Thomas R. Kurfess, Ph.D., P.E.

Chief Manufacturing Officer
Oak Ridge National Laboratory
Oak Ridge, Tennessee USA
October 29, 2020

I. EARNED DEGREES

Degree	Date	University	Field
Ph.D.	1989	Massachusetts Inst. of Tech.	Mechanical Eng.
S.M.	1988	Massachusetts Inst. of Tech.	Electrical Eng. & Comp. Sci.
S.M.	1987	Massachusetts Inst. of Tech.	Mechanical Eng.
S.B.	1986	Massachusetts Inst. of Tech.	Mechanical Eng.

II. EMPLOYMENT HISTORY

Title	Organization	Years
Chief Manufacturing Officer and Senior Distinguished Staff Member	Oak Ridge National Laboratory	2019-present
Manufacturing Science Division Director (Interim)	Oak Ridge National Laboratory	2020-present
HUSCO Ramirez Distinguished Chair in Fluid Power and Motion Control	Georgia Institute of Technology	2013-present (On Leave)
Professor	Georgia Institute of Technology	2012-present
Assistant Director for Advanced Manufacturing	Office of Science and Technology Policy, Executive Office of the President of the United States of America	2012-2013
Professor and BMW Chair of Manufacturing Emeritus	Clemson University	2012-present
Professor and BMW Chair of Manufacturing	Clemson University	2005-2012
Director of Automotive Engineering Program	Clemson University - International Center for Automotive Research	2008-2010
Director of the Carroll A. Campbell Jr. Graduate Engineering Center	Clemson University - International Center for Automotive Research	2005-2008
Professor	Georgia Institute of Technology	2000-2005
Summer Faculty	Sandia National Laboratories	2001

Associate Professor	Georgia Institute of Technology	1994-2000
Special Consultant to the Government of Malaysia	United Nations Development Program	1995-1999
Associate Professor	Carnegie Mellon University	1994
Assistant Professor	Carnegie Mellon University	1989-94
Participating Guest	Lawrence Livermore National Laboratory	1992-2006
Summer Faculty Participant	Lawrence Livermore National Laboratory	1992-1993
Draper Research Fellow	Robotics and Assembly Systems Division of the C. S. Draper Laboratory	1985-89
Research Intern	The Timken Company	1984-85
Research Student	Laboratory for Manufacturing and Productivity, M.I.T.	1982-85
Machinist	North Manufacturing and Eng., Inc.	1979-84

III. MAJOR BOARD POSITIONS

1. Board of Governors American Society of Mechanical Engineers (ASME) 2019 – present.
2. President –Society of Manufacturing Engineers (SME), 2018.
3. Member Scientific Advisory Committee for the Oak Ridge National Laboratory's Energy and Environmental Sciences Directorate, 2018 – 2019.
4. Member at Large – ASME Council on Standards & Certification, 2016 – 2019.
5. Board of Directors – National Center for Defense Manufacturing and Machining (NCDMM), 2013 – present.
6. Board of Trustees – MTConnect Institute, 2013 – present.
7. Member Technical Advisory Board, NEMAK S.A. de C.V., 2012 – 2014.
8. Board of Directors –Society of Manufacturing Engineers (SME), 2010 – 2019.
9. Board of Directors (Security Officer) – International TechneGroup, Incorporated, 2009 – 2019.
10. Board of Directors – National Center for Manufacturing Sciences (NCMS), 2009 – 2012, 2013 – present.
11. Member Technical Advisory Board, Metalsa S.A. de C.V., 2010 – 2013.
12. Chair, South Carolina Centers of Economic Excellence (COEE), Council of Chairs, 2010 – 2011.
13. President for the North American Manufacturing Research Institute of SME, 2007 – 2008.

IV. HONORS AND AWARDS

1. Elected to the National Academy of Engineering, for development and implementation of innovative digital manufacturing technologies and system architectures, 2020.
2. The Institution of Mechanical Engineers, Manufacturing Industries Division Board, Thatcher Brothers Prize, 2016.
3. The Woodruff School of Mechanical Engineering, Georgia Institute of Technology – Zeigler Outstanding Educator Award, 2015.
4. The American Society of Mechanical Engineering, Swanson Federal Fellow, 2012.
5. The Society of Manufacturing Engineers, Education Award, 2010.
6. Fellow of the American Association for the Advancement of Science, 2008.
7. Clemson University – Frank A. Burtner Award for Excellence in Advising, 2007.
8. Fellow of the Society of Manufacturing Engineers, 2006.
9. The Association for Manufacturing Technology, Charles F. Carter Jr., Advancing Manufacturing Award, 2005.
10. Fellow of the American Society of Mechanical Engineers, 2004.
11. The American Society of Mechanical Engineers' Gustus L. Larson Memorial Award, 2002.
12. Georgia Institute of Technology – Outstanding Faculty Leadership for the Development of Graduate Research Assistants Award, 2002.
13. The American Society of Mechanical Engineers' Blackall Machine Tool and Gage Award, 2001.
14. Georgia Institute of Technology – "Class of 1940 W. Howard Ector's Outstanding Teacher Award," 2000.
15. Society of Manufacturing Engineers Philip R. Marsilius Outstanding Young Manufacturing Engineer Award, 1996.
16. American Society of Mechanical Engineers' Pi Tau Sigma Gold Medal Award, 1995.
17. Best Paper Award, International Symposium for Automotive Technology and Automation Conference, Stuttgart, Germany, 1995.
18. National Science Foundation Presidential Faculty Fellow, one of 15 awarded in engineering in the U.S., 1993.
19. George Tallman Ladd Award for Excellence in Research at the Carnegie Institute of Technology (College of Engineering), Carnegie Mellon University, 1992.
20. National Science Foundation Young Investigator Award, 1992.
21. Brown & Sharpe Outstanding Metrology Grant Recipient of 1991.

22. Stephen Lee Award Department of Engineering and Public Policy, 1990.

V. RESEARCH, SCHOLARSHIP, AND CREATIVE ACTIVITIES

A. Published Books and Parts of Books

1. Kurfess, T.R., Handbook of Manufacturing and Automation, chapter on *Precision Engineering*, editors A. Kusiak and R. C. Dorf, pp. 345-369, John Wiley, New York, NY, 1994.
2. Kurfess, T.R., Jenkins, H.E., Control Handbook, chapter on *Ultra-High Precision Control*, editor, William Levine, pp. 1386-1405, CRC Press, Inc., Boca Raton, FL, 1996.
3. Kurfess, T.R., Jenkins, H.E., Control Systems Applications, chapter on *Ultra-High Precision Control*, editor, William Levine, pp. 212-231, CRC Press, Inc., Boca Raton, FL, 2000.
4. Kurfess, T.R., Jenkins, H.E., Dorf, R.C., Computer-Aided Design, Engineering, and Manufacturing System Techniques and Applications, *Manufacturing Systems Processes Vol. VI*, chapter on *Production of High Quality Parts by the Process of Grinding in Manufacturing Systems*, pp. 3-1 – 3-32, CRC Press, Inc., Boca Raton, FL, 2001.
5. Kurfess, T.R., Mechanical System Design Handbook, chapter on *Precision Manufacturing*, editors, O. Nwokah and Y. Hurmuzlu, pp. 151-179, CRC Press, Inc., Boca Raton, FL, 2002.
6. Heck, B.S., Kurfess, T.R., Mechatronics Handbook, chapter on *Digital Signal Processing for Mechatronic Applications*, pp. 29-1 – 29-19, CRC Press, Inc., Boca Raton, FL, 2002.
7. Dawson, T. G., Kurfess, T. R., Metal Cutting and High Speed Machining, chapter on *Wear Trends of PCBN Cutting Tools in Hard Turning*, pp. 221-231, editors D. Duidzinski, A. Molinaryu and H. Schulz, Kluwer Academic / Plenum Publishers, New York, NY, 2002.
8. Kurfess, T. R., Nagurka, M. L., The Engineering Handbook 2nd Edition, chapter on *Robots and Controls*, pp. 176-1 – 176-15, CRC Press, Inc., Boca Raton, FL, 2005.
9. Kurfess, T. R. (Editor), Robotics and Automation Handbook, CRC Press, Inc., Boca Raton, FL, 2005.
10. Jenkins, H. E., Nagurka, M. L., Kurfess, T. R., The Electrical Engineering Handbook 2nd Edition, chapter on *Robots Dynamics and Control*, CRC Press, Inc., Boca Raton, FL, pp. 14-13 – 14-37, 2006.
11. Kurfess, T. R., Billington, S. A., Liang, S. Y., Condition Monitoring and Control for Intelligent Manufacturing, chapter on *Advanced Diagnostics and Prognostic Techniques for Rolling Element Bearings*, Springer, London, pp. 137 – 165, 2006.

