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Drexel University
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<u>Degree</u>	<u>Institution</u>	<u>Subject</u>
Ph. D(1980)	Indian Institute of Technology, Delhi (India)	Electrical Engineering
M. Tech(1975)	Indian Institute of Technology, Delhi (India)	Applied Optics
M. Sc. (1972)	Kerala University, India.	Physics

Academic Positions

Allen Rothwarf Professor of Electrical and Computer Engineering, **July 1, 2001** onwards

Adjunct Professor of Radiology, Jefferson Medical College, Thomas Jefferson University, Philadelphia, **November 1998** onwards

Professor, Dept. of Electrical and Computer Engineering, and Affiliated faculty member of the School of Biomedical Engineering, Science and Health Systems, Drexel University, **September 1995** onwards

Associate Professor, Dept. of Electrical and Computer Engineering, and the School of Biomedical Engineering, Science and Health Systems, Drexel University, 1991 to 1995

Assistant Professor, Dept. of Electrical and Computer Engineering, and School of Biomedical Engineering, Science and Health Systems, Drexel University, 1986 to 1991

Visiting Assistant Professor, Dept. of Electrical and Computer Engineering, and School of Biomedical Engineering, Science and Health Systems, Drexel University, Sept. 1985, to Aug., 1986

Drexel Fellow, Dept. of Electrical and Computer Engineering, and Biomedical Engineering & Science Institute, Drexel University, Sept., 1983, to Aug., 1985

Postdoctoral Fellow, Biomedical Engineering, Drexel University, Nov. 1982, to Aug. 1983.

The William Girling Watson Traveling Fellowship in Electrical Engineering, University of Sydney, Australia, July, 1981, to October, 1982; August, 8-22, 1997.

Administrative Positions

Interim Department Head, Electrical and Computer Engineering Department, Drexel University, July 1, 2006 –June 30, 2007.

Director, Graduate Programs, College of Engineering (CoE), July 1, 1996-December 31, 2000

Program Director, Telecommunications Engineering, CoE, Jan. 1996 –Dec. 31, 2000

Director, Off-Campus Programs, Dept. of Elec. and Comp. Engineering, September 1998 to 2001

Assistant Head of Dept. for Graduate Affairs and Graduate Advisor, Dept. of Elec. and Comp. Engineering, Drexel University, Sept. 1, 1993 to Dec. 31, 1997, and Sept. 1999 to June 30, 2004.

Coordinator, MSEE on_line program, July 1, 2004 –June 30, 2009.

Awards and Honors

- 2005-2006 [Christian R. and Mary F. Lindback Foundation Award for Distinguished Teaching](#) in the University
- Recognized by the [Institute of Physics](#) (IOP), U. K. as one of 100 authors who have published papers that were key to the advancement of physics research in their particular subject area (April 2006) http://www.iop.org/ej/authors_edition/
- [Martin Kaplan distinguished service award](#), ECE department 2005
- [Outstanding Service Award](#), College of Engineering, 2003.
- Named [Allen Rothwarf Professor](#) of Electrical and Computer Engineering, July 1, 2001
- [Faculty Achievement award](#), College of Engineering, 1999.
- William Girling Scholarship, University of Sydney, 1981, 1997

Programs Developed

- Master of Science in EE/Telecommunications Engineering
- Master of Engineering
- Master of Science in Software Engineering
- Special Programs: Dean's Fellowship, Career-Integrated-Education (CIE), Fellowship for B.S./M.S. students
- BS in Software Engineering

Courses and Laboratories Developed

1. Interdisciplinary UG course in **Probability for Engineers**;

P. M. Shankar (Coordinator), A. Reddy (Civil and Arch. Engg.), A. Wang (Mech. Engg.) and M. Grady (Chem. Engg.)

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| 2. Engineering Horizons (with Raj Mutharasan of Chem. Engg.) | UG Junior/Senior Level |
| 3. Wireless Communications | UG <i>Junior Level</i> |
| 4. Lightwave Engineering I, II and III | UG <i>Senior Level</i> |
| 5. Fiberoptics and Optical Communications I, II, III | <i>Graduate Level</i> |
| 6. Fiberoptic and Integrated Optic Devices | <i>Graduate Level</i> |

Laboratories

Lightwave Engineering Laboratory	UG <i>Senior Level</i>
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Courses Taught

Undergraduate

Communication Theory (Junior Level), 1983/84 to 1988/89, 1995/96, 1996/97
Communications (Senior Level) 1998/99, Winter 2004-2005
Dynamic Engineering Systems (Sophomore level) 2010/11, 2011/12, 2012/13, 2013/2014
E M Theory (Junior Level), 1984/85
Electronics I (Junior Level), 1986/87
Engineering Applications of Probability (Junior Level) 1997/98-2001/2002
Engineering Horizons (Junior Level) 2000/'01 and 2001/2002
Freshmen Design 2005-2006, 2006-2007, 2008
Lightwave Engineering I, II and III (Senior Level), 1987/88 to 1995/96
Linear Engineering Systems (Sophomore level) 2010/11, 2011/12, 2012/13, 2013/2014
Nondeterministic Systems (Junior Level), 1983/84, 1984/85, 1987/88, 1995/96, 1996/97
Probability for Engineers (Junior Level) 2014-2015

University Seminar (Undergraduate Freshmen), 1991/92, 1992/93, 2003/2004, 2004/2005
Wireless Communications (Junior Level) 1997/98 onwards

Graduate

Advanced Wireless Channel modeling 2011/2012
Stochastic Systems I 1997/98, 1999/2000, 2004/2005
Electrooptics and Optical Processing, 1983/84
Fiber Optic and Integrated Optic Devices, 1989/90
Fiber Optics and Optical Communications--I, II, and III, 1985/86 to 1994/95, Fall 1994, Fall 2008 ,
2010/11

Graduate Students Supervised

Doctoral

10. Angela Leung (Chem. Engg.) *Detection of cells, proteins, and DNA using Tapered Fiber Optics Biosensors (TFOBS)*, (Joint advising with Dr. R. Mutharasan, Dept of Chemical & Biological Engg.) June 2007.

9. V. A. Dumane (Elec. Engg.) *Diversity and Compounding for Enhanced Discrimination of Breast Masses in Ultrasonic B-Scan Images*, November 2002.

8. P. Dala Krishna (Biomed. Engg.) *Modeling and characterization of ultrasound contrast agents*, August 1998.

7. J. Koshy (Elec. Engg.) *Modeling and evaluation of fiber-fed microcellular systems*, June 1997.

6. R. Molthen (Biomed. Engg.) *Ultrasonic tissue characterization using non-Rayleigh statistics*, June 1996.

5. V. M. Narayanan (Biomed. Engg.) *Non-Rayleigh statistics of ultrasonic backscattered echoes*, June 1996.

4. Y. Q. Wu (Biomed. Engg.) *Development of a fiberoptic sensor using light diffraction technique*, (Joint advising with Dr. P. Lewin, School of Biomedical Engineering, Science and Health Systems) Sept. 1993

3. T. J. Brophy (Elec. Engg.) *Optical fiber tapers: formation, modeling, and characterization*, June 1993.

2. D. P. Koller (Elec. Engg.) *Characterization of acoustical noise from bubble clouds in the ocean*, Dec. 1992.

1. Yue Li (Biomed. Engg.) *First order statistics of speckle around a scatterer volume density edge*, (Joint advising with Dr. V. L. Newhouse), July 1990.

