, Lisbon, Portugal, December 16, 1992.

"Solid modeling applications in manufacturing and inspection", seminar, IBM Distinguished Lecturer Series, Computer Science Department, Johns Hopkins University, November 6, 1992.

"Tolerancing theory", invited plenary talk, SIAM Conf. on Geometric Design, Tempe, AZ, November 8, 1991.

"Solid modeling: status and challenges", opening address, ACM Symposium on Solid Modeling Foundations and CAD/CAM Applications, June 5, 1991, Austin, TX.

"Geometric modelling and programmable automation", keynote address, V Symposium de Ingenieria, Mexicali, B.C., Mexico, November 8-11, 1988.

"Geometric modelling and programmable automation", keynote address, CADEMAT '88, October 3-4, 1988, Hong Kong.

"Geometric modelling and programmable automation", keynote address, IFIP Conf. on CAD/CAM Technology Transfer to Latin America, Mexico City, August 22-26, 1988.

"Geometric modelling and programmable automation", keynote address, Conference on CAD/CAM Present and Future in the Mechanical Industries, Bologna, Italy, May 25-26, 1988.

SERVICE TO PROFESSIONAL SOCIETIES (since 1986)

Editor in Chief, *IEEE Transactions on Nanotechnology*, 2007- 2010.

Technical Editor, *IEEE Transactions on Robotics and Automation*, 1991-1994.

Associate Editor, *ACM Transactions on Graphics*, 1984 - 1990.

Member of the Editorial Board, 2004-2008, and Member of the Honorary Board, 2009-present, *Nanomedicine: Nanotechnology, Biology and Medicine* (Elsevier).

Vice President for Publications, IEEE Nanotechnology Council (NTC), 2011-2013.

Co-Chair, Technical Committee on Micro and Nano Robotics and Automation, IEEE Robotics and Automation Society, 2004-2009.

Member of the Administrative Committee (AdCom), IEEE Nanotechnology Council (NTC), as representative of the IEEE Robotics and Automation Society; member of the NTC's Publication Committee, 2002-2004.

Reviewer for various IEEE and ACM publications and conferences 1970 - present.

Member of the Program Committee, *8th Int'l Conf. on Swarm Intelligence (ANTS 2012)*, Brussels, Belgium, September 12-14, 2012.

Member of the Program Committee, *IEEE Int'l Conf. on Nanotechnology,* Portland, OR, August 15-18, 2011.

Member of the Program Committee, *1st IEEE Workshop on Molecular and Nano Scale Communications (MoNaCom)*, Shanghai, China, April 10th, 2011.

Member of the Program Committee, *7th Int'l Conf. on Swarm Intelligence (ANTS 2010)*, Brussels, Belgium, September 8-10, 2010.

Member of the Program Committee, *IEEE Int'l Symp. on Assembly & Manufacturing (ISAM '09)*, Seoul, Korea, November 17-20, 2009.

Member of the Program Committee, *ACM Int'l Conf. on Nano-Networks (Nano-Net '09)*, Lucerne, Switzerland, October 18-20, 2009.

Member of the Program Committee, *Workshop on Nano, Molecular, and Quantum Communications (NanoCom 2009)*, San Francisco, CA, August 2-6, 2009.

Invited participant, National Academies Keck Futures Initiative on "Complex Systems", Irvine, CA, November 13-15, 2008; discussion summary published by the National Academies Press.

Member of the Program Committee, *IEEE Int'l Conf. on Biomedical Robotics and Biomechatronics (BioRob '08)*, Scottsdale, Arizona, October 19-22, 2008.

Lecturer and Organizer, Half-Day Tutorial "Introduction to Nanorobotics", *IASTED Int'l Conf. on Nanotechnology & Applications (NANA '08)*, Crete, Greece, September 29-October 1, 2008.

Member of the Program Committee, *IASTED Int'l Conf. on Nanotechnology & Applications (NANA '08)*, Crete, Greece, September 29-October 1, 2008.

Member of the Program Committee, *ACM Int'l Conf. on Nano-Networks (Nano-Net '08)*, Boston, MA, September 14-16, 2008.

Lecturer and Organizer, Half-Day Tutorial "Introduction to Nanorobotics", *IEEE/RSJ Int'l Conf. on Intelligent Robots and Systems (IROS '07)*, S. Diego, CA, October 29, 2007.

Member of the Program Committee, IEEE Int'l Conf. on Nanotechnology, August 2-5, 2007, Hong Kong SAR, P. R. China.

Member of the Program Committee, IEEE Int'l Symp. on Assembly and Manufacturing (ISAM07), July 22-25, 2007, Ann Arbor, MI.

Member of the Program Committee, IEEE/ICME Int'l Conf. on Complex Medical Engineering (CME 2007), May 23-27, 2007, Beijing, P. R. China.

Lecturer and Organizer, One-Day Tutorial on Nanorobotics, Singapore Robotic Games, Singapore, January 19, 2007.

Chief Judge, Singapore Robotic Games, Singapore, January 16-19, 2007.

Invited participant, National Academies Keck Futures Initiative on "Smart Prosthetics: Exploring Assistive Devices for the Body and Mind", Irvine, CA, November 9-11, 2006; discussion summary published by the National Academies Press.

Member of the Program Committee, IEEE Int'l Conf. on Automation Science & Engineering (CASE '06), Shanghai, P. R. China, October 8-10, 2006.

Member of the Program Committee, IEEE Int'l Conf. on Robotics & Automation (ICRA'06), Orlando, FL, May 15-19, 2006.

Member of the Program Committee, IEEE Int'l Conf. on Biomedical Robotics and Biomechatronics (BioRob '06), Pisa, Italy, February 20-22, 2006.

Member of the Program Committee, IEEE/IARIA Int'l Conf. on Autonomic and Autonomous Systems (ICAS '05), Papeete, Tahiti, French Polynesia, October 23-28, 2005.