12. Karhade, O.G., Kurfess, T. R., Micro-Manufacturing, chapter on *Metrology, Inspection and Process Control on Micro-Scales*, Wiley, Hoboken, NJ, pp. 71 – 96, 2011.
13. Lynn, R., Chen, A., Locks, S., Nath, C., Kurfess, T. R., IFIP Advances in Information and Communication Technology, chapter on *Intelligent and Accessible Data Flow Architectures for Manufacturing System Optimization*, IFIP Advances in Information and Communication Technology, pp.27-35, 2015.

B. Refereed Publications

Journal Papers Published or Accepted

1. Kurfess, T. R., Whitney, D. E. and Brown, M. L., "Verification of a Dynamic Grinding Model," ASME Journal of Dynamic Systems, Measurement, and Control, Vol. 110, No. 4, pp. 403-409, December 1988.
2. Whitney, D. E., Edsall, A. C., Todtenkopf A. B. and Kurfess, T. R., Tate, A. R., "Development and Control of an Automated Robotic Weld Bead Grinding System," ASME Journal of Dynamic Systems, Measurement, and Control, Vol. 112, No. 2, pp. 166-176, June 1990.
3. Kurfess, T. R. and Nagurka, M. L., "Understanding the Root Locus Using Gain Plots," IEEE Control Systems Magazine, Vol. 11, No. 5, pp. 37-40, August 1991.
4. Nagurka, M. L. and Kurfess, T. R., "Gain and Phase Margins of SISO Systems from Modified Root Locus Plots," IEEE Control Systems Magazine, Vol. 12, No. 3, pp. 123-127, June 1992.
5. Kurfess, T. R., Whitney, D. E., "Predictive Control of a Robotic Grinding System," ASME Journal of Engineering for Industry, Vol. 114, pp. 412-420, November 1992.
6. Kurfess, T. R. and Whitney, D. E., "An Analysis and Improvement of the Predictive Control Integrating Component," ASME Journal of Dynamic Systems, Measurement, and Control, Vol. 115, No. 1, pp. 183-188, March 1993.
7. Kurfess, T. R. and Whitney, D. E., "Decoupled Control/Error Weighting for Predictive Control," ASME Journal of Dynamic Systems, Measurement, and Control, Vol. 115, No. 1, pp. 188-193, March 1993.
8. Kurfess, T. R. and Nagurka, M. L., "Foundations of Classical Control Theory with Reference to Eigenvalue Geometry," Journal of the Franklin Institute, Vol. 330, No. 2, pp. 213-227, March 1993.
9. Nagurka, M. L. and Kurfess, T. R., "An Alternate Geometric Perspective on MIMO Systems," ASME Journal of Dynamic Systems, Measurement, and Control, Vol. 115, No. 3, pp. 538-543, September 1993.

10. Vasseur, H., Cagan, J. and Kurfess, T. R., "Economic Analysis of Quality Innovation," Manufacturing Review, Vol. 6, No. 4, pp. 343-352, December 1993.
11. Kurfess, T. R. and Nagurka, M. L., "Geometric Links Among Classical Controls Tools," IEEE Transactions on Education, Vol. 37, No. 1, pp. 77-83, February 1994.
12. Kurfess, T. R. and Nagurka, M. L., "A Geometric Representation of Root Sensitivity," ASME Journal of Dynamic Systems, Measurement, and Control, Vol. 116, No. 4, pp. 305-309, June 1994.
13. Kurfess, T. R. and Banks, D. L., "Statistical Verification of Part Geometry," Computer-Aided Design, Vol. 27, No. 5, pp. 353-361, May 1995.
14. Jenkins, H.E. Kurfess, T.R. and Dorf, R.C., "Design of a Robust Controller for a Grinding System," The IEEE Transactions on Control Systems Technology, Vol. 4, No. 2, pp. 40-49, January 1996.
15. Banks, D. L., Kurfess, T. R., and Wolfson, L. J. "Assessing Geometric Conformance," Computing Science and Statistics, 1995.
16. Kurfess, T. R., Banks, D. L., Wolfson, L. J., "A Multivariate Statistical Approach to Metrology," ASME Journal of Manufacturing Science and Engineering, November 1996, Vol. 118, No l., pp. 652-657.
17. Bittle, S. D., Kurfess, T. R., "An Active Piezoelectric Probe For Precision Measurement on a CMM," Mechatronics, June, 1997, Vol. 7, No. 7, pp. 337-354.
18. Jenkins, H. E., Ludwick, S. and Kurfess, T. R., "Determination of a Grinding Model," ASME Journal of Dynamic Systems, Measurement and Control, Vol. 119, No. 2, pp. 289-293, June 1997.
19. Jenkins, H. E. and Kurfess, T. R., "Dynamic Stiffness Implications for a Multi-Axis Grinding System," Journal of Vibration and Control, August 1997, Vol. 3, No. 3, pp. 297-313.
20. Vasseur, H., Cagan, J. and Kurfess, T. R., "Use of a Quality Loss Function to Select Statistical Tolerances," ASME Journal of Manufacturing Science and Engineering, Vol. 119, No. 3, pp. 410-416, August 1997.
21. Shiroishi, J., Li, Y., Liang, S., Kurfess, T., Danyluk, S., "Bearing Condition Diagnostics Via Multiple Sensors," *Mechanical Systems and Signal Processing*, Vol. 11, No. 5, pp. 693-705, September, 1997.
22. Ludwick, S., Jenkins, H. E., Kurfess, T. R., "Design and Implementation of a Tube Wall Thickness Measurement System," ASME Journal of Manufacturing Science and Engineering, Vol. 120, No. 2, pp. 471-475, May 1998.
23. Longanbach, D. L., Kurfess, T. R., "Real-Time Measurement for an Internal Grinding System," Transactions of the North American Research Institute, Vol. 26, pp. 317-322, May 1998.

24. Choi, W., Kurfess, T. R., "Uncertainty of Extreme Fit Evaluation for Three Dimensional Measurement Data Analysis," Computer-Aided Design, Vol. 30, No. 7, pp. 549-557, June 1998.
25. Gallagher, C. T., Kurfess, T. R., "Design and Implementation of a System for Rapid Inspection of Critical Dimensions In High Volume Production," Mechatronics, Vol. 87, No. 7, pp. 413-425, June, 1998.
26. Choi, W., Kurfess, T. R., Cagan, J., "Sampling Uncertainty in Coordinate Measurement Data Analysis," The Journal of the American Society for Precision Engineering, Vol. 22, No. 3, pp. 153-163, July 1998.
27. Zhang, C., Li, Y., Kurfess, T. R., Danyluk, S., and Liang, S., "Minimizing the influence of Operating Condition Variations in Bearing Diagnostics," International Journal of Condition Monitoring & Diagnostic Engineering Management (COMADEM), Vol. 2, No. 1, pp. 23-29, January 1999.
28. Yang, Y., Kurfess, T. R., Liang, S. Y., and Danyluk, S., "Application of A Specialized Capacitance Probe in Bearing Diagnosis," Wear, Vol. 225-229, Part 2, pp. 1215-1221, April 1999.
29. Jenkins, H. E. and Kurfess, T. R., "Adaptive Pole-Zero Cancellation in Grinding Force Control," The IEEE Transactions on Control Systems Technology, Vol. 7, No. 3, pp. 363-370, May 1999.
30. Shiroishi, J., Li, Y., Liang, S., Kurfess, T., Danyluk, S., "Vibration Analysis for Bearing Outer Race Condition Diagnostics," Journal of the Brazilian Society of Mechanical Sciences, Vol. 21, No. 3, pp. 484-492, 1999.
31. Choi, W., Kurfess, T. R., "Dimensional Measurement Data Analysis Part I, a Zone Fitting Algorithm," ASME Journal of Manufacturing Science and Engineering, Vol. 121, No. 2, pp. 238-245, May 1999.
32. Choi, W., Kurfess, T. R., "Dimensional Measurement Data Analysis Part II, Minimum Zone Evaluation Design," ASME Journal of Manufacturing Science and Engineering, Vol. 121, No. 2, pp. 246-250, May 1999.
33. Claudet, A. and Kurfess, T., "Data Reduction for Computational Analysis of 3D Coordinate Measurement Data," Transactions of the North American Research Institute, Vol. 27, pp. 287-292, May 1999.
34. Yang, Y., Kurfess, T.R., Liang, S., Danyluk, S., "Application of a Specialized Probe in Bearing Diagnosis," Wear (225-29), pp. 1215-1221, 1999.
35. Ulmer, B. C., Kurfess, T. R., "Integration of an Open Architecture Controller with a Diamond Turning Machine," Mechatronics, Vol. 9, No. 4, pp. 349-362, June 1999.
36. Li, Y., Billington, C., Zhang, C., Kurfess, T., Danyluk S., and Liang, S. Y., "Adaptive Prognostics for Rolling Element Bearing Condition," Mechanical Systems and Signal Processing, 13(1), pp. 103-113, 1999.