Masters

H. Haddock (Chem. Engg); G. Bhagavatheeswaran (Biomed. Engg); T. George (EE); V. Dumane (EE);
G. Prabhu (EE); J. Koshy (EE); G. George (Biomed. Engg); D. Koller (EE); B. Schrope (Biomed. Engg)

Book(s)/Chapters Published

- P. M. Shankar, *Fading and Shadowing in Wireless Systems*, Springer, 2012.
- P. M. Shankar, *Introduction to Wireless Systems*, John Wiley & Sons, 2001.
- P. M. Shankar, A. Reddy, A. Wang, and M. Grady, *Statistical Analysis of Engineering Systems*, Gateway Coalition, Drexel University, 2001.
- P. M. Shankar, 'Propagation characteristics of wireless channels,' Chapter in the *Internet Encyclopedia on Wireless*, H. Bidgoli (Ed.) John Wiley& Sons, 2003.
- P. M. Shankar and R. Mutharasan, 'Tapered Fibers for Cell Studies,' in *Reviews in Fluorescence 2005*, Vol. 2, pp. 63-74, Chris Geddes and Joseph Lakowicz (Ed.), Springer, New York 2005.
- P. M. Shankar, 'Wireless Channels,' in *Handbook on Wireless Information Security*, John Wiley, (Ed. H. Bidgoli), July 2005.
- A. Leung, Raj Mutharasan and P. M. Shankar, 'Evanescent Field Tapered Fiber Optic Biosensors (TFOBS): Fabrication, Antibody Immobilization and Detection,' in *Optical Fibers Research Advances*, Nova Science Publishers (Ed. Jürgen C. Schlesinger), 2008.

List of Publications since joining Drexel University

h-index as of April 2017 30 (Web of Science) 42 (Google Scholar)

Papers in Refereed Journals

111. P. M. Shankar, "A Matlab workbook on the pedagogy of generalized eigenvectors," Accepted for publication in *Computer Applications in Engineering Education*
110. P. M. Shankar, "Pedagogy of solutions to a set of linear equations using a Matlab workbook," Accepted for publication in *Computer Applications in Engineering Education*
109. P. M. Shankar, "Pedagogy of Cramer's Rule and beyond: A Matlab workbook," *Mathematics & Computer Education*, Fall 2016, Vol. 50 Issue 3, pp. 207-215, December 2016
108. P. M. Shankar, "Pedagogy of wireless fading channels: A Matlab demo," *International Journal of Electrical Engineering Education*, Vol. 53, No. 4, pp. 291-304, October 2016.
107. P. M. Shankar, "Performance of cognitive radio in N*Nakagami cascaded channels," *Wireless Personal Communications*, Vol. 88, Issue 3, pp. 657-667, June 2016.
106. P. M. Shankar, "Pedagogy of autonomous differential equations and equilibria using a Matlab workbook," *Mathematics & Computer Education*. Winter 2016, Vol. 50 Issue 1, p. 57-72.
105. P. M. Shankar, "Pedagogy of second order homogeneous differential equations: A holistic approach using a Matlab workbook," *Computer Applications in Engineering Education*, Vol. 24, No. 1, January 2016, pp. 114-121.
104. P. M. Shankar, "An overview of shadowed fading wireless channels in terms of a cascaded approach," *Physical Communication*, Vol. 15, pp. 59-65, June 2015.

103. P. M. Shankar, "A composite shadowed fading model based on the McKay distribution and Meijer G functions," *Wireless Personal Communications*, Vol. 81, Issue 3, pp. 1017-1030, March 2015.
102. P. M. Shankar, "Statistics of boundaries in ultrasonic B scan images," *Ultrasound in Medicine and Biology*, vol. 41, No. 1, pp. 268-280, January 2015.
101. P. M. Shankar, "Error rates in dual hop wireless links operating in cascaded fading channels," *Wireless Personal Communications*, Vol. 75, Issue 1, pp. 1-9, March 2014
100. P. M. Shankar, "Computational study of the effects of shadowing in double scattering wireless channels," *Australian J. of Electrical & Electronics Engg.*, Vol. 10, No. 4, pp. 542-55, Dec. 2013.
99. P. M. Shankar, "Diversity in cascaded N*Nakagami channels," *Annals of Telecommunications*, Vol. 68, Issue 7, pp. 477-483, July 2013.
98. P. M. Shankar, "A statistical model for the ultrasonic backscattered echo from tissue containing microcalcifications," *IEEE Trans. UFFC*, Vol. 60, No. 5, pp. 932-942, May 2013
97. P. M. Shankar, "Use of phase diversity and modified phase congruence for edge enhancement in ultrasonic imaging," *Signal, Image and Video Processing*, Vol. 7, Issue 2, pp. 317-324, 2013.
96. P. M. Shankar, "Maximal ratio combining (MRC) in shadowed fading channels in presence of shadowed fading cochannel interference (CCI)," *Wireless Personal Communications*, Vol. 68, Issue 1, pp. 15-25, Feb. 2013.
95. P. M. Shankar, "A pedagogic approach to cascaded fading channels and diversity in wireless systems," *Australian J. of Electrical & Electronics Engg.*, Vol. 9, No. 4, pp. 439-45, Dec. 2012.
94. P. M. Shankar, "A Nakagami-N-gamma model for shadowed fading channels," *Wireless Personal Communications*, Vol. 64, Issue 4, pp. 665-680, June 2012.
93. P. M. Shankar, "A Matlab® based demonstration of the effects of fading, shadowing and diversity in wireless communications for undergraduate electrical engineering students," *Far East J. of Electronics and Communications*, Vol. 7, No. 1, pp. 41 – 65, Sept. 2011.
92. P. M. Shankar, "Statistical models for fading and shadowed fading channels in wireless systems: a pedagogical perspective," *Wireless Personal Communications*, Vol. 60, No. 2, pp. 191-213, Sept. 2011.
91. P. M. Shankar, "Maximal ratio combining in independent identically distributed N*Nakagami fading channels," *Proc. IET Communications*, Vol. 5, No. 3, pp. 320–326, Feb 2011.
90. P. M. Shankar, "Use of two dimensional phase-only-filters (POF) and compounding for speckle reduction and edge detection in ultrasonic B scan images," *Applied Optics*, Vol. 48, No. 29, pp. 5589-5597, December 2009.