Member of the Program Committee, IEEE Int'l Conf. on Automation Science & Engineering (CASE '05), Edmonton, Canada, August 1-2, 2005.

Member of the Program Committee, IEEE Int'l Symp. on Assembly & Task Planning (ISATP '05), Montreal, Canada, July 19-21, 2005.

Lecturer and Organizer, Half-Day Tutorial on Nanorobotics, IEEE Int'l Conf. on Nanotechnology, Nagoya, Japan, July 11-15, 2005.

Member of the Program Committee, IEEE Int'l Conf. on Nanotechnology, Nagoya, Japan, July 11-15, 2005.

Member of the Program Committee, IEEE Int'l Conf. on Robotics and Biomimetics (ROBIO '05), Hong Kong and Macau, June 29-July 3, 2005.

Member of the Program Committee, 1st. Int'l Conf. on Complex Medical Engineering (CME 2005), May 15-18, 2005, Takamatsu, Japan.

Member of the Program Committee, IEEE Int'l Conf. on Robotics & Automation (ICRA'05), Barcelona, Spain, April 18-22, 2005.

Panelist, National Research Council meeting on the National Nanotechnology Initiative, Washington, DC, February 9-11, 2005.

Lecturer and Organizer, Half-Day Tutorial on Nanorobotics, IEEE/RSJ Int'l Conf. on Intelligent Robots & Systems (IROS '04), Sendai, Japan, September 28 – October 2, 2004.

Member of the Program Committee, IEEE/RSJ Int'l Conf. on Intelligent Robots & Systems (IROS '04), Sendai, Japan, September 28 – October 2, 2004.

Member of the Program Committee, Int'l Symp. on Robotics and Automation (ISRA 2004), Querétaro, Mexico, August 25-27, 2004.

Member of the Program Committee, IEEE Int'l Conf. on Nanotechnology, Munich, Germany, August 16-19, 2004.

Member of the Program Committee, IEEE/RSJ Int'l Conf. on Intelligent Robots & Systems (IROS '03), Las Vegas, NV, October 27-November 1, 2003.

Lecturer and Organizer, Half-Day Tutorial on Nanorobotics, IEEE Int'l Conf. on Robotics and Automation (ICRA '03), Taipei, Taiwan, September 14-19, 2003.

Lecturer and Organizer, Half-Day Tutorial on Nanorobotics, IEEE Int'l Conf. on Nanotechnology, S. Francisco, CA, August 11, 2003.

Member of the Program Committee, IEEE Int'l Symp. on Assembly & Task Planning (ISATP '03), Besançon, France, July 9-11, 2003.

Member of the Program Committee, IEEE Int'l Conf. on Nanotechnology, Washington, DC, August 26-28, 2002.

Lecturer and Organizer, Half-Day Tutorial on Nanorobotics, IEEE Int'l Conf. on Nanotechnology, Washington, DC, August 25, 2002.

Member of the Program Committee, IEEE Int'l Conf. on Nanotechnology, Maui, HI, October 28-30, 2001.

Member of the Program Committee, IEEE/RSJ Int'l Conf. on Intelligent Robots & Systems (IROS '00), Takamatsu, Japan, October 30-November 5, 2000.

Member of the Program Committee, IFIP Workshop on Geometric Modeling: Fundamentals and Applications (GEO-7), Parma, Italy, October 2-4, 2000.

Member of the Program Committee, IEEE/RSJ Int'l Conf. on Intelligent Robots & Systems (IROS '99), Kyongju, Korea, October 17-21, 1999.

Member of the Program Committee, IEEE Int'l Symp. on Assembly & Task Planning (ISATP '99), Porto, Portugal, July 21-24, 1999.

Lecturer, Half-day Tutorial on Basic Solid Modeling, ACM Symposium on Solid Modeling and Applications, Ann Arbor, MI, June 8, 1999.

Member of the Program Committee, IFIP Int'l Conf. on Visual Computing (ICVC '99), Goa, India, February 23-26, 1999.

Member of the Program Committee, SPIE Microrobotics and Micromanipulation Conf. (MM '98), Boston, MA, November 5-6, 1998.

Member of the Organizing Committee, CIRP Design Seminar on Multimedia Technologies for Collaborative Design and Manufacturing, Los Angeles, CA, October 8-10, 1997.

Member of the Program Committee, IEEE Int'l Symp. on Assembly & Task Planning (ISATP '97), Marina del Rey, CA, August 7-9, 1997.

Member of the Program Committee, IFIP Int'l Conf. on Integrated and Sustainable Industrial Production (ISIP '97), Lisbon, Portugal, May 14–16, 1997.

Member of the Program Committee, ACM Symposium on Solid Modeling and Applications, Salt Lake City, UT, May 17–19, 1995.

Member of the Program Committee, IFIP Workshop on Virtual Prototyping, Providence, RI, September 21–23, 1994.

Member of the Steering Committee, ASME Int'l Forum on Dimensional Tolerancing and Metrology, Dearborn, MI, June 17-19, 1993.

Member of the Program Committee, ACM Symposium on Solid Modeling and Applications, Montreal, Québec, Canada, May 19–21, 1993.

Panelist, "Robotics Education", IEEE Int'l Conf. Robotics & Automation, Nice, France, May 11–15, 1992.

Member of the Program Committee, ACM Symposium on Solid Modeling Foundations and CAD/CAM Applications, Austin, TX, June 5-7, 1991.

Member of the Program Committee, IFIP Conf. on CAD/CAM Technology Transfer to Latin America, La Habana, Cuba, November 19-24, 1990.

Session Chairman, AAAI Workshop on Manufacturing Planning, AAAI '90, Boston, MA, July 29-August 3, 1990.

Member of the Program Committee, GI/IFIP Symposium on Advanced Geometric Modeling for Engineering Applications, Berlin, West Germany, November 8 - 10, 1989.