37. Li, Y., Billington, C., Zhang, C., Kurfess, T., Danyluk S., and Liang, S. Y., "Dynamic Prediction of Defect Propagation on Rolling Element Bearing," Tribology Transactions of Society of Tribologists & Lubrication Engineers (STLE), Vol. 42, No. 2, pp. 385-392, 1999.
38. Zhang, C., Qiu, J., Kurfess, T. R., Danyluk, S., and Liang, S. Y., "Impact Dynamics Modeling of Bearing Vibration for Defect Size Estimation," International Journal of Condition Monitoring & Diagnostic Engineering Management (COMADEM), Vol. 3, No. 3, pp. 37-42, July 2000.
39. Li, Y., Kurfess, T. R., Danyluk, S., and Liang, S. Y., "Diagnostics and Prognostics of a Single Surface Defect on Roller Bearings," International Journal of Mechanical Engineering Sciences, pp. 1173-1185, Vol. 214, Part 3, 2000.
40. Dawson, T. G., Kurfess, T. R., "An Investigation of Tool Wear and Surface Quality in Hard Turning," Transactions of the North American Research Institute, Vol. 28, pp. 215-220, May 2000.
41. Li, Y., Kurfess, T. R., and Liang, S. Y., "Stochastic Prognostics for Rolling Element Bearings," Mechanical Systems and Signal Processing, Academic Press, London, Vol. 14, No. 5, pp. 747-762, 2000.
42. Kurfess, T. R., "Challenges and Directions for Integrating Mechatronics into Early Design," International Journal of Engineering Education, Vol. 17, No. 4, pp. 421-425, April 2001.
43. Dawson, T. G., Kurfess, T. R., "Hard Turning, Tool Life, and Surface Quality," Manufacturing Engineering, Vol. 126, No. 4, pp. 88-98, April 2001.
44. Dawson, T. G., Kurfess, T. R., "Tool Life, Wear Rates, and Surface Quality in Hard Turning," Transactions of the North American Research Institute, Vol. 29, pp. 175-182, May 2001.
45. Claudet, A. C., Kurfess, T. R., "Face Assignment for three Dimensional Coordinate Measurement Data," Transactions of the North American Research Institute, Vol. 29, pp. 557-562, May 2001.
46. Longanbach, D. M., Kurfess, T. R., "In-Process Gage Frequency Response Measurement," Mechatronics, Vol. 11, No. 4, pp. 754-757, June 2001.
47. Cowan, R., Kurfess, T. R., Schertz, D., "An Adaptive Statistically Based Controller for Through-Feed Centerless Grinding," ASME Journal of Manufacturing Science and Engineering, Vol. 123, No. 3, pp. 380-386, August 2001.
48. Razavi, H. A. Kurfess, T. R., "Real-Time Control of a Reciprocating Surface Grinder using Unfalsification and Learning Concept," International Journal of Adaptive Control and Signal Processing Vol. 15, no. 5, pp. 503-518, August 2001.

49. Williams, T., Ribadeneira, X, S. Billington, S. A., T. Kurfess, T. R., "Rolling Element Bearing Diagnostics in Run-To-Failure Lifetime Testing," Mechanical Systems and Signal Processing, Academic Press, London, Vol. 15, No. 5, pp. 979-993, 2001.
50. Kurfess, T. R., Witzel, J. G., "Using Mechatronics in Early Design," Mechatronics, Vol. 12, No. 2, pp. 241-249, March 2002.
51. Dawson, T. G., Kurfess, T. R., "Experimental Results from Turning Hardened AISI 52100 Steel with Ceramic-Coated PCBN Cutting Tools," Transactions of the North American Research Institute, Vol. 30, pp. 337-343, May 2002.
52. Stone, W. L., Kurfess, T. R., "Titanium Aluminide – Thermal Diffusivity, Heat Capacitance, and Coefficient of Thermal Expansion as a Function of Temperature," Transactions of the North American Research Institute, Vol. 30, pp. 417-421, May 2002.
53. Tucker, T. M., Kurfess, T. R., "Newton Methods for Parametric Surface Registration: Part I: Theory," Computer-Aided Design, Vol. 35, No. 1, pp. 107-113, 2003.
54. Tucker, T. M., Kurfess, T. R., "Newton Methods for Parametric Surface Registration: Part II: Experimental Validation," Computer-Aided Design, Vol. 35, No. 1, pp. 114-120, 2003.
55. Razavi, H. A., Danyluk, S., Kurfess, T. R., "Force Control Grinding of Gamma Titanium Aluminide," International Journal of Machine Tools & Manufacture, Vol. 43, pp. 185-191, 2003.
56. Crudele, M., Kurfess, T. R., "Implementation of a Fast Tool Servo with Repetitive Control for Diamond Turning," Mechatronics, Vol. 13, No. 3, Pages 243-257, 2003.
57. Razavi, H. A., Kurfess, T. R., "Detection of Wheel and Workpiece Contact/Release in Reciprocating Surface Grinding," ASME Journal of Manufacturing Science and Engineering, Vol. 125, No. 2, pp. 394-395, May 2003.
58. Kurfess, T. R., "Producing the Modern Engineer," International Journal of Engineering Education, Vol. 19, No. 1, pp. 118-123, May 2003.
59. Shilling, M., Kurfess, T. R., "Edge Point Extraction for Two Dimensional Analysis," Transactions of the North American Research Institute, Vol. 31, pp. 435-441, May 2003.
60. Kirkland, E., Kurfess, T. R., Liang, S. Y., "An Optical Coordinate Measuring Machine for Nanoscale Dimensional Metrology," Journal of Advanced Computational Intelligence and Intelligent Informatics, Vol. 8 No. 1, pp 39-44, January 2004.
61. Stone, W., Kurfess, T. R., "Grinding Titanium Aluminide: An Experimental Investigation of Subsurface Damage," Abrasives Magazine, pp. 22-26, Jan/Feb 2004.

62. Chen, A. H., Kurfess, T. R., "Bounding Box Techniques to Initialize Optimization of Primitive Geometry Fitting," Transactions of the North American Research Institute, Vol. 32, pp. 119-126, May 2004.
63. Chen, A. H., Kurfess, T. R., "Bounding Box Techniques to Initialize Optimization of Primitive Geometry Fitting," Journal of Manufacturing Systems, Vol. 23, No. 1, pp. 15-21, 2004 (same publication as previous reference).
64. Kirkland, E., Kurfess, T. R., Liang, S. Y., "A Nano Coordinate Measuring Machine Using Optical Auto-Focusing Probe," International Journal for Manufacturing Science and Technology, Vol. 6, No. 1, pp. 11-15, 2004.
65. Shin, D., Kurfess T. R., Three-Dimensional Metrology of Surface Extracted from a Cloud of Measured Points Using a New Point-to-Surface Assignment Method, An Application to PCB-Mounted Solder Pastes," Precision Engineering, Vol. 28, No. 3, pp. 302-313, July 2004.
66. Nichols, J. F., Kurfess, T. R., "Metrology of High Aspect Ratio MEMS," Journal of Microsystem Technologies, Vol. 10, No. 6, pp. 556-559, October 2004.
67. Kim, B., Schmittdiel, M. C., Degertekin, F. L., Kurfess, T. R., "Scanning Grating Microinterferometer for MEMS Metrology," ASME Journal of Manufacturing Science and Engineering, Vol. 126 No. 4, pp. 807-812, November 2004.
68. Chinn, D., Ostendorp, P., Haugh, M., Kershmann, R., Kurfess, T., Claudet, A., Tucker, T., "Three Dimensional Imaging of Liga-Made Microcomponents," ASME Journal of Manufacturing Science and Engineering, Vol. 126, No. 4, pp. 813-821, November 2004.
69. Claudet, A. A., Kurfess, T. R., "Comparison of Three Dimensional Coordinate Measurement Data and CAD Models," Nanotechnology and Precision Engineering, Vol. 3, No. 4, pp. 241-248, April 2005.
70. Dawson, T. G., Kurfess, T. R., "Quantification of Tool Wear Using White Light Interferometry and Three-Dimensional Computational Metrology," International Journal of Machine Tools and Manufacture, Vol. 45, No. 4-5, pp. 591-596, April 2005.
71. Schmittdiel, M. C., Kurfess, T. R., Degertekin, F. L., "Scanning Optical Microinterferometer for MEMS Metrology," Transactions of the North American Research Institute, Vol. 33, pp. 97-104, May 2005.
72. Dawson, T. G., Kurfess, T. R., "Modeling the Progression of Flank Wear on Uncoated and Ceramic-Coated PCBN Tools in Hard Turning," ASME Journal of Manufacturing Science and Engineering, , Vol. 128, No. 1, pp. 104-109, January, 2006.
73. Kurfess, T. R., "What can CMMs Do?" Manufacturing Engineering, Vol. 136, No. 3, pp. 173-184, March 2006.