89. P. M. Shankar, "Quantitative measures of boundary and contrast enhancement in speckle reduction in ultrasonic B mode images using spatial Bessel filters," *IEEE Trans. UFFC*, Vol. 56, No. 10, pp. 2086-2096, October 2009.
88. P. M. Shankar, "Contrast enhancement and phase sensitive boundary detection in ultrasonic speckle using Bessel spatial filters," *Proc. IET Image Processing*, Vol. 3, No. 2, pp. 41-51, April 2009.
87. P. M. Shankar, "Macro- and micro diversity in correlated shadowed fading channels," *IEEE Trans. Vehicular Technology*, Vol. 58, No. 2, pp. 727-732, Feb. 2009.
86. P. M. Shankar, "Outage probabilities of a MIMO scheme in shadowed fading channels with micro- and macrodiversity reception," *IEEE Trans. on Wireless Communications*, Vol. 7, No.6, pp. 2015-2019, June 2008.
85. P. M. Shankar, "Analysis of microdiversity and dual channel macrodiversity in shadowed fading channels using a compound fading model," *AEUE (International Journal of Electronics and Communications)*, Vol. 62, No.6, pp. 445-449, 2 June 2008.
84. A. Leung, P. M. Shankar and R. Mutharasan, "Label-free detection of DNA hybridization using gold-coated tapered fiber optic biosensors (TFOBS) in a flow cell at 1310 nm and 1550 nm," *Sensors and Actuators B-Chemical*, 131(2), 640-645, May 14, 2008.
83. A. Leung, P. M. Shankar and R. Mutharasan, "Model protein detection using antibody immobilized tapered fiber optic sensors (TFOBS) in a flow cell at 1310 nm and 1550 nm," *Sensors and Actuators B*, Vol. B 129, 716-725, February 2008.
82. A. Leung, P. M. Shankar and R. Mutharasan, "A review of fiber-optic biosensors," *Sensors and Actuators (Chemical)*, Vol. B 125, Issue 2, pp. 688-703, 8 August 2007.
81. A. Leung, P. M. Shankar, R. Mutharasan, "Real time monitoring of bovine serum albumin at femtogram/mL levels on antibody immobilized tapered fiber sensors," *Sensors and Actuators (Chemical)*, Vol. B 123, Issue 2, pp. 888-895, May 2007.
80. P. M. Shankar, "Outage performance in wireless systems with multiple interferers subject to shadowing and fading using a compound fading model," *AEUE (International J. of Electronics and Communications)*, Vol. 61, No. 4, pp. 255-261, April 2, 2007.
79. P. M. Shankar, "Speckle reduction in ultrasonic images through a maximum likelihood based adaptive filter," *Phys. Med. Biol.*, Vol. 51, pp. 5591-5602, 7 November, 2006
78. P. M. Shankar, "Performance analysis of diversity combining algorithms in shadowed fading channels," *Wireless Personal Comm.*, Vol. 37 (No. 1-2), pp. 61-72, April 2006.
77. P. M. Shankar, "Comments on the effect of logarithmic compression on the estimation of the Nakagami parameter for ultrasonic tissue characterization," *Phys. Med. Biol.*, Vol. 51, No 8, pp. L23-L26, April 2006.

76. A. Leung, K. Rijal, P. M Shankar and R. Mutharasan, "Effects of geometry on transmission and sensing potential of tapered fiber sensors," *Biosensors and Bioelectronics*, Vol. 21, No. 12, pp. 2202-2209, June 2006.
75. D. Maraldo, P. M Shankar and R. Mutharasan, "Measuring Bacterial Growth by Tapered Fiber and Changes in Evanescent Field," *Biosensors and Bioelectronics*, Vol. 21, No. 7, pp. 1339-1344, January 2006.
74. P. M. Shankar, "Outage probabilities in shadowed fading channels using a compound statistical model," *IEE Proc. Comm.*, Vol. 152, No.6, pp. 828-832, December 2005.
73. K. Rijal, A. Leung, P. M Shankar and R. Mutharasan, "Detection of pathogen *E. Coli* O157:H7 using antibody immobilized biconical tapered fiber sensors," *Biosensors and Bioelectronics*, Vol. 21, No.6, pp. 871-880, December 2005.
72. P. M. Shankar, C. W. Piccoli, J. M. Reid, F. Forsberg, B. B. Goldberg, "Application of the compound pdf for characterization of breast masses in ultrasonic B scans," *Phys. Med. Biol.*, Vol. 50, pp. 2241-2248, April 2005.
71. P. M. Shankar, "Error rates in generalized shadowed fading channels," *Wireless Personal Comm.*, Vol. 28, pp. 233-238, February 2004.
70. G. Bhagavatheeshwaran, W. T. Shi, F. Forsberg, and P M Shankar, "Subharmonic signal generation from contrast agents in simulated neovessels," *Ultrasound in Medicine and Biology*, Vol. 30, pp. 199-203, February 2004.
69. P. M. Shankar, "The use of the compound pdf in ultrasonic tissue characterization," *Phys. Med. Biol.*, Vol. 49, pp. 1007-1015, February 2004.
68. P. J. Wiejata, P. M. Shankar, and R. Mutharasan, "Fluorescent Sensing Using Biconical Tapers," *Sensors and Actuators*, Vol. B 96, pp. 315-320, November 2003.
67. H. S. Haddock, P. M. Shankar, and R. Mutharasan, "Fabrication of biconical tapered optical fibers using hydrofluoric acid," *Material Science & Engineering - B*, Vol. B 97, pp. 87-93, January 2003.
66. H. S. Haddock, P. M. Shankar, and R. Mutharasan, "Evanescent Sensing of biomolecules and cells," *Sensors and Actuators B*, Vol. 88, pp. 67-74, 2003.
65. P. M. Shankar, F. Forsberg, and L. Lown, "Statistical modeling of atherosclerotic plaque in carotid B mode images - A feasibility study," *Ultrasound in Medicine and Biology*, Vol. 29, No. 9, pp. 1305-1309, September 2003.
64. P. M. Shankar, V. A. Dumane, C. W. Piccoli, J. M. Reid, F. Forsberg and B. B. Goldberg, "Computer-aided classification of breast masses in ultrasonic B scans using a multiparameter approach," *IEEE Trans. on UFFC*, Vol. 50, No. 8, pp. 1002-1009, August 2003.