Invited Panelist, SIAM Conference on Geometric Design, Tempe, AZ, November 6 - 10, 1989.

Session Chairman, AAAI Workshop on Manufacturing Planning, IJCAI '89, Detroit, MI, August 22, 1989.

Member of the Steering Committee, Speaker, and Discussion Leader, ASME/NSF Workshop on Mechanical Tolerancing, Orlando, FL, September 28 - October 1, 1988.

Invited Speaker and Session Chairman, IFIP Workshop on Geometric Modeling, Rensselaerville, NY, September 18-22, 1988.

Program Co-Chairman, IFIP Conf. on CAD/CAM Technology Transfer to Latin America, Mexico City, August 22-26, 1988.

Member, Organizing Committee, Symposium on Integrated and Intelligent Manufacturing, ASME Winter Annual Meeting, Boston, MA, December 14-18, 1987.

Member, Program Committee, 5th International Conf. on Computer Graphics in Japan, Karuizawa, Japan, May 25-28, 1987.

Member, IEEE Computer Society ad-hoc Committee on Research, 1982 - 86.

Member, Program Committee, and Session Chairman, Symposium on Integrated and Intelligent Manufacturing, ASME Winter Annual Meeting, Anaheim, CA, December 8-12, 1986.

Member, Program Committee, and Session Chairman, ACM 1986 Workshop on Interactive 3-D Graphics, Chapel Hill, October 23-24, 1986.

Program Chairman, Eurographics '86, Lisbon, Portugal, August 25-29, 1986.

Lecturer, Solid Modelling, one-day course, Eurographics '86, Lisbon, Portugal, August 26, 1986.

OTHER ACTIVITIES (since 1986)

Member of the International Advisory Board, International Iberian Nanotechnology Laboratory, Braga, Portugal, 2006-present.

Member of the Advisory Board, COTEC (Associação Empresarial para a Inovação), Porto, Portugal, 2003-present.

Member of the Editorial Board, *Open Applied Physics Journal*, Bentham Science Publishers, 2007-2009.

Member of the Editorial Board, *Journal of Nanoscience and Nanotechnology*, American Scientific Publishers, 2001-2006.

Editor for Solid Modeling, *Graphical Models* (previously *CVGIP – Graphic Models and Image Processing)*, Academic Press, 1989-2006.

Member of the Editorial Board, *Journal of Design and Manufacturing*, Chapman and Hall, 1990-1996.

Member of the Editorial Board, Springer Verlag book series on Computer Graphics, 1982-2001.

Member of the Editorial Board, *VIRtual*, a World Wide Web publication, 1995-1997.

Reviewer for the British *Computer Aided Design* journal (Butterworths), and for NSF research proposals, 1980-present.

Chair of Session 1, “System Components”, NSF Workshop on Molecular Communication and Biological Communications Technology, Washington, DC, February 20-21, 2008.

Panelist, Taller Nacional de Articulacion de Nanotecnologia, advisory to the Chilean Government, October 5-7, 2006, Viña del Mar, Chile.

Panelist, "Object modeling and CAD for emerging bio/micro/nano systems", ASME Computers and Information in Engineering Conf., September 24-28, 2005, Long Beach, CA.

Member of the Program Committee, Robotics: Science & Systems (RSS 2005), June 8-11, 2005, Cambridge, MA.

Panelist in charge of nanorobotics, NSF/NASA Workshop on the Status of Robotics in the U.S., Arlington, VA, July 21-22, 2004.

Chair, "BioNEMS Symposium", a joint symposium of USC's Center for Interdisciplinary Research and the National Cancer Institute, Los Angeles, CA, May 22, 2004.

Panelist, "The Nano Republic Conference 2002", Los Angeles, CA, July 17, 2002.

Panelist, JETRO US-Japan Hi-Tech Partnership, "Japan Meets the Nano Republic of California", Torrance, CA, February 21, 2002.

Panelist, NSF-EC Nanomanufacturing and Processing Workshop, San Juan, Puerto Rico, January 5-7, 2002.

Panelist, Caltech/MIT Enterprise Forum "Macro Fortunes from Nanotech: Is it for the Entrepreneur?", Caltech, Pasadena, CA, December 8, 2001.

Panelist, NSF "Nanotechnology Experimentation and Testing Facility (NEXT)" Working Group, February 21, 2001.

Panelist, Workshop on "Vision for nanotechnology R&D in the next decade", Interagency Working Group on Nano Science, Engineering and Technology, Washington, D.C., January 27-29, 1999. Contributed to the report's chapters on "Synthesis, assembly and processing of nanostructures" and "Applications: nanodevices, nanoelectronics and nanosensors".

Moderator, "Design and Modeling", Symp. on Computer Graphics in the Next 50 Years of Computing, Fraunhofer Institute for Computer Graphics, Darmstadt, Germany, October 29-30, 1997. The Symposium was held to commemorate the 10th anniversary of the Institute and the opening of its new facilities.

Invited Lecturer, NSF Workshop on Visual Cognition and Decision Making in the Spatial Domain, May 15-17, 1997.

Member of the Program Committee, TeamCAD Workshop on Collaborative Design, Atlanta, GA, May 12-13, 1997.

Member of the Program Committee, Int'l Conf. on Manufacturing Automation, Hong Kong, April 28–30, 1997.

Lecturer, "Introduction to geometric modeling for computer aided design and maufacturing", one-day course, XV Taller de Ingenieria de Sistemas, Santiago, Chile, July 16, 1992.

Member of the Program Committee, International Conference on Manufacturing Automation, Hong Kong, August 1992.

Session Chair, NSF Int'l Workshop on Concurrent Engineering Design, Austin, TX, October 10-12, 1990.

Invited participant, DARPA Design Workshop, Ithaca, NY, August 14-16, 1990.