74. Krueger, K. W., Kurfess, T. R., "Bore Waviness Measurement Using an In-Process Gage," Transactions of the North American Research Institute, Vol. 34, pp. 507-514, May 2006.
75. Mears, L. M., Kurfess, T. R., "Application of a Linear Center identification Scheme to Deterministic Polar Positioning," Transactions of the North American Research Institute, Vol. 34, pp. 619-625, May 2006.
76. Chen, A. R., Kurfess, T. R., "Integrated Inspection and Process Control for Machining a Circular Contour on a Two-Axis Vertical Turning Lathe," International Journal of Manufacturing Research, Vol. 1, No.1, pp. 101-117, 2006.
77. Kurfess, T. R., "CMMs Are Key to Auto Quality" Manufacturing Engineering, Vol. 137, No. 3, pp. 131-140, September 2006.
78. Tucker, T. M., Kurfess, T. R., "Point Cloud to CAD Model Registration Methods in Manufacturing Inspection," ASME Journal of Computing and Information Science in Engineering, Vol. 6, No. 4, December, 2006.
79. Kurfess, T. R., "Vision Systems: Warts and All - Vision systems do many things well, but be sure you understand their limitations," Manufacturing Engineering, Vol 138, No. 1, January 2007.
80. Mears, L., Kolarits, F., Thompson, M. and Kurfess, T. R., "Design of a Flexible Centering Tooling System," International Journal of Computer Applications in Technology, pp. 52-62, Vol. 28, No. 1, January, 2007.
81. Soa, B.S., Jung, Y.H., Kurfess, T. R., Hwang, S. M., "5-Axis Machining Speed Enhancement by Step Length Optimization," Journal of Materials Processing Technology, Vol. 187-188, pp. 2-5, June 2007.
82. Stone, W., Kurfess, T. R., "Grinding Titanium Aluminide – Subsurface Damage, International Journal of Manufacturing Technology and Management, Vol. 12, No. 1-3, pp. 131-140, 2007.
83. Harrison, I. S., Kurfess, T. R., Oles, E. J., Singh, P. "Inspection of White Layer in Hard Turned Components Using Electrochemical Methods," ASME Journal of Manufacturing Science and Engineering, Vol. 129, No. 2, pp. 447-452, April 2007.
84. Mears, L. M., Kurfess, T. R., "Impulsive-Actuation Part Positioning Through Constrained Energy Balance Planning," Transactions of the North American Research Institute, Vol. 35, pp. 521-528, May 2007.
85. Kurfess, T. R., Tucker, T. M., Aravalli, K., Panyam, M., "GPU for CAD," Computer-Aided Design & Applications, Vol. 4, No. 6, pp. 853-862, 2007.
86. Kim, B., Degertekin, F.L., Kurfess, T. R., "Micromachined Scanning Grating Interferometer for Out-of-Plane Vibration Measurement of MEMS," Journal of Micromechanics and Microengineering, Vol. 17, No. 1, 17 pp. 1888-1898, 2007.

87. Nichols, J. F., Shilling, K. M., Kurfess, T. R., "A Review of MEMS metrology Solutions," International Journal of Manufacturing Technology and Management, Vol. 13, No. 2, pp. 344-359, March 2008.
88. Dawson, T. G., Kurfess, T. R., "Optimisation of Cutting Conditions in Hard Turning using Ceramic-Coated and Uncoated PCBN Cutting Tools" International Journal of Manufacturing Technology and Management, Vol. 14, No. 3/4, pp. 448-460, June 2008.
89. Tarbutton, J., Kurfess, T. R., "Modeling and System Identification of a High Precision Measurement Machine," International Journal of Manufacturing Research, Vol. 3, No. 2, pp. 198-215, March 2008.
90. Karhade, O. G., Degertekin, F. L., Kurfess, T. R., "SOI-Based Micro Scanning Grating Interferometer: Device Characterization, Control and Demonstration of Parallel Operation," Journal of Micromechanics and Microengineering, Vol. 18, No. 4, pp. 1-8, April 2008.
91. Vaughan, J., Fortgang, J., Singhose, W., Donnell, J., Kurfess, T. R., "Using Mechatronics to Teach Mechanical Design and Technical Communication," Mechatronics, Vol. 18, No. 4, pp. 179-186, May 2008.
92. Mears, L. M., Kurfess, T. R., "Open-Loop Velocity Planning to Mitigate the effect of Stiction in Pushing Positioning," Transactions of the North American Research Institute, Vol. 36, pp. 301-308, May 2008.
93. Tarbutton, J. A., Kurfess, T. R., "Auto-Tuning of a High Precision Measurement System," Transactions of the North American Research Institute, Vol. 36, pp. 121-128, May 2008.
94. Limroth, J. C., Tarbutton, J. A., Kurfess, T. R., "Review of Recent Patents Related to Graphical Embedded Programming,'' Recent Patents on Electrical Engineering, Vol. 1-13, pp. 1-9, June 2008.
95. Carter J. A., Tucker, T. M., Kurfess, T. R., "3-Axis CNC Path Planning Using Depth Buffer and Fragment Shader," Computer-Aided Design & Applications, Vol. 5, No. 5, pp. 612-621, 2008.
96. Kurfess, T. R., "Micro Metrology — Commercial Options," Commercial Micro Manufacturing Magazine, Vol. 1 No. 4 pp 22 - 28 & 41-42, August 2008.
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150. Lynn, R., Contis, D., Hossain, M., Huang, N., Tucker, T., and Kurfess, T.R., "Extending Access to HPC Manufacturability Feedback Software through Hardware-Accelerated Virtualized Workstations," in International Symposium on Flexible Automation (ISFA 2016), Cleveland, OH, 2016.
151. Lynn, R., Jablokow, K., Reddy, N., Saldana, C.J., Tucker, T., Simpson, T.W., Kurfess, T.R., and Williams, C., "Using Rapid Manufacturability Analysis Tools to Enhance Design-for-Manufacturing Training in Engineering Education," in ASME 2016 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (IDETC/CIE 2016), 2016.
152. Aminzadeh, M., Kurfess, T.R., "In-Situ Quality Inspection of Laser Powder-Bed Fusion using High-Resolution Visual Camera Images," Proceedings of the 27th Annual Solid Freeform Fabrication, August 2016.
153. Lynn, R., Louhichi, W., Parto, M., Wescoat, E., and Kurfess, T.R., "Rapidly Deployable MTConnect-Based Machine Tool Monitoring Systems," in Proceedings of the 12th ASME Manufacturing Science and Engineering Conference (MSEC), Los Angeles, CA, doi.org/10.1115/msec2017-3012, 2017.
154. Lynn, R., Sati, M., Tucker, T., Rossignac, J., Saldana, C.J., Kurfess, T.R., "Realization of the 5-Axis Machine Tool Digital Twin Using Direct Servo Control from CAM" in *NIST Model Based Enterprise (MBE) Summit 2018*, Washington, D.C., April 2018.
155. Kurfess, T.R., Silberglied, C., Lynn, R., Saleeby, K.S., Tucker, T.M., and Saldana, C.J., "Multi-Axis Voxel-Based CNC Machining of Centrifugal Compressor Assemblies," American Helicopter Society Forum 74, Phoenix, AZ, May, 2018.

