Unnikrishna Pillai

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Research Interests

Signal Processing and Communications

Synthetic Aperture Radar (SAR) Imaging, Waveform Design, Power Control for Wireless Mobiles, Electronic Signal Identification, Rational Approximation, Array Signal Processing, Portfolio Optimization, Swarming Technology for Autonomous Navigation, and Applications of Nonlinear Differential Equations to Signal Processing.

Most cited Google scholar under 'SAR': Google Scholar
4-th most cited Google scholar under 'Radar': Google Scholar

Experience

Professor **Sept 1995 – Present**
New York University, Tandon School of Engineering
Research: Radar Signal Processing, Synthetic Aperture Radar Imaging, Blind Signal Processing, Spectrum Estimation, System Identification, and Applications of Nonlinear Differential Equations to Signal Processing.
On half-time leave-of-absence since September 2010 to work at C&P Technologies Inc., on DoD research problems (2010–2022).
Teaching: Probability (UG/Grad), Stochastic Processes, Detection and Estimation, Communication Theory (UG).

President **2001 – 2023**
C&P Technologies Inc., Closter, NJ
(Half-Time from 2010 to 2023)
Chief scientist for DoD problems such as Space Based Radar, Hypersonic-SAR, Waveform Design.

Department Head **Sept 1998 – July 1999**
Polytechnic University, New York
Streamlined some inefficient practices within the department. Hired two 'star' faculty.

Associate Professor **Sept 1989 – Aug 1995**
Polytechnic University, New York
Teaching and researching on System Identification, Spectrum Estimation, and Network Synthesis.
Working with Prof. Youla.

Assistant Professor **Sept 1985 – Aug 1989**
Polytechnic Institute of New York
Teaching and researching on Array Signal Processing and Passive Time-Invariant Networks.

Deputy Engineer (Radar) **Jan 1978 – July 1980**
Bharat Electronics Limited (BEL), India
Entry level Radar Engineer. Designing and testing alpha numeric display terminals.

Education

University of Pennsylvania, Moore School of Engineering **1985**
PhD, Systems Engineering: "Array Signal Processing and Spectrum Estimation" *Philadelphia, PA*

Indian Institute of Technology (IIT), Kanpur **1982**
Master of Technology (M.Tech), Electrical Engineering: "Digital Communications/Troposcatter Modeling" *Kanpur, India*

Indian Institute of Technology (BHU-IT) **1977**
Bachelor of Technology (B.Tech), Electronics and Telecommunications Engineering *Varanasi, India*

Awards

Fellow, IEEE (2015)

Committees

Chair, Tenure and Promotions Committee **2015 – 2022, 2024 – Present**
New York University, Department of Electrical Engineering

Publications

- Over 250 educational videos on "Probability and Stochastic Processes" with over 1 Million views/downloads at Youtube Channel
- Most popular video on $Z = X + Y$ has over 100,000 views: Youtube Video
- Over 600 slides of lecture notes on Probability and Stochastic Processes at NYU Webpage

Keynote

[K01] "Alternate Approaches to Quantization and Compression Using Higher Order Medians," *IEEE ICASSP Workshop on Synthetic Apertures in Computational Imaging*, Hyderabad, India, April 7, 2025.
Link: sites.google.com/view/saciworkshop/schedule.

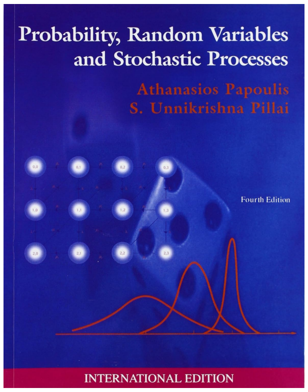
Recent Publications

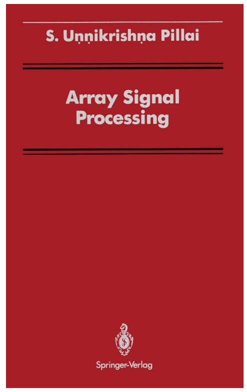
1. **U. Pillai** and L. Jiang, "The Effects of Nonlinearity and Time Dependency on Solutions to Physical Systems [Lecture Notes]," *IEEE Signal Process. Mag.*, vol. 42, no. 3, pp. 111–120, May 2025, doi: 10.1109/MSP.2025.3572424.
2. J. Farooq and **U. Pillai**, "A Probabilistic Alternative to Coverage Analysis in Uniform Random Wireless Networks," *IEEE Journal of Communications and Networks*, 2025, doi.org/10.23919/JCN.2025.000034.
3. **U. Pillai** and S. M. Kuchana, "Alternate Approaches to Quantization and Compression Using Higher Order Medians," *8th International Balkan Conference on Communications and Networking (BalkanCom)*, 2025.
4. **U. Pillai** and L. Jiang, "Characterization of Interrupted Brownian Noise and Performance Analysis of Receiver Mismatch," *IEEE Communications Letters*, doi: 10.1109/LCOMM.2025.3626677.
5. S. M. Kuchana and **U. Pillai**, "A New Dynamic Approach to Mobile Power Control Problem using Crowdsourcing," *2025 International Conference on Future Communications and Networks (FCN): Mobile and Wireless Communications*, 2025.
6. Y. Wang, **U. Pillai**, J. Farooq, and J. Chen, "Real-time multiple obstacle avoidance and navigation in unstructured spaces with applications to indoor delivery robots," *IEEE International Conference on Omni-Layer Intelligent Systems (COINS 2025)*, Madison WI, USA, 2025.

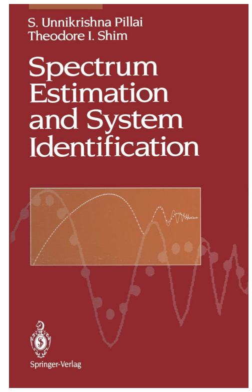
Books

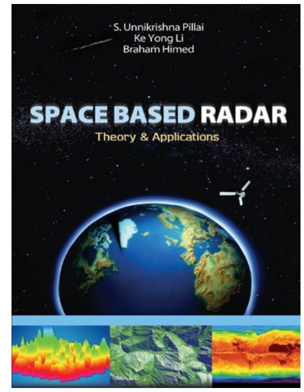
See Amazon Author

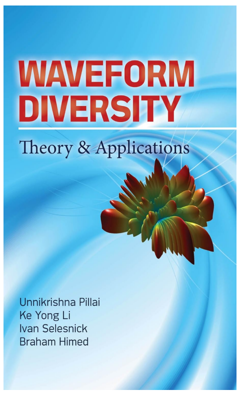
1. Probability, Random Variables and Stochastic Processes (2002)
   by Athanasios Papoulis and Unnikrishna Pillai, *Translated into Greek and Chinese*
2. Array Signal Processing (1989) *Translated into Chinese*
3. Spectrum Estimation and System Identification (1993) with Theodore I. Shim
4. Space Based Radar (2008) with Ke Yong Li and Braham Himed, *Translated into Chinese*
5. Waveform Diversity (2011) with Ke Yong Li, Ivan Selesnick, and Braham Himed
6. 401(k) and the Curse of Volatility (2012) with Vinay Murthy
7. Engineering Probability (2015) with Xiao Kang Chen
8. Problems and Solutions in Undergraduate Probability (2018)
   by Muhammad Junaid Farooq and Unnikrishna Pillai