Lecturer, "Geometric modeling for computer aided design and manufacturing", one-day course, broadcast nationally through satellite link, November 15, 1989.

Panelist and Session Chairman, DARPA Workshop on Concurrent Design and Engineering, Key West, FL, December 6-8, 1988.

Invited Lecturer, NATO Advanced Research Workshop on CAD-Based Programming for Sensory Robots, Castelvecchio Pascoli, Italy, July 4-6, 1988.

Invited Lecturer, Conference on CAD/CAM Present and Future in the Mechanical Industries, Bologna, Italy, May 25-26, 1988. The conference was one of the events held to commemorate the 900th anniversary of the University of Bologna.

Session Chairman, NSF Workshop on Features in Design and Manufacturing, Los Angeles, CA, February 25-28, 1988.

Invited Participant, International Workshop on Geometric Reasoning, Oxford, U.K., June 30 - July 3, 1986.

SEMINARS, CONFERENCE TALKS AND POSTERS (since 1986)

A. A. G. Requicha, "Automatic nanomanipulation and self-organizing nanorobot swarms", Workshop on 20 Years of Microrobotics: Progress, Challenges, and Future Directions, *IEEE/RSJ Int'l Conf. on Intelligent Robots and Systems* (*IROS '11*), San Francisco, CA, September 25-30, 2011.

A. A. G. Requicha, "Self-organizing and self-repairing robotic swarms", seminar, Santa Fé Institute, Santa Fé, NM, August 5, 2011.

A. A. G. Requicha, "Nanorobotic swarms", Workshop on Current State of the Art and Future Challenges in Nanorobotics, *IEEE/RSJ Int'l Conf. on Intelligent Robots and Systems (IROS '08*), Nice, France, September 22-26, 2008.

A. A. G. Requicha, "Swarm robotics for construction tasks", Workshop on Nanosensors: Self-Organization and Swarm Robotics, *ACM Int'l Conf. on Nano-Networks (Nano-Net '08)*, Boston, MA, September 14-16, 2008.

A. A. G. Requicha, "Biological communications technology: system components", NSF Workshop on Molecular Communication and Biological Communications Technology, Washington, DC, February 20-21, 2008.

A. A. G. Requicha (presenter) and D. J. Arbuckle, "Robotic self-assembly at small spatial scales", Workshop on Robotic Microassembly of 3D Hybrid MEMS, *IEEE/RSJ Int'l Conf. on Intelligent Robots and Systems (IROS '07*), S. Diego, CA, November 2, 2007.

B. Mokaberi, D. J. Arbuckle, J. Yun and A. A. G. Requicha (presenter), "Automatic manipulation of nanoparticles with a software-compensated AFM", *AVS 54th Int'l Symp. & Exhibition*, Seatttle, WA, October 14-19, 2007.

A. A. G. Requicha, "Swarm robotics for construction tasks", *2nd Workshop on Swarming in Natural and Engineered Systems*, Philadelpia, PA, May 16-17, 2007.

A. A. G. Requicha, "Robotic self-assembly and self-repair", Workshop on "Collective behaviors inspired by biological and biochemical systems", *IEEE Int'l Conf. on Robotics & Automation (ICRA '07)*, Rome, Italy, April 14, 2007.

A. A. G. Requicha, "Carbon nanotubes for breakfast", invited talk, SoCal Tech Group (venture capital and investment group) meeting, February 23, 2007.

A. A. G. Requicha, "Robotics at the molecular scale", seminar, Civil Engineering Department, University of Southern California, February 7, 2007.

A. A. G. Requicha, "Nanorobots", invited talk, Science in the Café, Singapore Science Centre, January 23, 2007.

A. A. G. Requicha, "Nanorobotics and nanosensor networks", invited talk, National Workshop on Nanotechnology, Viña del Mar, Chile, October 5-7, 2006.

A. A. G. Requicha, "Nanobiotechnology", invited talk, Biomedicina – Forum Internacional de Investigadores Portugueses, Porto, Portugal, September 21-23, 2006.

A. A. G. Requicha, "Instrumented cellular systems", invited talk, 2nd Annual Meeting of the American Academy of Nanomedicine, Washington, DC, September 9-11, 2006. (Abstract appears in *Nanomedicine: Nanotechnology, Biology and Medicine*, Vol. 2, No. 4, p. 278, December 2006.)

D. J. Arbuckle (presenter) and A. A. G. Requicha, "Coordination and programming of nanorobot swarms", Workshop on "Grand Chalenges in Micro and Nano Robotics", Robotics Science and Systems (RSS '06), Philadelphia, PA, August 16-19, 2006.

A. A. G. Requicha, "Progress in nanorobotics at USC", Workshop on "The role of robotics research in micro and nano technologies", *IEEE Int'l Conf. on Robotics & Automation (ICRA '06)*, Orlando, FL, May 15, 2006.

A. A. G. Requicha, "Nanomanipulation, building nanorobots and programming swarms of nanorobots", invited half-day tutorial, San Buenaventura University, Bogotá, Colombia, November 10, 2005.

A. A. G. Requicha, "Nanomanipulation, building nanorobots and programming swarms of nanorobots", invited half-day tutorial, Santo Tomás University, Bogotá, Colombia, November 11, 2005.

A. A. G. Requicha, "Nanorobotics", invited tutorial talk, Nanotechnology International Workshop, University of Western Australia, Perth, WA, Australia, July 17-20, 2005.

A. A. G. Requicha, "BioNEMS", seminar, Agilent, Palo Alto, CA, July 27, 2004.

A. A. G. Requicha, "Towards biomedical nanorobots and sensor/actuator networks", Workshop on "Biomedical robotics and biomechatronics: scientific and technical foundation for a new interdisciplinary field for research, medical application and industry", *IEEE Int'l Conf. on Robotics & Automation (ICRA '04)*, New Orleans, LA, April 25-30, 2004.