156. Praniewicz, M., Kurfess, T. R., Saldana, C.J. "Adaptive Geometry Transformation and Repair for Hybrid Manufacturing," Proceedings of the 13th ASME Manufacturing Science and Engineering Conference (MSEC), College Station, TX, June 18-22, 2018.
157. Miers, J., Tucker, T., Kurfess, T.R., Saldana, C.J., "Modeling of Tool-Workpiece Interaction in a Voxelized Framework," 45th SME North American Manufacturing Research Conference (NAMRC), College Station, TX, June 18-22, 2018.
158. Kurfess, T.R., Fijacko, S., "Positions and Advocacy Efforts of the ASME Manufacturing Public Policy Task Force (MPPTF)," Proceedings of the 13th ASME Manufacturing Science and Engineering Conference (MSEC), College Station, TX, June 18-22, 2018.
159. Lynn, R., Medrano, R.L., Contis, D., Tucker, T., Kurfess, T.R., "Automated Multi-User Analysis of Virtualized Voxel-Based CAM on Shared GPUs," Proceedings of the 13th ASME Manufacturing Science and Engineering Conference (MSEC), College Station, TX, June 18-22, 2018.
160. Saleeby, K.S., Kurfess, T.R., "Low Cost Wireless Accelerometer Sensor Platform with Internet-of-Things for Manufacturing (IOT4MFG) Applications," SPIE Defense + Commercial Sensing Symposium, Baltimore, MD, dx.doi.org/10.1117/12.2517437, April 2019.
161. Praniewicz,, M., Kurfess, T.R., Saldana, C.J., "Error Qualification for Multi-Axis BC-Type Machine Tools," 46h SME North American Manufacturing Research Conference (NAMRC), Erie, PA, June 10-14, 2019.
162. Kim, M.J., Praniewicz,, M., Kurfess, T.R., Saldana, C.J., "Adaptive Repair and Digitization for Hybrid Manufacturing," 46h SME North American Manufacturing Research Conference (NAMRC), Erie, PA, June 10-14, 2019.
163. Feldhausen, T., Hirani, A.H., King, W.E., Lynn, R., Thomas Kurfess, T.R., "Conceptualization and Design of a Low-Cost MTConnect-Enabled Refractometer for Coolant Health Monitoring," Proceedings of the 15th ASME Manufacturing Science and Engineering Conference (MSEC), Erie, PA, June 10-14, 2019.
164. Praniewicz, M., Thomas A Feldhausen. T.A., Kersten, S., Berez, J., Elliot Jost, Kurfess, T.R., Saldana, C.J., "Integrated Hardfacing of Stellite-6 Using Hybrid Manufacturing Process," Proceedings of the 30th Annual Solid Freeform Fabrication, August 2019.

ANSI / ISO Working Papers

1. Kurfess, T. R. and Banks, D. L., "Statistical Verification of Part Geometry," an ANSI working paper, presented to the ANSI Working Group B89.3.2, Dimensional Measurement Methods, Chicago, IL, April 1990.

2. Kurfess, T. R. and Banks, D. L., "Statistical Verification of Part Geometry," an ISO working paper, presented to ISO by ANSI May, 1990.

C. Other Publications

1. Whitney, D. E., Kurfess, T. R., Todtenkopf, A. B., Edsall, A. C., Brown, M. L. and Roxas, P. S., "Development and Control of an Automated Robotic Weld Bead Grinding System," Proceedings of the 15th National Science Foundation Grantees Conference on Production Research and Technology, Berkeley, CA, January 1989.
2. Kurfess, T. R. and Whitney, D. E., "Predictive Control of a Robotic Grinding System," Proceedings of the NMTBA Eastern Manufacturing Technology Conference, vol. 4, pp. 97-115, Hartford, CT, October 1989.
3. Kurfess, T. R., "Calibration of Tactile Scanning Devices," Proceedings of the 1991 National Science Foundation Design and Manufacturing Systems Conference, pp. 851-856, Austin, TX, January 1991.
4. Kurfess, T. R. and Nagurka, M. L., "An Alternate Representation of the Evans Root Locus: Gain Plots," Proceedings of the 1992 National Science Foundation Design and Manufacturing Systems Conference, pp. 1043-1050, Atlanta, GA, January, 1992.
5. Vasseur, H., Cagan, J. and Kurfess, T. R., "Optimal Tolerance Allocation for Improved Productivity," Proceedings of the 1993 National Science Foundation Design and Manufacturing Systems Conference, vol. 1, pp. 715-719, Charlotte, NC, January 1992.
6. Kurfess, T. R. and Sadiq, U., "Enhancing Frequency Analysis Resolution for Circular Part Measurement," Proceedings of the 1993 National Science Foundation Design and Manufacturing Systems Conference, vol. 2, pp. 1595-1599, Charlotte, NC, January 1992.
7. Wolfson, L. J., Banks, D. L. and Kurfess, T. R., "Assessing Geometric Conformance," Computing Science and Statistics, vol. 27, Conference on the Interface Between Statistics and Computing, June 1995.

Technical Reports

1. Banks, D. L. and Kurfess, T. R., "Statistical Inference for Part Geometry," Technical Report #12, Statistical Center for Quality Improvement, Carnegie Mellon University, University of Pittsburgh, Pittsburgh, PA, 1990.
2. Kurfess, T. R. and Banks, D. L., "Statistical Verification of Conformance to Geometric Tolerance," Technical Report #EDRC 24-38-90, Engineering Design Research Center, Pittsburgh, PA, 1990.
3. Kurfess, T. R. and Nagurka, M. L., "High Gain Control System Design with Gain Plots," Technical Report #EDRC 24-48-91, Engineering Design Research Center, Pittsburgh, PA, 1991.

4. Kurfess, T. R. and Nagurka, M. L., “New Design Paradigms for SISO Control System Synthesis,” Technical Report #EDRC 24-49-91, Engineering Design Research Center, Pittsburgh, PA, 1991.
5. Nagurka, M. L. and Kurfess, T. R., “New Design Paradigms for MIMO Control System Synthesis,” Technical Report, Engineering Design Research Center #EDRC 24-50-91, Pittsburgh, PA, 1991.
6. Kurfess, T. R. and Nagurka, M. L., “A New Approach to Control Design: Variable Gain Plots,” Technical Report #EDRC 24-43-91, Engineering Design Research Center, Pittsburgh, PA, 1991.
7. Laughlin, K. A., Kurfess, T. R., “A Tool for the Correct Application of Geometric Tolerances,” Technical Report #EDRC 24-44-91, Engineering Design Research Center, Pittsburgh, PA, 1991.
8. Kurfess, T. R. and Nagurka, M. L., “A Geometric Paradigm Exposing High Gain Root Sensitivity of Single-Input Single-Output Systems,” Technical Report #EDRC 24-60-91, Engineering Design Research Center, Pittsburgh, PA, 1991.
9. Cagan, J., and Kurfess, T. R., “Optimal Design for Tolerance and Manufacturing Allocation,” Technical Report #EDRC 24-67-91, Engineering Design Research Center, Pittsburgh, PA, 1991.
10. Padmanabhan, P. and Kurfess, T. R., “A New Perspective on Tolerance Analysis Based on Tolerance Zones,” Technical Report #EDRC 24-77-91, Engineering Design Research Center, Carnegie Mellon University, Pittsburgh, PA, 1991.
11. Wang, S. K., Kurfess, T. R. and Nagurka, M. L., “Asymptotic Behavior of Multivariable and Optimal System Designs,” Technical Report #EDRC 24-79-92, Engineering Design Research Center, Carnegie Mellon University, Pittsburgh, PA, 1991.
12. Vasseur, H., Kurfess, T. R. and Cagan, J., “Decision Making in Design for Quality,” Technical Report #EDRC 24-82-92, Engineering Design Research Center, Carnegie Mellon University, Pittsburgh, PA, 1991.
13. Nagurka, M. L. and Kurfess, T. R., “Geometric Analysis of Multivariable Control Systems,” Technical Report #EDRC EDRC 24-83-92, Engineering Design Research Center, Carnegie Mellon University, Pittsburgh, PA, 1991.
14. Vasseur, H., Cagan, J. and Kurfess, T. R., “Industrial Quality: A Missing Economic Variable,” Technical Report #EDRC 24-85-92, Engineering Design Research Center, Carnegie Mellon University, Pittsburgh, PA, 1991.
15. Vasseur, H., Cagan, J. and Kurfess, T. R., “Quantifying Industrial Quality in Economic Models,” Technical Report #EDRC 24-91-92, Engineering Design Research Center, Carnegie Mellon University, Pittsburgh, PA, 1992.

16. Kurfess, T. R., and Levine, B. M., "Actuator Stroke Requirements Based on a Zernike Decomposition of Atmospheric Turbulence," Technical Report #UCRL-ID-11968, Lawrence Livermore National Laboratory, Livermore, CA, 1992.
17. Vasseur, H., Cagan, J. and Kurfess, T. R., "Quality Innovation in Design and Manufacturing: an Economic Model," Technical Report #EDRC 24-103-93, Engineering Design Research Center, Carnegie Mellon University, Pittsburgh, PA, 1992.