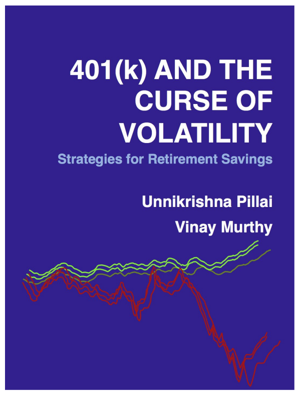


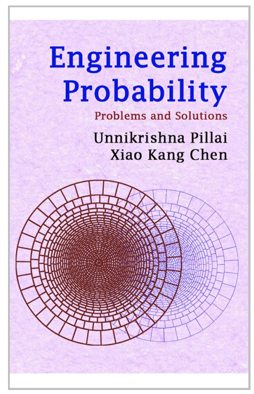


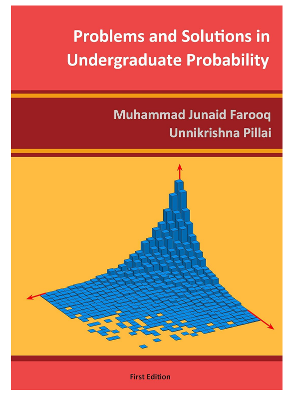












Journal & Conference Publications

See Google Scholar

1. K. Y. Li, **U. Pillai** and S. Mudaliar, "Minimum Detectable Velocity (MDV) for ATI and STAP for High Speed Platforms," *2019 IEEE Radar Conference (RadarConf)*, Boston, MA, USA, 2019, pp. 1–6, doi.org/10.1109/RADAR.2019.8835591.
2. **U. Pillai**, K. Y. Li, U. Majumder, M. Minardi, and D. Sobota, "Statistical performance analysis for GMTI using ATI phase distribution," in *Algorithms for Synthetic Aperture Radar Imagery XXIII*, vol. 9843, pp. 984307, May 2016, doi.org/10.1117/12.2224751.
3. K. Y. Li, **U. Pillai** and B. Himed, "Exploiting temporal proximity for moving target identification using bistatic/passive SAR," *2016 IEEE Radar Conference (RadarConf)*, Philadelphia, PA, USA, 2016, pp. 1–6, doi.org/10.1109/RADAR.2016.7485224.
4. **U. Pillai**, K. Y. Li, and S. Scarborough, "Geolocation of moving targets in Gotcha data using multimode processing," in *Algorithms for Synthetic Aperture Radar Imagery XXII*, vol. 9475, pp. 947508, May 2015, doi.org/10.1117/12.2183113.
5. K. Y. Li, **U. Pillai**, and B. Himed, "Moving target geolocation in bistatic/passive SAR images using ATI," *2015 IEEE Radar Conference (RadarCon)*, Arlington, VA, USA, 2015, pp. 0045–0050, doi.org/10.1109/RADAR.2015.7130968.
6. **U. Pillai**, K. Y. Li, and S. Scarborough, "Target geolocation in Gotcha data using panoramic processing," *2015 IEEE Radar Conference (RadarCon)*, Arlington, VA, USA, 2015, pp. 0021–0026, doi.org/10.1109/RADAR.2015.7130964.
7. M. E. Davis and **U. Pillai**, "Waveform diversity for ultra-wide band surveillance radars," in *IET Radar, Sonar & Navigation*, vol. 8, no. 9, pp. 1226–1233, 2014, doi.org/10.1049/iet-rsn.2014.0366.
8. F. Uysal, I. Selesnick, **U. Pillai**, and B. Himed, "Dynamic clutter mitigation using sparse optimization," in *IEEE Aerospace and Electronic Systems Magazine*, vol. 29, no. 7, pp. 37–49, July 2014, doi.org/10.1109/MAES.2014.130137.