A. A. G. Requicha, "BioNEMS: biomedical applications of nanoelectromechanical systems", seminar, USC School of Pharmacy, Los Angeles, CA, April 16, 2004.

S. Madhusoodhanan, A. S. Lee, S. F. Peteu, M. Mahapatro, M. E. Thompson, B. E. Koel, and A. A. G. Requicha, "Fabrication and characterization of nanoscale electroactive polymers", American Chemical Society Nat'l Mtg., Anaheim, CA, March 29, 2004 (oral presentation by Madhusoodhanan and Lee).

A. A. G. Requicha, "Nanoassembly", Feynman Nanotechnology Lecture Series, Los Angeles, CA, March 2, 2004.

A. A. G. Requicha, "Robotics at the Nanoscale", San Fernando Valley Engineers Council Symposium on Nano and Submicron Technologies, February 27, 2004.

A. A. G. Requicha, "Nanorobots and nanomachines", IEEE/RSJ IROS 2003, Workshop on Sensing and Manipulation of Micro and Nano Entities: Science, Engineering and Applications, Las Vegas, NV, October 31, 2003

A. A. G. Requicha, "Nanoassembly", IEEE/RSJ IROS 2003, Workshop on Robotics for Nanoscience and Nanotechnology, Las Vegas, NV, October 27, 2003

A. A. G. Requicha, "Nanorobotics and sensor networks", *Japan Meets the Nano Republic Conf. III*, Torrance, CA, October 16, 2003.

D. J. Arbuckle and A. A. G. Requicha, "Intelligent self-assembly from communicative components", poster presentation (by Arbuckle), *11th Foresight Conf. on Molecular Nanotechnology*, Burlingame, CA, October 9-12, 2003.

A. A. G. Requicha, "Biomedical nanorobotics", *The Nano Republic Conf.*, Pasadena, CA, July 10, 2003.

A. A. G. Requicha, "Nanorobotics", *NSF Workshop on Nanoscale Systems, Dynamics and Control*, Denver, CO, June 3, 2003.

S. Meltzer, P. Budau, B. Mokaberi-Nezhad, A. A. G. Requicha, B. E. Koel and M. E. Thompson, "SPM nanomanipulation by pushing laterally or with a simulated-edge tip", poster presentation, *Scanning Probe Microscopy, Sensors, and Nanostructures*, Las Vegas, NV, May 26-29, 2002.

A. A. G. Requicha, "Robotic assembly of nanostructures", *NSF-EC Nanomanufacturing and Processing Workshop*, San Juan, Puerto Rico, January 5-7, 2002.

A. A. G. Requicha, S. Meltzer, P. F. Terán Arce, J. H. Makaliwe, H. Sikén, S. Hsieh, D. Lewis, B. E. Koel and M. E. Thompson, "Manipulation of nanoscale components with the AFM: principles and applications", *IEEE Conf. on Nanoscience and Technology* (*NANO '01*), Maui, HI, October 27-29, 2001.

A. A. G. Requicha, "Nanorobotics", seminar, University of Pisa, Italy, October 23, 2001.

A. A. G. Requicha, "Molecular machines", seminar, University of Bologna, Italy, September 25, 2001.

J. H. Makaliwe and A. A. G. Requicha, "Automatic planning of nanoparticle assembly tasks", *IEEE Int'l Symp. on Assembly & Task Planning* (*ISATP '01*), Fukuoka, Japan, May 29, 2001.

A. A. G. Requicha, S. Meltzer, R. Resch, D. Lewis, B. E. Koel, and M. E. Thompson, "Layered nanoassembly of three-dimensional structures", *IEEE Int'l Conf. on Robotics & Automation (ICRA '01)*, Seoul, S. Korea, May 25, 2001.

A. A. G. Requicha, "Towards nanorobotics", tutorial, Workshop on Micro Sensors, Actuators and Robotics, *IEEE Int'l Conf. on Robotics & Automation*, Seoul, S. Korea, May 22, 2001.

A. A. G. Requicha, "Robotic assembly of functional nanostructures", NSF Partnership on Nanotechnology Conference, Arlington, VA, January 29-30, 2001.

A. A. G. Requicha and S. N. Spitz, "Spatial modeling and reasoning for automatic dimensional inspection", *7th IFIP Workshop on Geometric Modeling (GEO-7)*, Parma, Italy, pp. 233-238, October 3, 2000.

A. A. G. Requicha, "Nanorobotics", Tutorial, *ELBA-Max Planck Forum on Nanoscale Science & Technology*, Rome, Italy, September 27, 2000.

A. A. G. Requicha, "Nanorobotics", invited talk, Nanoengineering Workshop, Berkeley, CA, August 4-5, 2000.

S. N. Spitz and A. A. G. Requicha, "Multiple-goals path planning for Coordinate Measuring Machines", *IEEE Int'l Conf. Robotics & Automation*, S. Francisco, CA, pp. 2322-2327, April 24-28, 2000.

A. A. G. Requicha, "Nanorobotics", seminar, Samsung Advanced Institute of Technology (SAIT), Suwon, Korea, October 25, 1999.

R. Resch, D. Lewis, S. Melzer, N. Montoya, B. E. Koel, A. Madhukar, A. A. G. Requicha and P. Will, "Building nanostructures from the bottom up by manipulation and self-assembly", oral presentation (by R. Resch), *7th Foresight Conf. on Molecular Nanotechnology*, Santa Clara, CA, October 15-17, 1999.

A. A. G. Requicha, "Robotics at the nanometer scale: manipulation and assembly", invited presentation, *Swiss-US Forum on Nanoscience and Nanotechology*, Zürich, Switzerland, September 20-22, 1999.

A. A. G. Requicha, "Robotics at the nanometer scale", seminar, Jet Propulsion Laboratory, Pasadena, CA, September 10, 1999.