D. Presentations

Invited Seminars

1. Carnegie Mellon University, Department of Engineering and Public Policy, seminar, Title: "Conformance Verification for Manufactured Parts," Pittsburgh, PA, March 14, 1990.
2. Carnegie Mellon University, Department of Mechanical Engineering, Invited Seminar on Research in Control Theory, Title: "Control System Analysis and Design from Eigenvalue Trajectories," with M. L. Nagurka, Pittsburgh, PA, September, 1991.
3. Lawrence Livermore National Laboratory, Invited Seminar, "Gain Plots: A New Generation of Control Synthesis Tools," Livermore, CA, November, 1991.
4. University of California at Berkeley, Department of Mechanical Engineering, Invited Seminar on Research in Control Theory, Title: "Geometric Control Theory Conceptualizations Based on Eigenvalue Trajectories," Berkeley, CA, November, 1991.
5. University of California at Davis, Department of Electrical Engineering and Computer Science, Invited Seminar on Research in Control Theory, Title: "A New Geometric Perspective on Control Theory Using Eigenvalue Trajectories," Davis, CA, November, 1991.
6. University of North Carolina at Charlotte, Mechanical Engineering and Engineering Science Department, Invited Seminar on Research in Control Theory, Title: "A New Geometric Perspective on Control Analysis and Design Based on Eigenvalue Trajectories," Charlotte, NC, November, 1991.
7. Lawrence Livermore National Laboratory, Invited Seminar, "Quantifying Quality in Design and Manufacturing," with J. Cagan, Livermore, CA, July, 1992.
8. Carnegie Mellon University, Department of Mechanical Engineering, Seminar on Research in Metrology, Title: "The Direction of Inspection," Pittsburgh, PA, May, 1993.
9. Alcoa Technical, Invited Talk, "Statistical Metrology," with D. L. Banks, March 1994.

10. Rensselaer Polytechnic Institute, Department of Mechanical Engineering, Aerospace Engineering and Mechanics, Invited Talk, "A New Approach to Metrology," April 1994.
11. Rensselaer Polytechnic, Department of Mechanical Engineering, Aerospace Engineering and Mechanics, Institute Invited Talk, "Gain Plots in Control System Design," with M. L. Nagurka, April 1994.
12. University of Illinois at Chicago, Department of Mechanical Engineering, Aerospace Engineering and Mechanics, Invited Talk, "A New Approach to Metrology," May 1994.
13. Massachusetts Institute of Technology, Department of Mechanical Engineering, Invited Talk, "A New Approach to Metrology," December 1994.
14. Black Clawson Company, Invited Talk, "Research in Precision Engineering at GA Tech," February 1995.
15. Torrington Company, Invited Talk, "A New Approach to Metrology," Norcross, GA, February, 1995.
16. United Nations Development Program and Government of Malaysia, Invited Talk, "Requirements for Production and Prototyping Facilities for the Twenty-First Century," Kuala Lumpur, April 1996.
17. University of Illinois at Champaign - Urbana, Department of Mechanical Engineering, Invited Talk, "Adaptive Pole-Zero Cancellation in Grinding Force Control," Champaign, IL, September 1996.
18. Clemson, Department of Mechanical Engineering, Invited Talk, "Adaptive Pole-Zero Cancellation in Grinding Force Control," Clemson, SC, February 1997.
19. Northwestern University, Department of Mechanical Engineering, "Real-Time Monitoring of Bearing Faults for Diagnostics," March, 1997.
20. The Torrington Company, Invited Talk, "Three Dimensional Metrology," Norcross, GA, June, 1997.
21. Stanford University, Invited Talk, "Three Dimensional Metrology of Rapid Prototyped Parts," Palo Alto, CA, December 1997.
22. Pratt & Whitney, Invited Talk, "Advances in Precision Machining of Superalloys," February, 1998.
23. University of Pittsburgh, Department of Mechanical Engineering Seminar, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," Pittsburgh, PA, March 1998.
24. Boeing, Corporate Seminar, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," Seattle, WA, March 1998.

25. University of Washington, Department of Mechanical Engineering Seminar, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," Seattle, WA, March 1998.
26. Ecole Nationale Suprérieure d'Arts et Métiers, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," Paris, France, June 1998.
27. Ingersoll Rand, Needle Bearing Division, Invited Talk, "Grinding Control for Advanced Materials," Norcross, GA, October 1998.
28. University of Michigan, College of Engineering Seminar, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," Ann Arbor, MI, February 1999.
29. Lawrence Livermore National Laboratory, Precision Engineering Group Seminar, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," Livermore, CA, March 1999.
30. University of California at Berkeley, Mechanical Engineering Seminar, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," Berkeley, CA, March 1999.
31. Northwestern University, Mechanical Engineering Seminar, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," Evanston, IL, March 1999.
32. Lawrence Livermore National Laboratory, Invited Talk, "The Direction of Inspection," Livermore, CA, August, 2000.
33. Paraform, Inc., Invited Talk, "The Direction of Inspection," Santa Clara, CA, September, 2000.
34. The Torrington Company, Invited Talk, "The Direction of Inspection," Norcross, GA, February, 2000.
35. The Air Force Academy, "The Next Generation Engineer, The Renaissance Engineer," USAF Academy, CO, April 2000.
36. Pratt & Whitney, Invited Talk, "Investigating Tool Wear and Surface Quality in Hard Turning," Columbus, GA, September 2000.
37. Pratt & Whitney, Invited Talk, "Investigating Tool Wear and Surface Quality in Hard Turning," Columbus, GA, September 2000.
38. Department of Energy Nuclear Weapons Group (staff from Sandia National Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Oakridge National Laboratory as well as other DOE staff in attendance), Invited Talk, "Computational Systems for 3D Metrology and Model Generation," Sandia National Laboratory, Livermore, CA, October 2000.
39. Zeiss Corporation, Industrial Measurement Technology Division, Invited Talk, "Computational Systems for 3D Metrology and Model Generation," Oberkochen, Germany, October 2000.

40. Ecole Nationale Suprérieure d'Arts et Métiers, Invited Talk, "Investigating Tool Wear and Surface Quality in Hard Turning," Metz, France, October 2000.
41. Boeing Optics Group, "Computational Systems for 3D Metrology and Model Generation," Seattle, WA, November 2000.
42. Hewlett Packard, "Computational Systems for 3D Metrology and Model Generation," Corvallis, OR, November 2000.
43. Sandia National Laboratory, "Computational Systems for 3D Metrology and Model Generation," Livermore, CA, December 2000.
44. Purdue University, Mechanical Engineering Seminar, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," West Lafayette, IN, March 2000.
45. National Taiwan University, "Computational Systems for 3D Metrology and Model Generation," Taipei, Taiwan, June 2001.
46. Lawrence Livermore National Laboratory, Precision Engineering Seminar, "Computational Systems for 3D Metrology and Model Generation," Livermore, CA, June 2001.
47. GINTIC Institute of Manufacturing Technology, Invited Talk, "Computational Systems for 3D Metrology and Process Control," Singapore, September 2001.
48. GINTIC Institute of Manufacturing Technology, Invited Talk, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," Singapore, September 2001.
49. The Timken Company, Invited Talk, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," May, 2002.
50. Michigan Tech, Invited Talk, "Large Scale Computational Metrology for Large and Micro-Parts," Houghton, MI, November, 2002.
51. Sandia National Laboratories, Invited Talk, "Advances in Metrology for Micro-Components," Livermore, CA, December 2002.
52. Pennsylvania State University State Department if Industrial and Manufacturing Engineering Seminar, Invited Talk, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," State College, PA, February 2003.
53. National Instruments Academic Week, Invited Talk – Keynote Address, "Production of High Precision Components Using Next Generation Modeling and Control Techniques," Austin, TX, April 2003.
54. Sandia National Laboratories, Invited Talk, "Advances in Metrology for Micro-Components," Albuquerque, NM, May 2003.
55. University of Oklahoma, Invited Talk, "Advances in Metrology for Micro-Components," April, 2004.
56. Ohio State, Invited Talk, "Advances in Metrology for Micro-Components," Columbus OH, May 2004

57. Sensant Inc., Invited Talk, "MEMS Technology: Capabilities and Applications of a Microfabricated Scanning Grating Interferometer," San Leandro, CA, May 2004.
58. Stanford University, Invited Talk, "MEMS Technology: Capabilities and Applications of a Microfabricated Scanning Grating Interferometer," Stanford, CA, May 2004.
59. Sandia National Laboratories, Invited Talk, "MEMS Technology: Capabilities and Applications of a Microfabricated Scanning Grating Interferometer," Livermore, CA, May 2004.
60. Lawrence Livermore National Laboratory, Invited Talk, "MEMS Technology: Capabilities and Applications of a Microfabricated Scanning Grating Interferometer," Livermore, CA, May 2004.
61. International Machine Tool Show, Invited Talk, "Micro-Metrology for Small Scale Components," Chicago, IL, September 2004.
62. University of Florida, Invited Talk, "Advances in Metrology for Micro-Components," Gainesville, FL, September 2004.
63. US–South Africa Workshop on Emerging Manufacturing Technologies (Sponsored by NSF), Key-Note Talk, "Micro-Metrology for Small Scale Components," Cape Town South Africa, October 2004.
64. International Workshop on Scientific and Technological Manufacturing Research (Sponsored by the Government of South Africa), Key-Note Talk, "Collaborative Opportunities in Manufacturing Research," Johannesburg, South Africa, February 2005.
65. Nelson Mandela Metropolitan University, Invited Talk, "Production of High Precision Complex Geometries using Next Generation Processes and Materials," Port Elizabeth, February 2005.
66. U.S. House Science Committee, presentation on status of Micro-Manufacturing in Asia and Europe, Washington, DC, April 2005.
67. World Technology Evaluation Center, workshop on current status of Micro-Manufacturing, presentation on status of Sensors, Metrology and Controls in Micro-Manufacturing, Worldwide, Washington, DC, April 2005.
68. Illinois Institute of Technology, Invited Talk, "Advances in Metrology for Micro-Components," Chicago, IL, October 2006
69. Keynote Address meeting for the Chronicle for Higher Education, Los Vegas, NV, November 2006.
70. Keynote Address "Programmable Graphics Processors in Computer Aided Design," at 2007 International CAD Conference and Exhibition, Honolulu, HI, June 2007.
71. Russell Series Lecture, "The Car, the South, and the World: It's All Coming Together," Presbyterian College, Clinton, SC, October 2007.