9. F. Uysal, **U. Pillai**, I. Selesnick, and B. Himed, “Signal decomposition for wind turbine clutter mitigation,” *2014 IEEE Radar Conference*, Cincinnati, OH, USA, 2014, pp. 0060–0063, doi.org/10.1109/RADAR.2014.6875555.
10. **U. Pillai** and M. E. Davis, “Distribution of multi-look SAR and ATI using two phase centers,” *2014 IEEE Radar Conference*, Cincinnati, OH, USA, 2014, pp. 0022–0026, doi.org/10.1109/RADAR.2014.6875548.
11. F. Uysal, V. Murthy, K. Y. Li, **U. Pillai**, and M. E. Davis, “Joint Along Track Interferometry and Space-Time Adaptive Processing for target detection and geolocation,” *2013 IEEE Radar Conference (RadarCon13)*, Ottawa, ON, Canada, 2013, pp. 1–6, doi.org/10.1109/RADAR.2013.6585968.
12. K. Storm, V. Murthy, I. Selesnick, and **U. Pillai**, “Sparsity-based methods for interrupted radar data reconstruction,” *2012 IEEE Radar Conference*, Atlanta, GA, USA, 2012, pp. 0107–0111, doi.org/10.1109/RADAR.2012.6212120.
13. **U. Pillai**, V. Murthy, and I. Selesnick, “Missing data recovery using low rank matrix completion methods,” *2012 IEEE Radar Conference*, Atlanta, GA, USA, 2012, pp. 0101–0106, doi.org/10.1109/RADAR.2012.6212119.
14. V. Murthy, **U. Pillai**, and M. E. Davis, “Waveforms for simultaneous SAR and GMTI,” *2012 IEEE Radar Conference*, Atlanta, GA, USA, 2012, pp. 0051–0056, doi.org/10.1109/RADAR.2012.6212110.
15. K. Y. Li, F. Uysal, **U. Pillai**, and L. J. Moore, “Modified space-time adaptive processing for dismount detection using synthetic aperture radar,” *2012 IEEE Radar Conference*, Atlanta, GA, USA, 2012, pp. 0116–0121, doi.org/10.1109/RADAR.2012.6212122.
16. I. Selesnick and **U. Pillai**, “Chirp-like transmit waveforms with multiple frequency-notches,” *2011 IEEE RadarCon (RADAR)*, Kansas City, MO, USA, 2011, pp. 1106–1110, doi.org/10.1109/RADAR.2011.5960706.
17. **U. Pillai**, K. Y. Li, and B. Himed, “Constant envelope signals with prescribed discrete Fourier transform magnitude,” *2011 IEEE RadarCon (RADAR)*, Kansas City, MO, USA, 2011, pp. 470–473, doi.org/10.1109/RADAR.2011.5960582.
18. I. Selesnick, **U. Pillai**, K. Y. Li, and B. Himed, “Angle-Doppler processing using sparse regularization,” *2010 IEEE International Conference on Acoustics, Speech and Signal Processing*, Dallas, TX, USA, 2010, pp. 2750–2753, doi.org/10.1109/ICASSP.2010.5496219.
19. **U. Pillai**, K. Y. Li, and B. Himed, “Adaptive transmitter weight design for clutter suppression,” *2010 2nd International Workshop on Cognitive Information Processing*, Elba, Italy, 2010, pp. 360–363, doi.org/10.1109/CIP.2010.5604206.
20. I. Selesnick, **U. Pillai**, and R. Zheng, “An iterative algorithm for the construction of notched chirp signals,” *2010 IEEE Radar Conference*, Arlington, VA, USA, 2010, pp. 200–203, doi.org/10.1109/RADAR.2010.5494625.
21. **U. Pillai**, K. Y. Li, R. Zheng, and B. Himed, “Design of unimodular sequences using generalized receivers,” *2010 IEEE Radar Conference*, Arlington, VA, USA, 2010, pp. 729–734, doi.org/10.1109/RADAR.2010.5494526.
22. **U. Pillai**, K. Y. Li, and H. Beyer, “Reconstruction of constant envelope signals with given Fourier transform magnitude,” *2009 IEEE Radar Conference*, Pasadena, CA, USA, 2009, pp. 1–4, doi.org/10.1109/RADAR.2009.4976933.
23. J. R. Guerci, M. C. Wicks, J. S. Bergin, P. M. Techau, and **U. Pillai**, “Theory and application of optimum and adaptive MIMO radar,” *2008 IEEE Radar Conference*, Rome, Italy, 2008, pp. 1–6, doi.org/10.1109/RADAR.2008.4721122.
24. **U. Pillai**, K. Y. Li, and B. Himed, “Effect of wind on space-based radar performance,” *2008 IEEE Radar Conference*, Rome, Italy, 2008, pp. 1–5, doi.org/10.1109/RADAR.2008.4721102.
25. **U. Pillai**, K. Y. Li, and H. Beyer, “Waveform design optimization using bandwidth and energy considerations,” *2008 IEEE Radar Conference*, Rome, Italy, 2008, pp. 1–5, doi.org/10.1109/RADAR.2008.4721069.
26. **U. Pillai**, K. Y. Li, and J. R. Guerci, “Efficient wideband processing without subbanding,” *2008 IEEE Radar Conference*, Rome, Italy, 2008, pp. 1–5, doi.org/10.1109/RADAR.2008.4720938.
27. **U. Pillai**, K. Y. Li, and B. Himed, “Cramer-Rao bounds for target parameters in space-based radar applications,” in *IEEE Transactions on Aerospace and Electronic Systems*, vol. 44, no. 4, pp. 1356–1370, Oct. 2008, doi.org/10.1109/TAES.2008.4667714.

28. **U. Pillai**, "Robust optimal shading scheme for adaptive beamforming with missing sensor elements," in *Acoustical Society of America Journal*, vol. 123, no. 4, pp. 1825, Jan. 2008, doi.org/10.1121/1.2909047.

29. **U. Pillai**, K. Y. Li, and J. R. Guerci, "Effect of Bandwidth on Wideband-STAP Performance," *2007 Conference Record of the Forty-First Asilomar Conference on Signals, Systems and Computers*, Pacific Grove, CA, USA, 2007, pp. 2195–2198, doi.org/10.1109/ACSSC.2007.4487630.

30. K. Y. Li, **U. Pillai**, P. Zulch, and M. Callahan, "A Modulation Based Approach to Wideband-STAP," *2007 Conference Record of the Forty-First Asilomar Conference on Signals, Systems and Computers*, Pacific Grove, CA, USA, 2007, pp. 1825–1829, doi.org/10.1109/ACSSC.2007.4487550.

31. K. Y. Li, S. Mangiat, P. Zulch, and **U. Pillai**, "Clutter Impacts on Space Based Radar GMTI: A Global Perspective," *2007 IEEE Aerospace Conference*, Big Sky, MT, USA, 2007, pp. 1–15, doi.org/10.1109/AERO.2007.353071.

32. **U. Pillai**, B. Himed, and K. Y. Li, "Effect of earth's rotation and range foldover on space-based radar performance," in *IEEE Transactions on Aerospace and Electronic Systems*, vol. 42, no. 3, pp. 917–932, July 2006, doi.org/10.1109/TAES.2006.248188.

33. **U. Pillai**, K. Y. Li, and B. Himed, "Cramer-Rao bounds for target Doppler and power in space based radar," *2006 IEEE Conference on Radar*, Verona, NY, USA, 2006, pp. 452–458, doi.org/10.1109/RADAR.2006.1631839.

34. S. Mangiat, K. Y. Li, **U. Pillai**, and B. Himed, "Effect of terrain modeling and internal clutter motion on space based radar performance," *2006 IEEE Conference on Radar*, Verona, NY, USA, 2006, pp. 310–317, doi.org/10.1109/RADAR.2006.1631817.

35. **U. Pillai**, B. Himed, and K. Y. Li, "Effect of Earth's rotation and range foldover on space based performance," *IEEE International Radar Conference*, Arlington, VA, USA, 2005, pp. 137–142, doi.org/10.1109/RADAR.2005.1435808.

36. **U. Pillai**, T. Suel, and S. Cha, "The Perron-Frobenius theorem: some of its applications," in *IEEE Signal Processing Magazine*, vol. 22, no. 2, pp. 62–75, March 2005, doi.org/10.1109/MSP.2005.1406483.