A. A. G. Requicha, "Nanorobotics", seminar, Institute of Biophysics, University of Genoa, Italy, April 19, 1999.

A. A. G. Requicha, "A robotics perspective on nanotechnology", oral presentation, *Nanotechnology and Industrial Development Forum*, Milan, Italy, April 17, 1999.

A. A. G. Requicha, "Manipulation and assembly with the Atomic Force Microscope", Tutorial, *ELBA-Foresight Forum on Nanotechnology*, Rome, Italy, April 14, 1999.

R. Resch, B. E. Koel, A. Madhukar, N. Montoya, A. A. G. Requicha and P. Will, "Manipulation at the nanometer scale", *2nd Int'l Conf. on Integrated MicroNanotechnology for Space Applications*, oral presentation (by P. Will), Pasadena, CA, April 11-15, 1999.

A. A. G. Requicha, R. Resch, B. E. Koel, A. Madhukar, N. Montoya, and P. Will, "Assembling and linking nanoparticle structures", *ELBA-Foresight Forum on Nanotechnology*, Rome, Italy, April 14-16, 1999.

"Molecular Robotics Research at USC", Nanosystems Seminar, University of Southern California, January 22, 1999.

"Molecular Robotics", W. V. T. Rusch Engineering Honors Colloquium, University of Southern California, January 15, 1999.

"Manipulation of Nanoparticles with the Atomic Force Microscope", invited talk, *IBC's 3rd Annual Molecular Nanotechnology Conf.*, S. Francisco, CA, December 7-8, 1998

"Nanoparticle manipulation by mechanical pushing: underlying phenomena and real-time monitoring", poster presentation (by B. Koel), *6th Foresight Conf. on Molecular Nanotechnology*, Santa Clara, CA, November 12-15, 1998.

"Monitored mechanical nanomanipulation", oral presentation (by B. Koel), *American Vacuum Soc. 45th Int'l Symp.*, Baltimore, MD, November 2-6, 1998.

"Assembly of Nanostructures with the Atomic Force Microscope: Principles and Applications", oral presentation, *NanoSpace 98*, Houston, TX, November 1-6, 1998

"Pushing operations at the nanometer scale", *5th Int'l Conf. on Nanometer-Scale Science & Technology*, oral presentation, Birmingham, U.K., August 31-September 4, 1998.

"Measuring the tip-sample separation in dynamic mode atomic force microscopy", poster presentation (by A. Bugacov), *5th Int'l Conf. on Nanometer-Scale Science & Technology*, Birmingham, U.K., August 31-September 4, 1998.

"Nanoparticle manipulation and its applications", poster presentation, Nanotechnology for the Soldier System Conf., Cambridge, MA, July 7-9, 1998.

"Nanorobotic assembly of two-dimensional structures", IEEE Int'l Conf. on Robotics & Automation, Leuven, Belgium, May 20. 1998.

"Nanomanipulation", invited talk, workshop on Precision Manipulation at Micro and Nano Scales, IEEE Int'l Conf.on Robotics & Automation, Leuven, Belgium, May 16. 1998.

"Assembly of nanoelectromechanical systems (NEMS) with a scanning probe microscope", Albany Conf. on Biomolecular Motors & Nanomachines, Rensselaerville, NY, September 4-7, 1997.

"Robotics and Nanotechnology", invited talk, Robot Faire '96, Robotic Society of Southern California, Costa Mesa, CA, October 5, 1996.

"Robotic manipulation with an SPM in a networked computing environment", 4th. Int'l Conf. on Nanometer-Scale Science & Technology, Beijing, China, September 10, 1996.

"Raciocínio geométrico e fabricação inteligente", seminar, University of Coimbra, Portugal, June 25, 1996.

"Hint generation and completion for feature recognition", 29th. Int'l Symp. on Automotive Technology & Applications - Mechatronics, Firenze, Italy, June 4, 1996.

"Tolerance modeling and application programming interfaces", Int'l Symp. on Tools & Methods for Concurrent Engineering, Budapest, Hungary, May 29, 1996.

"Molecular Robotics", seminar, Harvey Mudd College, Claremont, CA, November 30, 1995.

"Molecular robotics: a Computer Science perspective on nanotechnology", invited talk, 4th Foresight Conf. on Molecular Nanotechnology, Palo Alto, CA, November 9, 1995.

"Research on feature recognition", invited talk, Seminar on Feature-Based Modeling in Product Development, Fraunhofer Institut für Graphische Datenverarbeitung, Darmstadt, Germany, November 10, 1994.

"Research on intelligent manufacturing at USC", workshop on Advanced Design and Manufacturing, IEEE Int'l Conf.on Robotics & Automation, S. Diego, CA, May 9, 1994.

"Design by features and feature recognition", seminar, UCLA, April 28, 1994

"Geometric computation in mechanical design and manufacture", invited talk, NSF Workshop on Manufacturing and Computational Geometry, New York, NY, April 1, 1994.

"Automatic inspection planning", seminar, USC Information Sciences Institute, December 2, 1993.

"Research at USC's Programmable Automation Lab", LA Area Robotics and Automation Symposium, Los Angeles, November 12, 1993.

"The offset-zone theory of tolerancing", invited talk, SIAM Conf. on Geometric Design, Tempe, AZ, November 3, 1993.

"Mathematical meaning and computational representation of tolerance specifications", invited talk, ASME Int'l Forum on Dimensional Tolerancing and Metrology, Dearborn, MI, June 17, 1993.

"Automatic planning for dimensional inspection", invited talk, ASME Int'l Forum on Dimensional Tolerancing and Metrology, Dearborn, MI, June 18, 1993.

"Geometric uncertainty and automatic inspection", DARPA ESTO briefing, Washington, DC, January 29, 1993.

"Solid modeling applications in manufacturing and inspection", invited talk, International Symposium on Computers in Mechanical Design and Visualization, Lyon, France, October 15, 1992.