63. P. M. Shankar, V.A. Dumane, T. George, C. W. Piccoli, J. M. Reid, F. Forsberg, B. B. Goldberg, "Classification of breast masses in ultrasonic B scans using Nakagami and K distributions," *Phys. Med. Biol.*, Vol. 48, No. 14, pp. 2229-2240, 21 July 2003.
62. P. M. Shankar, "Estimation of the Nakagami parameter from log-compressed ultrasonic backscattered envelopes," *J. Acoustical Soc. of Amer.*, Vol. 114, pp. 70-72, July 2003.
61. P. M. Shankar, "A compound scattering pdf for the ultrasonic echo envelope and its relationship to K and Nakagami distributions," *IEEE Trans. on UFFC*, Vol. 50, No. 3, pp. 339-343, March 2003.
60. S. Gefen, O. J. Tretiak, C. W. Piccoli, K. D. Donohue, A. P. Petropulu, P. M. Shankar, V. A. Dumane, L. Huang, M. A. Kutay, V. Genis, F. Forsberg, J. M. Reid, B. B. Goldberg, "ROC analysis of tissue characterization classifiers for breast cancer detection," *IEEE Trans. on Medical Imaging*, Vol. 22, No. 2, pp. 170-177, Feb. 2003.
59. G. S. Prabhu and P. M. Shankar, "Performance Analysis of Fiber-Fed Microcellular Networks using $\pi/4$ -DQPSK in a Frequency Selective, CCI-limited, Nakagami Fading Environment," *IEEE Trans. on Vehicular Technology*, Vol. 51, No. 5, pp.1258-1264, September 2002.
58. G. S. Prabhu and P. M. Shankar, "Simulation of flat fading using MATLAB for classroom instruction," *IEEE Trans. on Education*, Vol. 45, No. 2, pp. 19-25, February 2002.
57. P. M. Shankar, V. A. Dumane, C. W. Piccoli, J. M. Reid, F. Forsberg and B. B. Goldberg, "Classification of breast masses in ultrasonic B-mode images using a compounding technique in the Nakagami distribution domain," *Ultrasound in Medicine and Biology*, Vol. 28, No. 10, pp. 1295-1300, 2002.
56. V. A. Dumane, P. M. Shankar, C. W. Piccoli, J. M. Reid, F. Forsberg and B. B. Goldberg, "Computer aided classification of masses in ultrasonic mammography," *Medical Physics*, Vol. 29, No. 9, pp. 1968-1973, September 2002.
55. V. A. Dumane, P. M. Shankar, C. W. Piccoli, J. M. Reid, V. Genis, F. Forsberg and B. B. Goldberg, "Classification of ultrasonic B-scan images of breast lesions using frequency diversity and Nakagami statistics," *IEEE Trans. on UFFC*, Vol. 49, No. 5, pp. 664-668, May 2002.
54. P. M. Shankar, "Ultrasonic tissue characterization using a generalized Nakagami model," *IEEE Trans. on UFFC*, Vol. 48, No. 6, pp. 1716-1720, November 2001.
53. V. A. Dumane and P. M. Shankar, "Use of frequency diversity and Nakagami statistics in ultrasonic tissue characterization," *IEEE Trans. on UFFC*, Vol. 48, No. 4, pp. 1139-1146, July 2001.
52. P. M. Shankar, V. A. Dumane, J. M. Reid, V. Genis, F. Forsberg, C. W. Piccoli, and B. B. Goldberg "Classification of ultrasonic B mode images of breast masses using Nakagami distribution," *IEEE Trans. on UFFC*, Vol. 48, No. 2, pp. 569-580, March 2001.

51. P. M. Shankar, V. A. Dumane, J. M. Reid, V. Genis, F. Forsberg, C. W. Piccoli, and B. B. Goldberg, "Classification of masses in B-scan images of the breast using K-distribution," *Ultrasound in Medicine and Biology*, Vol. 26, No. 9, pp. 1503-1510, 2000.
50. P. M. Shankar and B. A. Eisenstein, "Project based Instruction in Wireless Communications at the Junior Level," *IEEE Trans. on Education*, Vol. 43, No. 3, August 2000, pp. 245-249.
49. P. M. Shankar, "A general statistical model for ultrasonic scattering from tissues," *IEEE Trans. on UFFC*, Vol. 47, No. 3, pp. 727-736, May 2000.
48. J. Koshy and P. M. Shankar, "Spread-Spectrum Techniques for Fiber-Fed Microcellular Networks," *IEEE Trans. on Vehicular Technology*, Vol. 48, No. 3, pp. 847-857, May 1999.
47. P. M. Shankar, P. D. Krishna, and V. L. Newhouse, "Subharmonic scattering properties of ultrasound contrast agents," *JASA*, Vol. 106, No. 4, pp. 2104-2110, October 1999.
46. P. D. Krishna, P. M. Shankar and V. L. Newhouse, "Subharmonic generation from Ultrasonic Contrast agents," *Physics in Med. Biology*, Vol. 44, March 1999, pp. 681-694.
45. J. Koshy and P. M. Shankar, "Effect of Nonlinearities on Outage Performance of Fiber-Fed Microcellular Networks for GMSK Systems," *IEEE Trans. on Vehicular Technology*, Vol. 47, No. 3, pp. 819-829, Aug. 1998.
44. P. M. Shankar, P. Dala Krishna, and V. L. Newhouse, "Advantages of Subharmonic over Second Harmonic Backscatter for Contrast-to-Tissue Echo Enhancement," *Ultrasound in Medicine & Biology*, Vol. 24, No. 2, pp. 395-399, 1998.
43. R. C. Molthen, V. M. Narayanan, P. M. Shankar, J. M. Reid, V. Genis, F. Forsberg, E. J. Halpern, and B. B. Goldberg, "Using Phase Information in Ultrasonic Backscatter for In Vivo Liver Analysis," *Ultrasound in Medicine & Biology*, Vol. 24, No. 1, pp. 79-91, 1998.
42. R. C. Molthen, P. M. Shankar, J. M. Reid, F. Forsberg, E. J. Halpern, C. W. Piccoli, and B. B. Goldberg, "Comparisons of the Rayleigh and K-distribution models using *in vivo* breast and liver tissue," *Ultrasound in Medicine & Biology*, Vol. 24, No. 1, pp. 93-100, 1998.
41. B. J. Koshy and P. M. Shankar, "Performance Analysis of GMSK in Microcellular Mobile Systems Employing Fiberoptic Feeders," *IEEE J. of SAC*, Vol. 15, No. 4, pp. 694-706, May 1997.
40. V. M. Narayanan, R. C. Molthen, P. M. Shankar, L. Vergara and J. M. Reid, "Studies On Ultrasonic Scattering from Quasi-Periodic Structures," *IEEE Trans. on UFFC*, Vol. 44, pp. 114 – 124, January 1997.
39. P. M. Shankar, R. Molthen, V. M. Narayanan, J. M. Reid, V. Genis, F. Forsberg, C. W. Piccoli, A. E. Lindenmayer and B. B. Goldberg, "Studies on the use of non-Rayleigh statistics for ultrasonic tissue characterization," *Ultrasound in Medicine & Biology*, Vol. 22, No. 7, 1996, pp. 873-882.
38. P. M. Shankar, "A model for ultrasonic scattering from tissues based on K distribution," *Phys. Med. Biol.*, Vol. 40, pp. 1633-1649, October 1995.