37. **U. Pillai**, B. Himed, and K. Y. Li, "Orthogonal pulsing schemes for improved target detection in space based radar," *2005 IEEE Aerospace Conference*, Big Sky, MT, USA, 2005, pp. 2180–2189, doi.org/10.1109/AERO.2005.1559510.

38. **U. Pillai**, B. Himed, and K. Y. Li, "Waveform diversity for space based radar," *2004 International Waveform Diversity & Design Conference*, Edinburgh, UK, 2004, pp. 1–5, doi.org/10.1109/IWDDC.2004.8317576.

39. C. Sgraja, J. Lindner, and **U. Pillai**, "A comparison of receiver concepts for doubly-dispersive random channels," *2004 International Waveform Diversity & Design Conference*, Edinburgh, UK, 2004, pp. 1–3, doi.org/10.1109/IWDDC.2004.8317520.

40. **U. Pillai**, B. Himed, and K. Y. Li, "Modeling of Earth's rotation for space based radar," *Conference Record of the Thirty-Eighth Asilomar Conference on Signals, Systems and Computers, 2004.*, Pacific Grove, CA, USA, 2004, pp. 1682–1686, doi.org/10.1109/ACSSC.2004.1399445.

41. C. Sgraja, J. Lindner, and **U. Pillai**, "Receiver design for rapidly time-varying channels," *International Symposium onInformation Theory, 2004. ISIT 2004. Proceedings*, Chicago, IL, USA, 2004, pp. 553–, doi.org/10.1109/ISIT.2004.1365588.

42. **U. Pillai**, J. R. Guerci, and S. R. Pillai, "Efficient tapering methods for STAP," *Proceedings of the 2004 IEEE Radar Conference (IEEE Cat. No.04CH37509)*, Philadelphia, PA, USA, 2004, pp. 408–413, doi.org/10.1109/NRC.2004.1316459.

43. **U. Pillai**, J. R. Guerci, and S. R. Pillai, "Performance analysis of data sample reduction techniques for STAP," *IEEE International Symposium on Phased Array Systems and Technology, 2003.*, Boston, MA, USA, 2003, pp. 565–570, doi.org/10.1109/PAST.2003.1257043.

44. **U. Pillai**, J. R. Guerci and S. R. Pillai, "Wideband STAP (WB-STAP) for passive sonar," *Oceans 2003. Celebrating the Past ... Teaming Toward the Future (IEEE Cat. No.03CH37492)*, San Diego, CA, USA, 2003, pp. P2814–P2818, doi.org/10.1109/OCEANS.2003.178353.

45. **U. Pillai** and H. S. Oh, "Optimum MIMO transmit-receiver design in presence of interference," *Proceedings of the 2003 International Symposium on Circuits and Systems, 2003. ISCAS '03.*, Bangkok, Thailand, 2003, pp. 436–439, doi.org/10.1109/ISCAS.2003.1205870.

46. **U. Pillai**, J. R. Guerci and S. R. Pillai, "Joint optimal Tx-Rx design for multiple target identification problem," *Sensor Array and Multichannel Signal Processing Workshop Proceedings, 2002*, Rosslyn, VA, USA, 2002, pp. 553–556, doi.org/10.1109/SAM.2002.1191101.

47. D. A. Garren, A. C. Odom, M. K. Osborn, J. S. Goldstein, **U. Pillai**, and J. R. Guerci, "Full-polarization matched-illumination for target detection and identification," in *IEEE Transactions on Aerospace and Electronic Systems*, vol. 38, no. 3, pp. 824–837, July 2002, doi.org/10.1109/TAES.2002.1039402.

48. **U. Pillai** and S. R. Pillai, "Projection approach for STAP," *Proceedings of the 2002 IEEE Radar Conference (IEEE Cat. No.02CH37322)*, Long Beach, CA, USA, 2002, pp. 397–402, doi.org/10.1109/NRC.2002.999751.

49. D. A. Garren, M. K. Osborn, A. C. Odom, J. S. Goldstein, **U. Pillai**, and J. R. Guerci, "Enhanced target detection and identification via optimised radar transmission pulse shape," in *IEE Proceedings - Radar, Sonar and Navigation*, vol. 148, no. 3, pp. 130-138, June 2001, doi.org/10.1049/ip-rsn:20010324.

50. D. A. Garren, M. K. Osborn, A. C. Odom, J. S. Goldstein, **U. Pillai**, and J. R. Guerci, "Optimal transmission pulse shape for detection and identification with uncertain target aspect," *Proceedings of the 2001 IEEE Radar Conference (Cat. No.01CH37200)*, Atlanta, GA, USA, 2001, pp. 123–128, doi.org/10.1109/NRC.2001.922963.

51. **U. Pillai**, Y. L. Lim, and J. R. Guerci, "Generalized forward/backward subaperture smoothing techniques for sample starved STAP," in *IEEE Transactions on Signal Processing*, vol. 48, no. 12, pp. 3569–3574, Dec. 2000, doi.org/10.1109/78.887049.

52. D. A. Garren, M. K. Osborn, A. C. Odom, J. S. Goldstein, **U. Pillai**, and J. R. Guerci, "Optimization of single transmit pulse shape to maximize detection and identification of ground mobile targets," *Conference Record of the Thirty-Fourth Asilomar Conference on Signals, Systems and Computers (Cat. No.00CH37154)*, Pacific Grove, CA, USA, 2000, pp. 1535–1539, doi.org/10.1109/ACSSC.2000.911247.

53. J. R. Guerci and **U. Pillai**, "Adaptive transmission radar: the next "wave"?," *Proceedings of the IEEE 2000 National Aerospace and Electronics Conference. NAECON 2000. Engineering Tomorrow (Cat. No.00CH37093)*, Dayton, OH, USA, 2000, pp. 779–786, doi.org/10.1109/NAECON.2000.894993.

54. J. R. Guerci and **U. Pillai**, "Theory and application of optimum transmit-receive radar," *Record of the IEEE 2000 International Radar Conference [Cat. No. 00CH37037]*, Alexandria, VA, USA, 2000, pp. 705–710, doi.org/10.1109/RADAR.2000.851920.

55. **U. Pillai**, H. S. Oh, and J. R. Guerci, "Multichannel matched transmit-receiver design in presence of signal-dependent interference and noise," *Proceedings of the 2000 IEEE Sensor Array and Multichannel Signal Processing Workshop. SAM 2000 (Cat. No.00EX410)*, Cambridge, MA, USA, 2000, pp. 385–389, doi.org/10.1109/SAM.2000.878035.