72. Invited Presentation, update European Union on CU-ICAR and Automotive Engineering Program, Zürich, Switzerland, November 2007.
73. Presentation of CU-ICAR and Automotive Engineering Program to Congressional Delegation, November, 2007.
74. Invited Presentation, update Japanese Government on UC-ICAR and Automotive Engineering Program, Yamaguchi, Japan, December 2007.
75. University of Notre Dame, Invited Talk, "The Globe, the Car, and the Co-Processor: A Tale about Producing the Most Complex Consumer Product on Earth," South Bend, IN, January, 2008.
76. The Association for Manufacturing Technology, Invited Talk, "The Globe, the Car, and the Co-Processor: A Tale about Producing the Most Complex Consumer Product on Earth," Orlando, FL, March, 2008.
77. University of Minnesota, Invited Talk, "The Globe, the Car, and the Co-Processor: A Tale about Producing the Most Complex Consumer Product on Earth," Minneapolis, MN, May, 2008.
78. South Carolina Trucking Association, Keynote Address, "Trucks: Moving the Loads, the South, the Economy, and the Future," Hilton Head, SC, June, 2008.
79. Illinois Institute of Technology, Mechanical, Materials and Aerospace Engineering Symposium on Sustainability and Product Development, Keynote Address, "The Globe, the Car, and the Engineer: A Tale about Producing the Most Complex Consumer Product on Earth," Chicago, IL, August, 2008.
80. The Association for Manufacturing Technology, Invited Talk, "The Globe, the Car, and the Co-Processor: A Tale about Producing the Most Complex Consumer Product on Earth," Orlando, FL, March, 2008.
81. Keynote presentation on Advances in Manufacturing within the United States, Association of Machine Tool Builders, Cleveland, OH, October, 2008.
82. Keynote presentation to Light Armored Vehicles Summit on Advances in Automotive Systems for Dual Use, Vienna, VA, November, 2008.
83. Invited presentation on Long Range Direction of Automotive Manufacturing to European Union Commission on Intelligent Manufacturing Systems 2020, Brussels, Belgium, January 2009.
84. Keynote speaker at Manufacturing Engineering Society International Conference, entitled, "The Direction of Inspection," Alicante, Spain, June 2009.
85. Presentation to German American Chamber of Commerce on research at CU-ICAR, August, 2009, Greenville, SC.
86. Keynote Address to Southeastern Institute of Manufacturing and Technology, Salute to Manufacturing Event, September, 2009, Florence, SC.

87. Presented Concepts in Titanium Up-Armoring in conjunction with American Titanium Works and Picatinny Arsenal to BMW Research and Armored Vehicle Division, October, 2009, Munich, Germany.
88. Keynote Address, Radical Innovations Forum for Defense Manufacturing, Orlando, FL, October 2009.
89. Presentation to Boeing executives on research at CU-ICAR, February, 2010, Charleston, SC.
90. Keynote talk, "State-of-the-Art Research on Manufacturing in the U.S.," Association of Manufacturing Technology, Nashville, TN, March, 2010.
91. Presentation to Sandvik executives on research at CU-ICAR, April, 2010, Clemson, SC.
92. Presentation to Veeco on research at CU-ICAR, Tucson, AZ, April, 2010.
93. Keynote speaker at National Center for Defense Manufacturing and Machining Annual Conference, talk title, "The Globe, the Car, and the Co-Processor: A Tale about Producing the Most Complex Consumer Product on Earth," Latrobe, PA, May 2010.
94. Keynote Panel Moderator on Integrating Education and Research in Manufacturing, North American Manufacturing Research Conference, Kingston, Canada, May 2010.
95. Invited Panelist for the Illinois Coalition for Manufacturing Innovation (ICMI) Educational Workshop, Illinois Institute of Technology, Chicago, IL, March 2010.
96. Invited Panelist for the American Association of Retired Persons (AARP), Session on the Future Technology, Orlando, FL, October 2010.
97. Invited Panelist for the Federal Reserve Annual Economic Forum, Panel on U.S. and Mexico Manufacturing: Common Bonds, Keynote Address entitled, "Collaborative Manufacturing, the Road to the Future," El Paso, TX, November 2010.
98. Invited Panelist for the Federal Reserve Federal Reserve Bank of Chicago – Detroit Branch meeting, Keynote Address entitled, "The Growing Role of Electronics in Automobiles," Detroit, MI, June 2011.
99. Keynote Lecture on Advances of in Manufacturing for the Heavy Industry Sector, National Defense, Industrial Association, Washington, DC, August 2011.
100. Keynote Lecture on Manufacturing Technology and Policy Issues for the United States, MIT Sloan School Supply Chain Forum, Cambridge, MA, July 2012
101. NI Week Keynote Lecture on Manufacturing Technology and Policy Issues for the United States, Austin, TX, August 2012.

102. Purdue Nano-Hub Keynote Lecture on Manufacturing Technology and Policy Issues for the United States, Indianapolis, IN, September 2012.
103. Panelist for National Academy of Engineering Manufacturing Engineering Program Review, Washington, DC, October 2012.
104. Keynote for Central Intelligence Agency Series on Emerging Technologies, Focus on Additive Manufacturing, Langley, VA, October 2012.
105. Panelist for National Science Foundation Division of Civil Advisory Board meeting, Washington, DC, October 2012.
106. National Academies of Engineering update on the Fraunhofer Institutes, Washington, DC, December 2012.
107. Update and Present Recommendations to the President's Council of Advisors on Science and Technology (PCAST) at the National Academies of Science and Engineering, Washington, DC, January 2013.
108. MIT Club of Washington, Presentation on Manufacturing Technology and Policy Issues for the United States, Washington, DC, January 2013.
109. Presentation to the Attorney General of the United States of America on Technology Issues Related to Gun Safety, resulted in Presidential Action, "Direct the Attorney General to issue a report on the availability and most effective use of new gun safety technologies and challenge the private sector to develop innovative technologies," January 2013.
110. Emerging Issues Forum, Keynote Address entitled, "A National Manufacturing Blueprint," Raleigh, NC, February 2013.
111. American Society for Engineering Education, Engineering Dean's Public Policy Colloquium, Keynote Address entitled, "Manufacturing, the Road to Success," Washington, DC, March 2013.
112. National Center for Manufacturing Science, Board of Directors update on policy issues related to manufacturing in the United States of America, at Kennedy Space Center, Coco Beach, FL, February 2013.
113. ASME Webinar entitled, "Manufacturing, the Road to Success," March 2013.
114. University of California at Berkeley, College of Engineering invited seminar entitled, "Manufacturing, the Road to Success," Berkeley, CA, March 2013.
115. BMW invited seminar entitled, "Manufacturing, the Road to Success," Munich, Germany, April 2013.
116. Ohio State College of Engineering, invited seminar entitled, "Manufacturing, the Road to Success," Columbus, OH, March 2013.
117. Honda of America, Manufacturing, invited seminar entitled, "Manufacturing, the Road to Success," Marysville, OH, March 2013.