37. R. C. Molthen, P. M. Shankar and J. M. Reid, "Tissue Characterization in Ultrasonic B scans using Non-Rayleigh Statistics," *Ultrasound in Med. & Biol.*, Vol. 21, No. 2, pp. 161-170, 1995.
36. Y. Q. Wu, P. M. Shankar, and P. A. Lewin, "Characterization of Ultrasonic Transducers using a Fiberoptic Sensor," *Ultrasound in Medicine & Biology*, Vol. 20, pp. 645-653, Oct. 1994.
35. Y. Q. Wu, P. M. Shankar, P. A. Lewin and D. Koller, "Fiberoptic ultrasound sensor using Raman-Nath light diffraction," *IEEE Trans. on UFFC*, Vol. 41, pp. 166- 171, Mar. 1994.
34. V. M. Narayanan, P. M. Shankar and J. M. Reid, "Non-Rayleigh Statistics of Ultrasonic Backscattered Signals," *IEEE Trans. on UFFC*, Vol. 41, pp. 845- 852, November 1994.
33. D. Koller and P. M. Shankar, "Acoustic emissions from bubble clouds," *Ultrasonics*, Vol. 32, No. 3, pp. 229-233, May 1994.
32. T. J. Brophy, P. M. Shankar, and Lloyd C. Bobb, "Formation and measurement of tapers in optical fibers," *Rev. of Sci. Instrum.*, Vol. 64, no. 9, pp. 2650-2654, Sept. 1993.
31. T. J. Brophy, L. C. Bobb and P. M. Shankar, "An in-line single-mode fibre interferometer via concatenated biconical tapers," *Electr. Letters*, Vol. 29, No. 14, pp. 1276-77, 8th July 1993.
30. P. M. Shankar, J. M. Reid, H. Ortega, C. W. Piccoli, and B. B. Goldberg, "Use of non-Rayleigh statistics for the identification of tumors in the ultrasonic B scans of the breast," *IEEE Trans. on Medical Imaging*, Vol. 12, No. 4, pp. 687-692, Dec. 1993.
29. D. P. Koller and P. M. Shankar, "Low frequency oscillations of bubble plumes," *JASA*, Vol. 93, pp.1362-1365, Mar. 1993.
28. L. Bobb and P. M. Shankar, "Tapered optical fiber components and sensors," *Microwave Journal*, pp. 218-222, May 1992.
27. Y. Li, V. L. Newhouse and P. M. Shankar, and P. Karpur, "Speckle reduction in ultrasonic synthetic aperture images," *Ultrasonics*, Vol. 30, pp. 233-237, July 1992.
26. Y. Li, D. Koller, G. George, P. M. Shankar and V. L. Newhouse, "Underwater bubble sizing using a double frequency technique," *J. Acoust. Soc. Amer.*, Vol. 92, pp. 1177- 79, Aug. 1992.
25. D. Koller, Y. Li, P. M. Shankar, and V. L. Newhouse, "High speed bubble sizing using the double frequency technique for oceanographic applications," *IEEE J. Oceanic Engineering*, Vol. 17, pp. 288-90, July 1992.
24. Li Weng, J. Reid, P. M. Shankar, K. Soetanto and X. Lu, "Nonuniform phase distribution in ultrasound speckle analysis I: Background and experimental demonstration," *IEEE Trans. on UFFC*, Vol. 39, pp. 352- 359, May 1992.

23. Li Weng, J. Reid, P. M. Shankar, K. Soetanto and X. Lu, "Nonuniform phase distribution in ultrasound speckle analysis II: Parametric expression and a frequency sweeping technique to measure mean scatterer spacing," *IEEE Trans. on UFFC*, Vol. 39, pp. 360-365, May 1992.
22. P. M. Shankar, L. Bobb, and H. Krumboltz, "Coupling of modes in bent biconically tapered single mode fibers," *J. Lightwave Technology*, Vol. 9, No. 7, pp. 832-37, July 1991.
21. L. Bobb, H. Krumboltz and P. M. Shankar, "A novel pressure sensor using bent biconically tapered single mode fibers," *Optics Letters.*, Vol. 16, No. 2, Jan. 15, pp. 112-114, 1991.
20. Li Weng, J. Reid, P. M. Shankar, and K. Soetanto, "Ultrasound speckle analysis using K-distribution," *JASA*, Vol. 89, pp. 2992- 2995, June 1991.
19. L. Bobb, P. M. Shankar, and H. Krumboltz, "Bending effects in biconically tapered single mode fibers," *J. of Lightwave Technology*, Vol. LT- 8, pp. 1084-1090, July 1990.
18. B. Schrope, P. M. Shankar and V. L. Newhouse, "In vitro detection and sizing of microbubbles using a two frequency ultrasonic system," *ITBM*, Vol. 11, No. 6, 1990, pp. 612-615.
17. D. Cathignol, J. Y. Chapelon, V. L. Newhouse, and P. M. Shankar, "Bubble sizing with high spatial resolution," *IEEE Trans of UFFC*, Vol. 37, pp. 30-37, Jan. 1990.
16. P. M. Shankar, "Performance of LED-single mode fiberoptic Systems," *J. Optical Communications*, Vol. 10, pp. 132-137, Dec. 1989.
15. P. M. Shankar, "Modal redistribution and power loss in on-fiber devices," *Optical and Quantum Electronics*, Vol. 21, pp. 321-329, May 1989.
14. P. M. Shankar, "Bit error degradation due to modal noise in single mode fiberoptic communication systems," *J. Opt. Comm.*, Vol. 10, No. 1, pp.19-23, March 1989.
13. P. M. Shankar, P. Karpur, V. L. Newhouse and J. Rose, "Split spectrum processing: Analysis of polarity thresholding algorithm for the improvement of SNR and detectability of ultrasonic signals," *IEEE Trans of UFFC*, Vol. 36, pp. 101-108, Jan. 1989.
12. P. M. Shankar, "Mode coupling in on-fiber devices," *Microwave and Optical Technology Letters*, Vol. 1, pp. 291-293, Oct. 1988.
11. P. M. Shankar, "Effect of modal noise on single mode fiber optic networks," *Optics Communications*, Vol. 65, pp. 347-350, Mar. 1988.
10. P. Karpur, P. M. Shankar, J. L. Rose and V. L. Newhouse, "Split spectrum processing: Determination of the available bandwidth for spectral splitting," *Ultrasonics*, Vol. 26, pp. 204-209, July 1988.
9. J. Y. Chapelon, V. L. Newhouse, D. Cathignol and P. M. Shankar, "Bubble detection and sizing with a double frequency Doppler system," *Ultrasonics*, Vol. 26, pp. 148-154, May 1988.

8. P. M. Shankar, U. Bencharit, N. M. Bilgutay and J. Saniie, "Grain noise suppression through bandpass filtering," *Materials Evaluation*, Vol. 46, pp. 1100-1106, Jul. 1988.
7. P. Karpur, P. M. Shankar, J. Rose and V. L. Newhouse, "Split spectrum processing: Optimizing the processing parameters using minimization," *Ultrasonics*, Vol. 25, pp. 204-208, Jul. 1987.
6. M. El-Sherif, P. M. Shankar, P. Herczfeld, L. Bobb and H. Krumboltz, "On-fiber electrooptic modulator/switch," *Applied Optics*, Vol. 25, pp. 2469-2470, Aug. 1986.
5. P. M. Shankar, "Speckle reduction in ultrasound B scans using weighted averaging in spatial compounding," *IEEE Trans of UFFC*, Vol. 33, pp. 754-758, Nov. 1986.
4. P. M. Shankar, J. Y. Chapelon and V. L. Newhouse, "Fluid pressure measurement using bubbles," *Ultrasonics*, Vol. 24, pp. 333-336, May 1986.
3. P. M. Shankar and V. L. Newhouse, "Speckle reduction with improved resolution in ultrasound Images," *IEEE Trans of UFFC*, Vol. SU-32, pp. 537-543, July 1985.
2. J. Y. Chapelon, P. M. Shankar and V. L. Newhouse, "Ultrasonic measurement of bubble cloud size profiles," *JASA*, Vol. 78, pp. 196-201, July 1985.
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Other Publications

P. M. Shankar, "Bringing Optics to High School: From eyeglasses to holograms," *Materials Research Society Bulletin*, Aug. 1992, P.72.