56. **U. Pillai**, H. S. Oh, D. C. Youla, and J. R. Guerci, "Optimal transmit-receiver design in the presence of signal-dependent interference and channel noise," in *IEEE Transactions on Information Theory*, vol. 46, no. 2, pp. 577–584, March 2000, doi.org/10.1109/18.825822.

57. **U. Pillai**, D. C. Youla, H. S. Oh, and J. R. Guerci, "Optimum transmit-receiver design in the presence of signal-dependent interference and channel noise," *Conference Record of the Thirty-Third Asilomar Conference on Signals, Systems, and Computers (Cat. No.CH37020)*, Pacific Grove, CA, USA, 1999, pp. 870–875, doi.org/10.1109/ACSSC.1999.831834.

58. J. Boccuzzi, **U. Pillai**, and J. H. Winters, "Adaptive antenna arrays using sub-space techniques in a mobile radio environment with flat fading and CCI," *1999 IEEE 49th Vehicular Technology Conference (Cat. No.99CH36363)*, Houston, TX, USA, 1999, pp. 50–54, doi.org/10.1109/VETEC.1999.778014.

59. **U. Pillai** and B. Liang, "Blind image deconvolution using a robust GCD approach," in *IEEE Transactions on Image Processing*, vol. 8, no. 2, pp. 295–301, Feb. 1999, doi.org/10.1109/83.743863.

60. Y. L. Kim, **U. Pillai**, and J. R. Guerci, "Optimal loading factor for minimal sample support space-time adaptive radar," *Proceedings of the 1998 IEEE International Conference on Acoustics, Speech and Signal Processing, ICASSP '98 (Cat. No.98CH36181)*, Seattle, WA, USA, 1998, pp. 2505–2508, doi.org/10.1109/ICASSP.1998.681660.

61. **U. Pillai**, J. R. Guerci, and Y. L. Kim, "Generalized forward/backward subaperture smoothing techniques for sample starved STAP," *Proceedings of the 1998 IEEE International Conference on Acoustics, Speech and Signal Processing, ICASSP '98 (Cat. No.98CH36181)*, Seattle, WA, USA, 1998, pp. 2501–2504, doi.org/10.1109/ICASSP.1998.681659.

62. D. C. Youla, F. Winter, and **U. Pillai**, “A new study of the problem of compatible impedances,” in *International Journal of Circuit Theory and Applications*, vol. 25, no. 6, pp. 541–560, 1997, doi.org/10.1002/(SICI)1097-007X(199711/12)25:6¡541::AID-CTA974¿3.0.CO;2-W.

63. B. Liang and **U. Pillai**, “Two-dimensional blind deconvolution using a robust GCD approach,” *Proceedings of International Conference on Image Processing*, Santa Barbara, CA, USA, 1997, pp. 424–427 vol.1, doi.org/10.1109/ICIP.1997.647797.

64. B. Liang and **U. Pillai**, “Blind image deconvolution using a robust 2-D GCD approach,” *1997 IEEE International Symposium on Circuits and Systems (ISCAS)*, Hong Kong, China, 1997, pp. 1185–1188, doi.org/10.1109/ISCAS.1997.622024.

65. L. Carin, L. B. Felsen, D. R. Kralj, H. S. Oh, W. C. Lee, and **U. Pillai**, “Wave-oriented signal processing of dispersive time-domain scattering data,” in *IEEE Transactions on Antennas and Propagation*, vol. 45, no. 4, pp. 592–600, April 1997, doi.org/10.1109/8.564084.

66. **U. Pillai** and W. C. Lee, “Parameterization of stable systems from partial impulse response sequences,” in *IEEE Transactions on Circuits and Systems I: Fundamental Theory and Applications*, vol. 44, no. 3, pp. 234–242, March 1997, doi.org/10.1109/81.557366.

67. W. C. Lee and **U. Pillai**, “Multichannel stable systems that extend the partial impulse response matrices,” in *IEEE Transactions on Signal Processing*, vol. 44, no. 10, pp. 2521–2536, Oct. 1996, doi.org/10.1109/78.539036.

68. J. R. Guerci, **U. Pillai**, and Y. L. Kim, “Efficient space-time adaptive processing for airborne MTI-mode radar,” *1996 IEEE International Conference on Acoustics, Speech, and Signal Processing Conference Proceedings*, Atlanta, GA, USA, 1996, pp. 2781–2784, doi.org/10.1109/ICASSP.1996.550130.

69. **U. Pillai**, W. C. Lee, and J. Guerci, “Multichannel space-time adaptive processing,” *Conference Record of The Twenty-Ninth Asilomar Conference on Signals, Systems and Computers*, Pacific Grove, CA, USA, 1995, pp. 1183–1186, doi.org/10.1109/ACSSC.1995.540886.

70. W. C. Lee and **U. Pillai**, “Beamforming for efficient interference suppression in a mobile communication environment,” *Conference Record of The Twenty-Ninth Asilomar Conference on Signals, Systems and Computers*, Pacific Grove, CA, USA, 1995, pp. 771–775, doi.org/10.1109/ACSSC.1995.540805.

71. **U. Pillai** and W. C. Lee, “Design of stable allpass filters with prescribed phase characteristics,” *IEEE Pacific Rim Conference on Communications, Computers, and Signal Processing Proceedings*, Victoria, BC, Canada, 1995, pp. 391–394, doi.org/10.1109/PACRIM.1995.519551.

72. W. C. Lee and **U. Pillai**, “Model order reduction of multichannel stable systems,” *Proceedings of 1994 28th Asilomar Conference on Signals, Systems and Computers*, Pacific Grove, CA, USA, 1994, pp. 410–414, doi.org/10.1109/ACSSC.1994.471486.

73. **U. Pillai** and H. S. Oh, “Resonant mode extraction from scattered noisy data,” *Proceedings of 1994 28th Asilomar Conference on Signals, Systems and Computers*, Pacific Grove, CA, USA, 1994, pp. 816–820, doi.org/10.1109/ACSSC.1994.471575.

74. **U. Pillai** and W. C. Lee, “Parametrization of stable systems from impulse response data,” *Proceedings of ICASSP ’94. IEEE International Conference on Acoustics, Speech and Signal Processing*, Adelaide, SA, 1994, pp. IV/377–IV/380, doi.org/10.1109/ICASSP.1994.389802.

75. L. Carin, L. B. Felsen, D. Kralj, **U. Pillai**, and W. C. Lee, “Dispersive modes in the time domain: analysis and time-frequency representation,” in *IEEE Microwave and Guided Wave Letters*, vol. 4, no. 1, pp. 23–25, Jan. 1994, doi.org/10.1109/75.267683.