"Computational geometry and artificial intelligence for computer-aided design and manufacture", seminar, University of Southern California, October 6, 1992.

"Automatic programming of coordinate measuring machines for quality control", invited address, XV Taller de Ingenieria de Sistemas, Santiago, Chile, July 14, 1992.

"Shape uncertainty", NSF Workshop on Geometric Uncertainty in Motion Planning, June 15, Catalina Island, CA.

"Intelligent Engineering Systems", seminar, University of Southern California, January 28, 1992.

"Geometric modeling", seminar, Fraunhofer Institut für Graphische Daten-verarbeitung, Darmstadt, Germany, January 15, 1992.

"Artificial intelligence and geometric modeling for computer aided design and manufacture", half-day presentation, IBEAR program, University of Southern California, December 3, 1991.

"Tolerancing theory", invited plenary lecture, SIAM Conf. on Geometric Design, Tempe, AZ, November 8, 1991.

"Computing global accessibility directions for the faces of a solid", SIAM Conf. on Geometric Design, Tempe, AZ, November 5, 1991. (With A. J. Spyridi.)

"CNRG: a constructive model for non-regularized structures", SIAM Conf. on Geometric Design, Tempe, AZ, November 4, 1991. (With J. R. Rossignac.)

"Geometric modeling for mechanical CAD/CAM", invited Advanced Technology lecture, Intergraph Users Group, San Antonio, TX, October 15, 1991.

"Artificial intelligence and computational geometry for computer aided design and manufacture", seminar, University of Southern California, September 11, 1991.

"Mathematical meaning of tolerance specifications", invited panel presentation, ASME Int'l Computers in Engineering Conf., S. José, CA, August 19, 1991.

"Solid modeling: status and challenges", opening address, ACM Symposium on Solid Modeling Foundations and CAD/CAM Applications, June 5, 1991, Austin, TX.

"Research in Programmable Automation at USC", seminars, Kyoto University, Japan, May 22, 1991; University of Tokyo, Japan, May 9, 1991.

"Introduction to geometric modeling for computer-aided design and manufacture", half-day tutorial, Advanced Software Technology and Mechatronics Research Institute (ASTEM), Kyoto, Japan, May 27, 1991.

"Spatial reasoning for manufacturing and inspection planning", half-day research presentation, Advanced Software Technology and Mechatronics Research Institute (ASTEM), Kyoto, Japan, May 21, 1991.

"Automatic recognition of machinable features in solid models", seminars, Fujitsu Laboratories, Kawasaki, Japan, May 13, 1991; NEC Technology Center, Kawasaki, Japan, May 10, 1991.

"Inteligência artificial e computação geométrica para o reconhecimento das formas", seminar, Federal University of Pernambuco (UFPe), Recife, PE, Brazil, February 21, 1991; State University at Campinas (UNICAMP), Campinas, SP, Brazil, February 1, 1991.

"Geometria algébrica na robótica e modelagem geométrica", a series of 5 lectures, Institute for Pure and Applied Mathematics (IMPA), Rio de Janeiro, Brazil, February 4 - 8, 1991.

"Accessibility analysis", invited lecture, Workshop on Geometric Modeling, Institute for Pure and Applied Mathematics (IMPA), Rio de Janeiro, Brazil, January 18, 1991.

"Constructive Geometry", invited lecture, Workshop on Geometric Modeling, Institute for Pure and Applied Mathematics (IMPA), Rio de Janeiro, Brazil, January 11, 1991.

"Recognition of machinable features", seminar, Arizona State University, Tempe, AZ, November 2, 1990.

"Semantics of tolerance specifications", invited presentation to the ANSI Y14.5.1 committee on the Mathematical Definition of Tolerancing Principles, Gaithersburg, MD, September 12, 1990.

"Spatial reasoning for automatic recognition of interacting form features", ASME Int'l Conf. on Computers in Engineering, Boston, MA, August 7, 1990.

"The role of geometric reasoning in manufacturing planning", Workshop on Manufacturing Planning, AAAI '90, Boston, MA, July 31, 1990.

"Geometric modeling research at USC", Research Forum Seminar, Autodesk, Inc., Sausalito, CA, June 7, 1990.

"Recognition of interacting machining features", Schlumberger CAD seminar, University of Michigan, Ann Arbor, MI, May 9, 1990.

"Feature representations and object-oriented paradigms for automated geometric reasoning", General Motors Research Labs, Warren, MI, May 8, 1990.

"Solid modeling applications in machining and inspection", Research Conf. on Geometric Modeling and Design, Detroit, MI, May 7, 1990.

"A toolkit for geometric modeling", Product Modeling Project Meeting, CAM-I, Inc., Culver City, CA, February 22, 1990.

"Automatic inspection of mechanical parts by Coordinate Measuring Machines", Seminar, Northwestern University, Evanston, IL, December 7, 1989.

"Solid modeling challenges: applications and tools", panel on "Solid modeling: where to now?", SIAM Conf. on Geometric Design, Tempe, AZ, November 6-10, 1989.

"From toleranced solid models to inspection plans for coordinate measuring machines", AAAI Workshop on Manufacturing Planning, IJCAI '89, Detroit, MI, August 22, 1989.

"Form features for concurrent engineering", AAAI Workshop on Concurrent Engineering, IJCAI '89, Detroit, MI, August 21, 1989.

"Geometry and uncertainty", DARPA Workshop on Concurrent Design and Engineering, Key West, FL, December 6-8, 1988.

"Mechanical tolerancing and geometric uncertainty", ERC Seminar, Carnegie-Mellon University, Pittsburgh, PA, November 18, 1988.

"Current research in solid modeling at USC", CAM-I Geometric Modeling Project Meeting, Culver City, CA, November 8, 1988.