Conference Proceedings (Refereed) in Wireless Communications

P. M. Shankar, "Performance of N*Nakagami cascaded fading channels in dual selection combining diversity," 2011 International Wireless Communications and Mobile Computing Conference [IWCMC2011], Istanbul, Turkey, July 4-8, 2011.

P. M. Shankar and Camillo Gentile, "Statistical analysis of short term fading and shadowing in Ultra-Wideband systems," IEEE ICC 2010 - Wireless Communications Symposium ('ICC'10 WCS'), Cape Town, South Africa, 23 – 27 May 2010.

Conference Proceedings (Refereed) in ULTRASONICS/ ACOUSTICS

J. M. Reid, B. B. Goldberg, P. M. Shankar, F. Forsberg, N. Bilgutay, P. Bloomfield, F. Cohen, K. Donohue, E. Halpern, P. A. Lewin, B. Onaral, A. Petropoulou, C. Piccoli, O. J. Tretiak, M. Wheatley, "Progress in cancer diagnosis with ultrasound," Proceedings of the 23rd Annual International Conference of the IEEE Engg. Med. Biol. Soc., Oct. 25-28, 2001, Istanbul, Turkey.

L. Vergara, R. Miralles and P. M. Shankar, "Feature extraction from K distributed noise by higher order spectral analysis," Proceedings of the IEEE Signal Processing/ATHOS Work shop on Higher Order Statistics, Girona, Spain, June 12-14, 1995.

L. Vergara, J. Megias, and P. M. Shankar, "A statistical interference approach to parameter estimation of K distributed noise," VII European Signal Processing Conference (EUSIPCO-94), Sept. 13-16, 1994, Univ. of Edinburgh, Scotland, U. K.

R. Molthen, V. M. Narayanan, P. M. Shankar, J. Reid, V. Genis, and L. Vergara-Dominguez, "Ultrasound echo evaluation using K distribution," 1993 Ultrasonics Symposium, Nov. 1993, Baltimore, MD.

L. Weng, J. M. Reid, P. M. Shankar, K. Soetanto, "Non-uniform ultrasound speckle phase distribution applied to scatterer spacing estimation," 1990 IEEE Ultrasonics Symposium, Dec. 4-7, 1990, Honolulu, Hawaii.

L. Weng, J. M. Reid, P. M. Shankar, K. Soetanto, Y. Li, X. Lu, H. Oung, R. Raghavan, V. Genis, and A. W. Schimdt, "Moments and phase of non-Rayleigh speckle statistics applied to ultrasound image analysis," 12th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Nov. 1-4, 1990, Philadelphia, PA.

D. Cathignol, J. Y. Chapelon, Y. Thiellevé, V. L. Newhouse and P. M. Shankar, "Bubble sizing with high spatial resolution," 1988 IEEE Ultrasonics Symposium, Oct. 1988, Chicago, IL.

Y. Li, P. Karpur, V. L. Newhouse and P. M. Shankar, "Speckle reduction in ultrasonic SAFT images through split spectrum processing," Review of Progress in Quantitative NDE, San Francisco, Aug. 1988.

J. Y. Chapelon, D. Cathignol, V. L. Newhouse and P. M. Shankar, "A double frequency Doppler technique for bubble size measurement," IEEE Ultrasonics Symposium, Oct. 1987, Denver, CO.

V. L. Newhouse, J. L. Rose, P. Karpur and P. M. Shankar, "Split spectrum processing: analysis of polarity thresholding algorithm for improvement of signal-to-noise ratio and detectability in ultrasonic signals," Review of progress in Quantitative NDE, Williamsburg, June 21, 1987.

J. Y. Chapelon, P. M. Shankar and V. L. Newhouse, "Applications of double frequency technique in bubble sizing and pressure measurement in fluids," 14th Symposium on Acoustical Imaging, April 22-25, 1985, Delft University of Technology, The Netherlands.

J. Y. Chapelon, P. M. Shankar and V. L. Newhouse, "Noninvasive measurement of pressure in fluids," Societe Francaise d'Application des Ultrasons a la Medicine et a la Biologie, Sept. 1985, Lyon, France.

P. M. Shankar and V. L. Newhouse, "Specificity and Sensitivity of Lesion Detection by Spatial Compounding of B mode Images," 1984 IEEE Ultrasonics Symposium, Dallas, TX, Nov. 1984.

P. M. Shankar and V. L. Newhouse, "Double frequency bubble diagnostics," 1983 IEEE Ultrasonics Symposium, Oct. 31 - Nov. 2, 1983, Atlanta, Georgia.

[Conference Presentations in ULTRASONICS/ ACOUSTICS](#)

P. M. Shankar[@], "Statistical modeling of scattering from biological media," 143rd meeting of the Acoustical Society of America, June 3-7, June 2002, Pittsburgh, PA.

V. A. Dumane, P. M. Shankar, C. W. Piccoli, J. M. Reid, F. Forsberg and B. B. Goldberg , "Multiparameter classification of masses in ultrasonic mammography," 143rd Meeting of the Acoustical Society of America, June 3-7, 2002, Pittsburgh, PA.

V. A. Dumane, P. M. Shankar, C. W. Piccoli, J. M. Reid, F. Forsberg and B. B. Goldberg , "Ultrasonic Classification of Breast Masses using Texture and Margin Characteristics," International Symposium on ultrasonic imaging and tissue characterization, June 3-6, 2002, Arlington, VA.

T. Karayianni, O. J. Tretiak, F. S. Cohen, K. D. Donohue, P. M. Shankar, R. C. Molthen, N. Herrmann, E. J. Halpern, C. W. Piccoli, F. Forsberg, B. B. Goldberg, and J. M. Reid, "ROC analysis of RF based ultrasonic tissue characterization features," 22nd International Symposium on Ultrasonic Imaging and Tissue Characterization, Arlington, VA, June 2-5, 1997.

R. C. Molthen, P. M. Shankar, V. M. Narayanan, J. M. Reid, V. Genis, F. Forsberg, C. W. Piccoli, A. E. Lindenmayer, and B. B. Goldberg, "Use of the K distribution and phase statistics to define tissue scattering conditions," 38th Annual Meeting of the American Association of Physicists in Medicine, July 25, 1996, Philadelphia, PA.

R. C. Molthen, P. M. Shankar, V. M. Narayanan, J. M. Reid, V. Genis, F. Forsberg, C. W. Piccoli, A. E. Lindenmayer, and B. B. Goldberg, "Using the K distribution and phase statistics to examine in vivo breast and liver data," 21st International Symposium on Ultrasonic Imaging and Tissue Characterization, Arlington, VA, June 6, 1996.