76. **U. Pillai** and T. I. Shim, “Multichannel rational system identification,” *Proceedings of 27th Asilomar Conference on Signals, Systems and Computers*, Pacific Grove, CA, USA, 1993, pp. 184–188, doi.org/10.1109/ACSSC.1993.342496.

77. **U. Pillai** and W. C. Lee, “Parametrization of stable systems from impulse response data,” *Proceedings of 27th Asilomar Conference on Signals, Systems and Computers*, Pacific Grove, CA, USA, 1993, pp. 174–178, doi.org/10.1109/ACSSC.1993.342494.

78. T. I. Shim, **U. Pillai**, and W. C. Lee, “Uniqueness of a two-step predictor based spectral estimator that generalizes the maximum entropy concept,” in *IEEE Transactions on Signal Processing*, vol. 41, no. 9, pp. 2942–2946, Sept. 1993, doi.org/10.1109/78.236517.

79. **U. Pillai**, T. I. Shim, and D. C. Youla, "A new technique for ARMA-system identification and rational approximation," in *IEEE Transactions on Signal Processing*, vol. 41, no. 3, pp. 1281–1304, March 1993, doi.org/10.1109/78.205730.

80. **U. Pillai**, T. I. Shim, and D. C. Youla, "A new approach to system identification and rational approximation," *[1992] Conference Record of the Twenty-Sixth Asilomar Conference on Signals, Systems & Computers*, Pacific Grove, CA, USA, 1992, pp. 199–203, doi.org/10.1109/ACSSC.1992.269286.

81. **U. Pillai** and W. C. Lee, "Nonminimum phase systems and a geometrical solution to the double-extension problem," *[1992] Conference Record of the Twenty-Sixth Asilomar Conference on Signals, Systems & Computers*, Pacific Grove, CA, USA, 1992, pp. 493–497, doi.org/10.1109/ACSSC.1992.269223.

82. **U. Pillai** and W. C. Lee, "Identification of nonminimum phase rational systems," *[1992] IEEE Sixth SP Workshop on Statistical Signal and Array Processing*, Victoria, BC, Canada, 1992, pp. 408–411, doi.org/10.1109/SSAP.1992.246871.

83. D. C. Youla, **U. Pillai**, F. Winter, and W. C. Lee, "Maximally flat low and high-pass reactance-ladder diplexers with adjustable crossover attenuation," *[Proceedings] 1992 IEEE International Symposium on Circuits and Systems*, San Diego, CA, USA, 1992, pp. 2057–2060, doi.org/10.1109/ISCAS.1992.230370.

84. D. C. Youla, **U. Pillai**, and F. Winter, "Theory and design of maximally flat low-pass high-pass reactance-ladder diplexers," in *IEEE Transactions on Circuits and Systems I: Fundamental Theory and Applications*, vol. 39, no. 5, pp. 337–350, May 1992, doi.org/10.1109/81.139285.

85. **U. Pillai**, T. I. Shim, and M. H. Benteftifa, "A new spectrum extension method that maximizes the multistep minimum prediction error-generalization of the maximum entropy concept," in *IEEE Transactions on Signal Processing*, vol. 40, no. 1, pp. 142–158, Jan. 1992, doi.org/10.1109/78.157189.

86. **U. Pillai** and R. N. Madan, "Design of linear phase FIR filters with uniformly flat band-response," *[1991] Conference Record of the Twenty-Fifth Asilomar Conference on Signals, Systems & Computers*, Pacific Grove, CA, USA, 1991, pp. 1015–1020, doi.org/10.1109/ACSSC.1991.186600.

87. **U. Pillai** and N. D. Sinha, "Improvements on the Cramer-Rao bound," *[Proceedings] ICASSP 91: 1991 International Conference on Acoustics, Speech, and Signal Processing*, Toronto, ON, Canada, 1991, pp. 3565–3568, doi.org/10.1109/ICASSP.1991.150245.

88. D. Pearson, **U. Pillai**, and Y. Lee, "An algorithm for near-optimal placement of sensor elements," in *IEEE Transactions on Information Theory*, vol. 36, no. 6, pp. 1280–1284, Nov. 1990, doi.org/10.1109/18.59928.

89. **U. Pillai** and B. Elliott, "Image reconstruction from one bit of phase information," in *Journal of Visual Communication and Image Representation*, vol. 1, no. 2, pp.153–157, Nov. 1990, doi.org/10.1016/1047-3203(90)90004-F.

90. **U. Pillai** and N. D. Sinha, "Higher Order Cramer-Rao Bounds and UMVUEs," *1990 Conference Record Twenty-Fourth Asilomar Conference on Signals, Systems and Computers, 1990.*, Pacific Grove, CA, USA, 1990, pp. 769–773, doi.org/10.1109/ACSSC.1990.523443.

91. **U. Pillai**, "Generalization of maximum entropy spectrum extension method," *International Conference on Acoustics, Speech, and Signal Processing*, Albuquerque, NM, USA, 1990, pp. 2619–2622, doi.org/10.1109/ICASSP.1990.116151.

92. **U. Pillai**, "Signal resolution using generalized eigenvalues for coherent sources," *Fourth IEEE Region 10 International Conference TENCON*, Bombay, India, 1989, pp. 284–288, doi.org/10.1109/TENCON.1989.176942.

93. B. H. Kwon and **U. Pillai**, "New resolution threshold results in three source scenes," *Twenty-Third Asilomar Conference on Signals, Systems and Computers, 1989.*, Pacific Grove, CA, USA, 1989, pp. 772–776, doi.org/10.1109/ACSSC.1989.1201003.

94. D. C. Youla and **U. Pillai**. "A uniqueness characterization in terms of signed magnitude for functions in the polydisc algebra A(U^n): errata," in *Journal of the Optical Society of America A*, vol. 6, no. 10, pp. 1643–1643, Oct. 1989, doi.org/10.1364/JOSAA.6.001643.

95. **U. Pillai** and B. H. Kwon, "Performance analysis of MUSIC-type high resolution estimators for direction finding in correlated and coherent scenes," in *IEEE Transactions on Acoustics, Speech, and Signal Processing*, vol. 37, no. 8, pp. 1176–1189, Aug. 1989, doi.org/10.1109/29.31266.