"Geometric modelling and programmable automation", Keynote Address presented at: V Symposium de Ingenieria, Mexicali, B.C., Mexico, November 8-11, 1988; CADEMAT '88, October 3-4, 1988, Hong Kong; IFIP Conf. on CAD/CAM Technology Transfer to Latin America, Mexico City, August 22-26, 1988; and Conference on CAD/CAM Present and Future in the Mechanical Industries, Bologna, Italy, May 25-26, 1988.

"The role and nature of tolerancing theory", ASME/NSF Workshop on Mechanical Tolerancing, Orlando, FL, September 28 - October 1, 1988.

"Specification and recognition of form features", IFIP Workshop on Geometric Modeling, Rensselaerville, NY, September 18-22, 1988.

"Solid modelling — a 1988 update", NATO Advanced Research Workshop on CAD-Based Programming for Sensory Robots, Castelvecchio Pascoli, Italy, July 4-6, 1988.

"Growing and shrinking operations for solid modelling", Seminar, Mechanical Engineering Department, University of California at Irvine, February 19, 1988.

"Geometric modelling research at USC", Tektronix Research Labs, Beaverton, OR, February 8, 1988.

"Extending the geometric coverage of solid modellers", Cornell Modelling Meeting, Cornell University, January 21, 1988

"Growing and shrinking operations for solid modeling", ERC Seminar, Purdue University, West Lafayette, IN, November 13, 1987.

"Geometric Modeling and Programmable Automation", Computer Science and Engineering Research Review, University of Southern California, October 15, 1987.

"Tolerance analysis", Seminar, IBM T. J. Watson Research Center, Yorktown Heights, NY, May 29, 1987.

"Research in Programmable Automation at USC", Seminar, McDonnell-Douglas Manufacturing and Engineering Systems Co., Cypress, CA, May 27, 1987.

"Representation and analysis of tolerancing information", Fourth State-Of-The-Art Conference on Solid Modelling, Boston, MA, May 5, 1987.

"Modelling geometric uncertainty", 1987 IEEE Int'l Conf. on Robotics and Automation, Raleigh, NC, April 1, 1987.

"Growing and shrinking solids for blending, tolerancing and other applications", invited address, CAD Kolloquium, Technical University of Berlin, Berlin, FRG, November 24, 1986.

"Research on geometric modelling and programmable automation - The Rochester connection", Solid Modelling '86 Conference, Boston, MA, October 22, 1986.

"Geometric modelling for computer aided design and manufacturing (CAD/CAM)", IBM Scholar Lecture, Northeastern University, Boston, MA, October 21, 1986.

"Models and representations", and "Application algorithms and systems", Eurographics '86 Tutorial on Solid Modelling, Lisbon, Portugal, August 27, 1986.

"Can surface features be represented in a CSG geometric modeller?", Eurographics '86 Panel on Geometric Modelling, Lisbon, Portugal, August 28, 1986.

"Semi-algebraic geometric models", Workshop on Geometric Reasoning, Oxford, U.K., July 3, 1986.

"Constructive Solid Geometry", Seminar, Department of Computer Science, University of Southern California, April 25, 1986.

"Research on Programmable Automation at the University of Rochester", Seminar, Hewlett-Packard Research Labs, Palo Alto, CA, March 12, 1986.

"Constructive Solid Geometry", Seminar, Department of Mechanical, Aerospace and Nuclear Engineering, University of California at Los Angeles, March 5, 1986.

UNIVERSITY SERVICE (since 1986)

Steering Committee on the USC Bionanotechnology Initiative, 2005-2009.

Steering Committee on the USC Bioimaging Initiative, 2005-2009.

School of Enginering Committee on Nanotechnology Recruiting, 2004-2005.

Group Leader, Autonomous Systems, 2002-2003.

Group Leader, Intelligent Systems, 1999-2001.

School of Engineering Research Committee, 1999 - 2001.

School of Engineering Faculty Council, 1995 - 1996.

Teaching Load Subcommittee, School of Engineering Restructuring Committee, 1995 – 1996.

Ph. D. Admissions Committee, Computer Science Department, 1995 - 1997. (Chair, 1996 - 1997.)

University Academic Computing Advisory Committee, 1991 - 1993.

School of Engineering Research Committee, 1991 - 1993.

School of Engineering Committee on Computational Science and Engineering, 1991-1993.

School of Engineering Long Range Academic Planning Committee, 1989 - 1990.

School of Engineering Computer Committee, 1987- 1993.

School of Engineering CAD/CAM Committee, 1989 - 1990.

Search Commitee, Mechanical Engineering Department Chair, 1989 - 1990.

Search Commitee, Computer Science Department Chair, 1988 - 1990. (Chair, 1988/9.)

Executive Commitee, Computer Science Department, 1988 - 1990.

Ph. D. Curriculum Committee, Computer Science Department, 1987 - 1988.

MISCELLANEOUS

U. S. Coast Guard Auxiliary, Flotilla 11S-5-4 (formerly 11S-3-4), 2007-present. Flotilla Staff Officer, Secretary and Records, 2008-2010. Aids-to-Navigation Verifier qualification, 2009. Crew qualification, 2009. Coxswain qualification, 2009. Flotilla Commander's Award, 2009. Annual Service Performance Awards (Operations), 2009 and 2010. Vice Flotilla Commander, 2011.

Director, Catalina Conservancy Divers, 1996 - 2001. Research Diver, USC Wrigley Marine Science Center, Catalina, 1992 - present. Scuba diving certification, 1962 (CPAS, Portugal), and 1990 (NAUI); Research Diver certification, 1994 (PADI); Nitrox certification, 1998 (NAUI).

Western New York yachting team (Lasers), Empire State Games, 1981 and 1983.

Soccer team, Imperial College of Science & Technology, London, U.K., 1967-68.

Team handball varsity, Instituto Superior Técnico, Lisbon, Portugal (perennial champions), 1956 - 63. Team handball varsity, Liceu Pedro Nunes, Lisbon, Portugal, 1954 - 56.