V. M. Narayanan, R. C. Molthen, P. M. Shankar and J. M. Reid, "Non-Rayleigh statistics of ultrasonic backscattered echo from tissue," Presented at the 127th meeting of the Acoustical Soc. of America, Cambridge, MA, June 6-10, 1994.

Y. Q. Wu, P. A. Lewin, and P. M. Shankar, "Fiberoptic ultrasound sensor," Presented at the 18th Int. Symposium on Ultrasonic Imaging and Tissue Characterization, Arlington, VA, June 7-9, 1993.

D. Koller, Y. Li, P. M. Shankar, "Low frequency oscillations of bubble plumes," Presented at the 124th meeting of the Acoustical Soc. of America, New Orleans, LA, Nov. 2, 1992.

D. Koller, Y. Li, P. M. Shankar, and V. L. Newhouse, "High speed bubble sizing," 123rd meeting of the Acoustical Society of America, May 1992, Salt Lake City, UT.

G. George, D. Koller, Y. Li, P. M. Shankar, and V. L. Newhouse, "Long range detection and sizing of millimeter size bubbles," 120th meeting of the Acoust. Soc. of Amer., Nov. 1990, San Diego, CA.

Li Weng, P. M. Shankar, K. Soetanto, and J. M. Reid, "Scatterer concentration estimation based on K- distribution," 15th International Symposium on Ultrasonic Imaging and Tissue Characterization, June 1990, Silver Spring, MD.

Yue Li, V. L. Newhouse and P. M. Shankar, "Edge detection in speckled environment with split spectrum processing," 15th International Symposium on Ultrasonic Imaging and Tissue Characterization, June 1990, Silver Spring, MD.

P. M. Shankar[@], "Bubble sizing for cardiac Applications," World Conference on Medical Physics and Biomedical Engineering, San Antonio, TX, Aug. 6-12, 1988.

P. M. Shankar[@], "Noninvasive ultrasonic bubble sizing," 16th Annual Technical Symposium of the Ultrasonic Industry Association, April 17, 1985, New York, NY.

[Conference Proceedings \(Refereed\) in OPTICS](#)

B. J. Koshy and P. M. Shankar, "Effect of fading and Poisson traffic on the performance of the fiber-optic microcellular systems," CLEO/QELS 1997, May 21, Baltimore, MD.

L. Bobb, H. Krumboltz, and P. M. Shankar, "An optical fiber alternating-gradient magnetometer," 8th OFS, Jan. 29-31, 1992, Monterey, CA.

L. Bobb, H. Krumboltz, and P. M. Shankar, "A new sensor: the bent biconically tapered single mode fiber," CLEO-90, May 25-29, Anaheim, CA.

M. El-Sherif, P. M. Shankar, P. Herczfeld, L. Bobb and H. Krumboltz, "An on-fiber active transducer", TRANSDUCERS'87, Japan, June 5, 1987.

M. El-Sherif, P. M. Shankar, P. Herczfeld, L. Bobb and H. Krumboltz, "An optical fiber electro-optic modulator," SPIE Cambridge Symposium, Sept. 1986.

P. Herczfeld, L. Akins and P. M. Shankar, "System considerations for an optically controlled phased array antenna," IEEE AP-S International Symposium, Philadelphia, June 9, 1986.

[Conference Proceedings \(Refereed\) in EDUCATION](#)

G. W. Hislop, S. Mancoridis and P. M. Shankar, 'A Collaborative Bachelor's degree in software engineering,' 33rd ASEE/IEEE Frontiers in Education Conference, Nov. 5-8, 2003, Boulder, CO.

R. Mutharasan and P. M. Shankar, 'Interdisciplinary Electives in the Upper Level Engineering Curricula,' ASEE 2002 Annual Conference, Montreal, Canada, June 2002.

[@] **invited talk**

G. W. Hislop, S. Mancoridis, and P. M. Shankar, "Creating a jointly sponsored Master of Science in Software Engineering," Proc. of the 29th ASEE/IEEE Frontiers in Education Conference, San Juan, Puerto Rico, pp. 13a3-7 to 13a3-11, Nov. 10-13, 1999.

Conference Presentations in EDUCATION

R. Mutharasan and P. M. Shankar, 'Upper Level Interdisciplinary Courses: Drexel Experiment,' 2002 AIChE Meeting, Nov. 3-8, Indianapolis, Indiana.

R. Mutharasan and P. M. Shankar, 'Upper Level Interdisciplinary Courses in the Engineering Curricula,' Presented at AIChE meeting, Reno, NV, Nov. 2001.

Conference Presentations in OPTICS

A. Leung, P. M. Shankar, R. Mutharasan, Tapered fiber optic biosensor detects 10 fg/mL BSA At 1310 nm and 1550 nm in a flow cell configuration, The Ninth World Congress on Biosensors, May 10 – 12, 2006, Sheraton Centre Toronto, Ontario, Canada

A. Leung, P. Shankar, R. Mutharasan, "Detection of pathogens using antibody-immobilized biconical tapered fiber sensors at 1330 and 1550 nm", 2005 AIChE Meeting, Nov. 1-4, Cincinnati, OH.

A. Leung, K. Rijal, G. Thomas, R. Mutharasan and P. M. Shankar, "Continuous tapered fibers as sensors for cellular growth and pathogen detection", 2004 AIChE Meeting, Nov. 7-12, Austin, TX.

H. S. Haddock, R. Mutharasan, P. M. Shankar and P. J. Wiejata, "Evanescent sensing of cell concentration in microvolumes," 2002 AIChE Meeting, Nov. 3-8, Indianapolis, Indiana.

P. M. Shankar, "Coupling of modes in on-fiber devices," Presented at the 1988 OSA Annual Meeting, Nov. 1988, Santa Clara, CA.

Book Reviews Published

P. M. Shankar, Review of "Lasers and Optical Fibers in Medicine," by A. Katzir, (Academic Press), in *Optics and Photonics News*, July 1994, pp. 61-63.

P. M. Shankar, Review of "Optical fiber sensors: Principles and components," by J. Dakin and B. Culshaw, (Artech House), *Optics and Photonics News*, July 1990, pp. 53-54.

P. M. Shankar, Review of "Fiber Optic Splices and Connectors" by C. M. Miller, S. C. Mettler and I. A. White (Marcel Dekker) in *Optics News*, January 1988, P. 51.

P. M. Shankar, Review of "Fiber Optics: Technology and Applications" by S. E. Personick, (Plenum Press) in *Optics News*, January 1986, P. 52.