96. B. H. Kwon and **U. Pillai**, ‘A self inversive array processing scheme for angle-of-arrival estimation,” in *Signal Processing*, vol. 17, no. 3, pp. 259–277, July 1989, doi.org/10.1016/0165-1684(89)90007-8.
97. D. C. Youla and **U. Pillai**. “A uniqueness characterization in terms of signed magnitude for functions in the polydisc algebra A(U^n),” in *Journal of the Optical Society of America A*, vol. 6, no. 6, pp. 859–862, June 1989, doi.org/10.1364/JOSAA.6.000859.
98. **U. Pillai** and Y. Lee, “Coherent signal classification using symmetry considerations,” in *IEEE Transactions on Acoustics, Speech, and Signal Processing*, vol. 37, no. 1, pp. 135–138, Jan. 1989, doi.org/10.1109/29.17514.
99. **U. Pillai** and B. H. Kwon, “Forward/backward spatial smoothing techniques for coherent signal identification,” in *IEEE Transactions on Acoustics, Speech, and Signal Processing*, vol. 37, no. 1, pp. 8–15, Jan. 1989, doi.org/10.1109/29.17496.
100. **U. Pillai** and B. H. Kwon, “GEESE (GEneralized Eigenvalues Utilizing Signal Subspace Eignevectors) - A New Technique For Direction Finding,” *Twenty-Second Asilomar Conference on Signals, Systems and Computers*, Pacific Grove, CA, USA, 1988, pp. 568–572, doi.org/10.1109/ACSSC.1988.754606.
101. B. H. Kwon and **U. Pillai**, “Performance analysis of eigenvector-based high resolution estimators for direction finding in correlated and coherent scenes,” *Fourth Annual ASSP Workshop on Spectrum Estimation and Modeling*, Minneapolis, MN, USA, 1988, pp. 103–107, doi.org/10.1109/SPECT.1988.206172.
102. Y. Lee and **U. Pillai**, “An algorithm for optimal placement of sensor elements,” *ICASSP-88., International Conference on Acoustics, Speech, and Signal Processing*, New York, NY, USA, 1988, pp. 2674–2677, doi.org/10.1109/ICASSP.1988.197199.
103. **U. Pillai** and F. Haber, “Statistical analysis of a high resolution spatial spectrum estimator utilizing an augmented covariance matrix,” in *IEEE Transactions on Acoustics, Speech, and Signal Processing*, vol. 35, no. 11, pp. 1517–1523, Nov. 1987, doi.org/10.1109/TASSP.1987.1165068.
104. **U. Pillai**, Y. Bar-Ness, and F. Haber, “A new approach to array geometry for improved spatial spectrum estimation,” in *Proceedings of the IEEE*, vol. 73, no. 10, pp. 1522–1524, Oct. 1985, doi.org/10.1109/PROC.1985.13324.
105. **U. Pillai**, “A MAP estimate that maximizes entropy—An alternative interpretation for an autoregressive model,” in *Proceedings of the IEEE*, vol. 73, no. 4, pp. 843–844, April 1985, doi.org/10.1109/PROC.1985.13208.

Patents

Over 15 U.S. patents. See Google Patents

1. **Localized dynamic swarming for automobile accident reduction (US20160041560A1)**

A method, system, and apparatus to detect when one or more moving vehicles are close to a first vehicle, and to take necessary actions to maintain a minimum distance between vehicles in a dynamic environment by automatic navigation. A computer method and apparatus for automobile accident reduction by maintaining a minimum distance with respect to all nearby vehicles on the road. In addition, methods to synchronously move a group of vehicles on a highway through a swarming action where each vehicle keeps a region immediately around it free of other vehicles while maintaining the speed of the vehicle immediately in front or nearby is also disclosed.

2. **Method and apparatus for dynamic swarming of airborne drones for a reconfigurable array (US9488981B2)**

A method, system and apparatus to detect when one or more airborne unmanned aerial vehicles (drones) are close to each other, and to take necessary actions to maintain a minimum distance between drones as well as a maximum distance among the drones in a dynamic environment by automatic navigation. A computer method and apparatus for holding a group of drones in a swarm formation by maintaining the group centroid of the group of drones within a tolerance of a predetermined location is also disclosed. Additionally, methods to move a swarm of drones along a predetermined path while maintaining the swarm formation of the drones is also disclosed.

3. **Wideband waveform synthesis using frequency jump burst-type waveforms (US20150130660A1)**

Methods are provided for obtaining wideband waveforms from a set of narrowband waveforms. The synthesized wideband waveforms are suitable for generating fine range resolution synthetic aperture radar images. Furthermore, narrowband pulse compressed data can be siphoned from the processing chain to be used in multi-look GMTI processing either independently or jointly.

4. **Method and apparatus for simultaneous multi-mode processing performing target detection and tracking using along track interferometry (ATI) and space-time adaptive processing (STAP) (US8797206B2)**

The present invention discloses one or more methods to perform multimode processing using a single set of measured data in a multi-sensor fusion framework. In this context, various data processing methodologies are combined in parallel in a suitable manner to simultaneously image, detect, identify and track moving targets over clutter such as stationary background using data obtained from a single set of measurements. Traditionally multiple sets of data would be required to perform these tasks, furthermore the disparate datum would be processed independently of one another. By using a common data source and interconnected processors the information content of the measured data can be fully exploited and leveraged to provide actionable intelligence and aid logistics.

5. **Method for controlling and communicating with a swarm of autonomous vehicles using one-touch or one-click gestures from a mobile platform (US20130289858A1)**

A method for controlling a swarm of autonomous vehicles to perform a multitude of tasks using either a one touch or a single gesture/action command. These commands may include sending the swarm on an escort mission, protecting a convoy, distributed surveillance, search and rescue, returning to a base, or general travel to a point as a swarm. A gesture to initiate a command may include a simple touch of a button, drawing a shape on the screen, a voice command, shaking the unit, or pressing a physical button on or attached to the mobile platform.

6. **Prescribed modulus chirp-like waveforms with multiple frequency notches (US8830120B2)**

An iterative method for modifying an initial time signal to form a created signal having a prescribed envelope, and frequency notches at prescribed frequency values, wherein the created signal closely resembles the initial time signal, the envelope of the created time signal is the prescribed envelope, and the Fourier magnitude of the created time signal at the prescribed frequency values is nearly zero. The created time signal may be a real-valued signal as well as a complex-valued time signal which closely resembles an arbitrary initial time signal, including initial time signals which are standard transmit signals for radar systems, and which have Fourier transform magnitudes with notches and stop-bands at prescribed frequency values. These notches and stop bands are created by enforcing nulls of prescribed order at the prescribed frequency values within the modified time signal.