Administrative and Committee Service

1 Interim Department Head, ECE Department (July 1, 2006 to July 6, 2007)

- Managed a group of 34 tenured/tenure track faculty, several adjunct faculty and 14 staff members including annual evaluation of faculty
 - Managed the department operating budget of \$5-6 M
 - Managed a research expenditure of \$10 M
 - Prepared the department for the ABET visit (October 14-16, 2007)
 - Handled the tenure/promotion cases
2. **Assistant Head** of Dept for Graduate affairs and **Graduate Advisor** (ECE)
 - September 1993 to December 1997, **and**, September 1999 to July 2004.
 - Reviewed all the applications to ECE graduate programs (~ 400/year)
 - Oversaw all aspects of graduate studies
 - Faculty loading and teaching assignments for graduate courses
 - Managed the TA budget
 - Revamped **the 15 year old graduate curriculum (completed in May 2004)**
 3. **Chairman**, Graduate Program and Research Committee (GPRC), College of Engineering
Fall 1994 to August 31, 2000
 4. **Director**, Graduate Programs, College of Engineering, July 1, 1996 to December 31, 2000.
 - Oversee the enrollment in the COE; work closely with the Office of Admissions
 - Oversee the quality of the Graduate Program in the COE
 - Chair the Graduate Programs Committee of the COE
 - Coordinate the Bachelors/Masters Program in the College of Engineering
 - Responsible for putting together the College Brochure and Newsletters (1998 and 1999)

Major Accomplishments as Chair, GPRC and Director, Graduate Programs, COE

- Initiated, and developed a Masters in EE/Telecomm. Engineering in the ECE Department.
 - Developed the **Master of Engineering** (Manufacturing) Program in the College of Engineering.
 - Took the leadership role (Coordinator) in the development the new **Master of Science** in Software Engineering. This is a joint program of ECE Department, Computer Science Department, and the College of Information Science of Technology. A joint program was developed for offering BS in Software Engineering.
 - Initiated the process for setting up the **Career-Integrated-Education** (CIE): Course ENGR-701, 702. CIE is now available (starting Fall 1998) for all MS Programs in the College of Engineering.
 - Proposed a fellowship plan for Full Time Graduate Students in the College of Engineering. This plan was finally approved by the University and is being offered. This fellowship, '**Deans Fellowship**', will provide 40-60% tuition remission to outstanding graduate students who could not be supported as a TA or RA. This plan has now been adopted by the whole University.
 - Put together a plan to provide **scholarships/fellowships** for students to pursue Bachelors/Masters Program. These students receive fellowships to keep their tuition at the UG level for five years to complete both their B. S. and M. S. degrees. Initially **proposed for the COE students**, after approval by the University administration, the policy is currently available University wide. The enrollment in B.S./M.S. Program has increased significantly since the plan went into effect.
5. **Chair**, Colehower Scholarship Committee, ECE Department, 1992 to 2004
 6. Member, Senate Committee on Academic Affairs, Fall 1992 to 1996
 7. **Vice Chair**, Faculty Club Board, 1991 to 1995.

Professional Activities

Chairman, Awards Committee, IEEE Philadelphia Section, 1998

Serving as a member of the Working Group (Standards) On 'Cavitation Detection and Monitoring', Acoustical Society of America, 1991 to 2001.

Delivered an invited talk on "Bubble sizing for cardiac applications" at the World Congress on Medical Physics and Biomedical Engineering, San Antonio, TX, August 6-12, 1988.

Chaired the session on Ultrasound II (Doppler Effect) at the 13th Northeast Bioengineering Conference, University of Pennsylvania, Philadelphia, PA, March 1987.

Served on the Organizing Committee for the International Symposium on "Computers in Ultrasound," held at American College, PA, September 1985.

Delivered an invited talk on "Non-invasive ultrasonic bubble sizing" at the 16th Annual Technical Symposium of the Ultrasonic Industry Association, April, 17, 1985, New York.

Chaired the session on "Inverse scattering" at the IEEE Ultrasonics Symp., Dallas, TX, Nov. 1984.

Serves/served as a reviewer for *Applied Optics*, *Optics Communications*, *Sensors*, *Optical Engineering*, *Electronics Letters*, ETRI (Korea), *Materials Evaluation*, *Canadian J. Electrical & Comp. Engg.*, *IEEE Tran on UFFC*, *IEEE Transactions on BME*, *IEEE Transactions on Education*, *IEEE Trans. on MTT*, *IEEE Trans. on Vehicular Technology*, *IEEE Trans. on Signal Processing*, *IEEE Trans. on Medical Imaging*, *IEEE Trans. on Communications*, *IEEE Trans. on Circuits and Systems for Video Technology*, *IEEE Trans. Instrumentation & Measurement*, *Ultrasound in Medicine & Biology*, *J. Acoustical Soc. America*, *Applied Signal Processing*, *IEEE Comm. Letters*, *Physics in Medicine and Biology*, *American Institute of Ultrasound in Medicine (AIUM)*, *Measurement Science and Technology*, *Proc. IET/IEE (Comm.)*, *IET/IEE Proc. Image Processing*, *J. of the Franklin Institute*, *Int. J. of Elect. Comm. (AEUE)*, *Wireless Personal Communication (WIRE)*, *Computational and Mathematical Methods in Medicine*, *Computational Statistics*, *J. Mathematical Imaging and Vision*, *Optics and Lasers in Engineering*, *NSF*

Areas of interest

Biophotonics, Fiber optics, Medical Ultrasound, Wireless Communications

Research Proposals Funded

Department of Education, "GAANN Fellowships to Develop Renaissance Engineers," September 1, 2006 for three years; \$504 K; One of nine (9) investigators

NSF, "Ultra Sensitive Continuous Tapered Fiber Biosensors for Pathogens and Bioterrorism Agents," September 1, 2003-August 31; 2008. \$450K, R. Mutharasan (PI) and P. M. Shankar (Co-PI)

NIH R01, "Ultrasound Hydrophone and Its Calibration up to 100 MHz," October 1, 2001 for three years; \$700 K, P. A. Lewin (PI) and P. M. Shankar (Co-PI)

US Army, "Estimation of tumor angiogenesis with contrast enhanced subharmonic ultrasound imaging" July 2000 June 2002 \$ 62 K, P. M. Shankar (Thomas Jefferson University, PI)

NIH Program Project, "Developing Ultrasonic Tissue Characterization methods",

Project Director and On-site Project Coordinator, \$3.5 M, July 1998-June 2002 Co-Project Directors: J. M. Reid and B. Goldberg

Development of Techniques for Tissue Characterization; Signal Processing for Enhanced Tissue Characterization: Principal Investigator, P. M. Shankar, \$185 K, NCI-NIH, September 1994 to August 1997.

Ultrasonic Tissue Characterization Using non-Rayleigh statistics: Principal Investigator, P. M. Shankar, \$170 K, NSF, 1992-1995.

Signal Processing for Enhanced Tissue Imaging: Principal Investigator, P. M. Shankar, \$154 K, NCI-NIH, 1993 to 1994.

Concatenated Tapered Single Mode Fibers: Principal Investigator, P. M. Shankar, \$76 K, NAWC, 1992-1993

Fiberoptic Sensors Using Stretched Fibers, Principal Investigator, P. M. Shankar, \$ 70 K, NADC, 1989-1990.

Use of K Distribution in Ultrasonic Nondestructive Testing and Tissue Characterization: Principal Investigator, P. M. Shankar, \$ 4000, NATO, 1991-1992.

Bubble Size Profiling: Principal Investigator, P. M. Shankar, \$40 K, ONR, 1991-1992.

Improved Bubble Size Profiling, Principal Investigators, P. M. Shankar and V. L. Newhouse, \$375K, ONR, 1989-1991