7. **Multichannel constant envelope orthogonal waveforms using receiver design (US20110183625A1)**

An radar apparatus including a first transmitter, a second transmitter, a first receiver, a second receiver, and a control device. The control device is programmed to use both the characteristics of a first transmit signal from the first transmitter and a second transmit signal from the second transmitter to determine a first control signal for applying to the first receiver to determine its impulse response characteristics, and to determine a second control signal for applying to the second receiver to determine its impulse response characteristics which differ from the first receiver. These control signals have the ability to separate out the first transmit signal and the second transmit signal from their combined sum that appears at the input of the receiver. The procedure can be generalized to include any number of transmit signals and a corresponding number of control signals to separate out the transmit signals from their combined form.

8. **Matched filter approach to portfolio optimization (US20090132433A1)**

Given a fixed amount of capital, how to invest it optimally by distributing it among a set of stocks and securities so as to maximize the return while minimizing the overall risk is addressed here. Given that one has full freedom in selecting the type of stocks, a new strategy is outlined here by maximizing the ratio of the gain to risk—rather than minimizing the risk alone—to determine the fraction of capital that must go to each stock. An optimum gain versus variance plot can be used to determine the type of stocks to be selected in addition to their relative quantity for maximum yield over the duration of interest. By modifying the definition of risk to include a function of the covariance matrix of secondary stocks that are sympathetic to the primary stocks of interest, an alternate investment strategy is also developed here. If short selling of stocks and securities is not allowed in a portfolio, then stock selection becomes important so as to maintain the desired fractions to be positive. In this context, a new iterative method that incrementally increases the diagonal loading of the covariance matrix of the primary returns so as to achieve positive weight factors is also developed.

9. **Target and clutter adaptive on-off type transmit pulsing schemes (US20130289858A1)**

One or more embodiments of the present invention relates to the design an adaptive transmit non-periodic ON-OFF pulse width modulated (PWM) signal sequence over a radar dwell time that is matched to the target and clutter characteristics so as to maximize the target response adaptively. In this context, in the first step, some optimality criterion such as maximizing the ratio of the target output signal power to the mean clutter power at the receiver input is used to design a pre-transmit waveform. In the second step, a Pulse Width Modulation method is used to convert the pre-transmit waveform so designed to a non-periodic ON-OFF pulse width modulated (PWM) waveform signal without destroying the target and clutter matching characteristics of the pre-transmit signal. This allows maximum response from the target and minimum response from the clutter and the environment when the target and its surroundings are interrogated with the non-periodic ON-OFF pulse width modulated (PWM) signal waveform.

10. **Generation of a constant envelope signal (US8050880B2)**

One or more embodiments of the present invention relates to an iterative method for generating an almost-constant, nearly constant, or substantially-constant envelope time signal with prescribed Fourier transform magnitude in the frequency domain, and a constant envelope time signal whose Fourier transform magnitude closely matches the prescribed Fourier transform magnitude in the frequency domain. Different starting points for the iterative algorithm give rise to different solutions and their accuracy can be adjusted using a monotonic error criterion presented here.

11. **Efficient methods for wideband circular and linear array processing (US20090147625A1)**

The objective of this patent is to develop new signal processing algorithms for a wide-band circular electronically scanned array (CESA) or a wideband linear electronically scanned array (LESA) for use in surveillance and communications applications, where a sequence of pulses are transmitted and their returns are collected by the array for further processing. Instead of partitioning the entire wideband frequency into various subbands and then processing them separately using narrowband schemes, a frequency focusing method is proposed here to compensate and focus the wideband spatio-temporal data into a single narrow frequency band. This is made possible by operating with a pre-computed frequency focusing matrix that transforms the data from various frequency slots that are spread across the entire wideband region into a common narrowband frequency for the array outputs. Finally the focused narrowband data can be processed using conventional space-time adaptive processing methods to suppress the clutter/noise returns and detect any targets present.

12. **Simultaneous savings in bandwidth and energy using waveform design in presence of interference and noise (US7538720B2)**

A transmit signal is output from a transmitter towards a target and towards interference. A combination signal is received at a receiver, wherein the combination signal includes the transmit signal modified by interacting with the target and the interference along with noise. The receiver has a filter having a transfer function and the filter acts on the combination signal to form a receiver output signal having a receiver output signal waveform. The receiver output signal has a receiver output signal waveform that describes an output signal to interference to noise ratio (SINR) performance. Bandwidth and signal energy of the transmit signal are reduced simultaneously by modifying the transmit signal waveform and receiver output signal waveforms without sacrificing the output SINR performance level.

13. **Energy - bandwidth tradeoff and transmit waveform design using interference and noise whitening method (US20080170492A1)**

A new method for transmitter-receiver design that enhances the desired signal output from the receiver by whitening the total interference and noise input to the receiver and maximizing the output Signal to Interference plus Noise power Ratio (SINR) is presented. As a result of the whitening process, the receiver "sees" a desired signal in white noise, and the receiver structure is then optimized to maximize the receiver output at the desired decision making instant. Furthermore the new design scheme proposed here can be used for transmit signal energy and bandwidth tradeoff. As a result, transmit signal energy can be used to tradeoff for "premium" signal bandwidth without sacrificing the system performance level in terms of the output Signal to Interference plus Noise power Ratio (SINR).

14. **Apparatus and method for providing energy - bandwidth tradeoff and waveform design in interference and noise (US20080170491A1)**

A new method for transmitter-receiver design that enhances the desired signal output from the receiver while minimizing the total interference and noise output from the receiver at the desired decision making instant is presented. Further the new design scheme proposed here can be used for transmit signal energy and bandwidth tradeoff. As a result, transmit signal energy can be used to tradeoff for the "premium" signal bandwidth without sacrificing the system performance level in terms of the output Signal to Interference plus Noise power Ratio (SINR). The two designs—the one before and the one after the tradeoff—will result in two different transmitter-receiver pairs that have the same performance level. In many applications such as in telecommunications, since the available bandwidth is at premium, such a tradeoff will result in releasing otherwise unavailable bandwidth at the expense of additional signal energy. The bandwidth so released can be used for other applications or to add additional telecommunication capacity to the system.

15. **Robust optimal shading scheme for adaptive beamforming with missing sensor elements (US7280070B2)**

A new technique for re-computing shading parameters for low sidelobe levels for a radar or sonar system is disclosed. When some of the sensor elements become inoperative, remaining shading parameters are recomputed using a new constraint. This approach leads to an overall gain pattern that is superior compared to the one without re-computing the weights.