118. The United States of America Council on Competitiveness Keynote Address entitled, "Fostering a Highly Collaborative Infrastructure for the Open Exchange of Additive Manufacturing Information and Research," Oakridge TN, April 2013.
119. University of Pittsburgh, Energy Center, invited seminar entitled, "Manufacturing, the Road to Success," Pittsburgh, PA, May 2013.
120. Stanford University, invited seminar entitled, "Manufacturing, the Road to Success," Palo Alto, CA, May 2013.
121. National Center for Defense Manufacturing and Machining, Keynote Address entitled, "Manufacturing, the Future for America, the Future for Americans," Blairsville, PA, May 2013.
122. The National Academies, Committee on Science, Technology, and Law Policy and Global Affairs Division, Keynote Address entitled, "Policy Considerations for Additive Manufacturing," Washington, DC, May 2013.
123. Intelligent Manufacturing Systems, Keynote Address entitled, "Policy Issues and Strategies for Manufacturing in the United States of America," Charleston, SC, May 2013.
124. The 3D Collaboration and Interoperability Conference, Keynote Address entitled, "A Roadmap for Impact: Driving Innovation in the New Age of Manufacturing," Colorado Springs, May 2013.
125. Joint North American Manufacturing Research Conference and ASME International Manufacturing Science and Engineering Conference, Keynote Address entitled, "Manufacturing, the Road to Success," Madison, WI, June 2013.
126. Intelligent Manufacturing Conference, Keynote Address entitled, "Manufacturing, the Road to Success," Beijing, China, June 2013.
127. Enabling Nanofabrication for Rapid Innovation Workshop, Keynote Address entitled, "Making Chips, The Digital Future," Napa, CA, August 2013.
128. The George C. Marshall Program Keynote Presentation to the Government and industry leaders of Austria, Vienna, entitled, "The American Agenda for Advanced Manufacturing," Vienna, Austria, September, 2013.
129. Destination Nano, Keynote Presentation, entitled, "Advanced Manufacturing: A Federal Perspective," Lowell Massachusetts, September, 2013.
130. U.S. Army Research Office, Keynote Presentation entitled, "From Small to Large, A Digital 3-D World Made by Digital Manufacturing," Raleigh, NC, October 2013
131. Automotive Industry Action Group (AIAG), Automotive Engineering & Technology Forum, Keynote Address entitled, "The Globe, the Car, and the Co-Processor: A Tale about Producing the Most Complex Consumer Product on Earth," Southfield, Michigan, October 2013.

132. The Association of Technology, Management, and Applied Engineering, 2013 Annual Conference, *Developing the Future Workforce*, Keynote Address entitled, "Enabling Innovation and Ensuring the Talent Pipeline, the Future of U.S. Manufacturing," New Orleans, LA, November 2013.
133. Flexible and Printed Electronics Conference, Keynote, "Manufacturing, the Road to Success," January, 2014, Phoenix, AZ.
134. Marquette University, *Connecting with the World Lecture* entitled, "The Globe, the Car, and the Co-Processor: A Tale about Producing the Most Complex Consumer Product on Earth," Southfield, Michigan, October 2013.
135. Massachusetts Institute of Technology, Institute Seminar entitled, "Making Chips, The Digital Future of Manufacturing," Cambridge, MA, March 2014.
136. Massachusetts Institute of Technology, Departmental Seminar entitled, "The Globe, the Car, and the Co-Processor: A Tale about Producing the Most Complex Consumer Product on Earth," Cambridge, MA March 2014.
137. University of California at Berkeley, Seminar entitled, "Policy Issues and Strategies for Manufacturing in the United States of America," Berkeley, CA, April 2014.
138. Sam Nunn Bank of America Policy Forum, Keynote Address entitled, "Energy and Manufacturing in the Southeast," Atlanta, GA, April 2014.
139. American Society of Precision Engineering, Spring Meeting Keynote address entitled, "Metrology Needs for Additive Manufacturing," Berkeley, CA, April 2014.
140. American Society of Mechanical Engineers, webinar on the National Network for Manufacturing Innovation (NNMI), On-Line, April, 2014.
141. Cambridge University, The Babbage Lecture entitled, "The Digital Future of Manufacturing, Policy and Technology Opportunities for American Innovation," Cambridge, UK, May 2014.
142. Chinese Mechanical Engineering Society's Forum on New Industrial Revolution and Intelligent Manufacturing, Keynote address entitled, "Policy Issues and Technology Targets for Manufacturing in the United States of America," Beijing, China, May 2014.
143. Society of Manufacturing Engineers, address to Manufacturing Education and Research Division entitled, "Manufacturing Education, Answering the Needs of the Nation," Detroit, MI, June 2014.
144. Society of Manufacturing Engineers, Big M Conference, Keynote address on Advanced Manufacturing Partnership, Strategies for the National Network for Manufacturing Innovation, Detroit, MI, June, 2014.

145. Congressional Briefing entitled, "Policy Issues and Strategies for Manufacturing in the United States of America," Washington, DC, August 2014.
146. American Society of Mechanical Engineers, Board of Governors address, "ASME and Manufacturing: Moving the Nation Forward & Providing a Technical Foundation for the Future," Charleston, SC, July 2014.
147. 3D Printing and Additive Manufacturing Summit, Panelist on, "Workforce Development for Additive Manufacturing," Pittsburgh, PA, September 2014.
148. 3D Printing and Additive Manufacturing Summit, Keynote entitled, "Product Development and Design," Pittsburgh, PA, September 2014.
149. Society of Manufacturing Engineers Webinar entitled, "How Software and Automation are Improving Manufacturing Efficiency," On-Line, September, 2015.
150. Automotive Industry Action Group (AIAG), Automotive Engineering & Technology Forum, Keynote Address entitled, "The Globe, the Car, and the Co-Processor: A Tale about Producing the Most Complex Consumer Product on Earth," Southfield, Michigan, October 2014.
151. Industrial Research Institute, monthly brown bag webinar entitled, "Rethinking Additive Manufacturing and Intellectual Property Protection," October 2014.
152. Japan International Machine Tool Fair / 16th Annual International Machine Tools Engineers' Conference, Opening Keynote Address entitled, "The Future of Digital Manufacturing," Tokyo, Japan, October 2014.
153. Invited lecture at Senior University at Mercer College entitled, "Enabling Innovation and Ensuring the Talent Pipeline. The Future of Manufacturing in the United States," Atlanta, GA November, 2014.
154. Rutgers University, invited technical seminar entitled, "Digital Manufacturing, Laying the Foundation Today for Tomorrow's Opportunities," Piscataway, NJ, December 2014.
155. Rutgers University, invited College of Engineering Policy entitled, "Policy Issues and Strategies for Manufacturing in the United States of America," Piscataway, NJ, December 2014.
156. Society of Manufacturing Engineers Webinar entitled, "Advanced Manufacturing and Using Big Data to Enhance Production from Big Shops to Small Shops," On-Line, December, 2014.
157. Keynote, GA Manufacturing Extension Partnership Annual meeting, talk entitled, "Digital Manufacturing, Laying the Foundation Today for Tomorrow's Opportunities," Atlanta, GA, January 2015.
158. Invited talk, University of Nebraska, talk entitled, "Policy Issues and Strategies for Manufacturing in the United States of America," Lincoln, NE, February 2015.

159. NSF Smart Manufacturing Workshop, Keynote talk entitled, "Policy Issues and Strategies for Manufacturing in the United States of America," February 2015.
160. Workshop leader on Advanced Manufacturing Opportunities for Caterpillar, Peoria, IL, February, 2015.
161. Participant in UK/USA discussion on future interactions between the National Network for Manufacturing Innovation and the UK Catapult Program, the White House, Washington, DC, March, 2015.
162. Keynote Speaker, DMDII Cyber Security Workshop, talk entitled, "The Factory of the Future, Enabling Innovation," Gaithersburg, MD, April, 2015.
163. Keynote speaker, South Carolina Chamber of Commerce, talk entitled, "The Factory of the Future, Enabling Innovation," Greenville, SC, April, 2015.
164. Dinner speech, AMSE 2015 Engineering Public Policy Symposium, Washington, DC, April, 2015.
165. Keynote Speaker, AMT MTConnect Conference, talk entitled, "Digital Manufacturing, Laying the Foundation Today for Tomorrow's Opportunities," Chicago, IL, April, 2015.
166. Moderator, Advanced Manufacturing Opportunities in the Food Factory of the Future, University of Nebraska, Lincoln, NE, May 2015.
167. Keynote Speaker, University of Pennsylvania Advanced Manufacturing Workshop, talk entitled, "Engaging Academe to Meet the Manufacturing Needs of the Nation," Philadelphia, PA, May, 2015.
168. Center for Compact and Efficient Fluid Power workshop on Advanced Manufacturing, keynote talk entitled, "The Factory of the Future, Enabling Innovation," Atlanta, GA, July 2015.
169. Keynote Speaker on CENTRA Conference on 3D and 4D Printing Trends and Their Potential Impact on National Security, Washington, DC, August 2015.
170. Round Table Discussion with Secretary of Commerce, DMDII, August, 2015.
171. Keynote speaker, Babbage Symposium, Cambridge University, talk entitled, "Policy Thoughts on Advanced Manufacturing and its Directions," Cambridge, UK, September, 2015.
172. Update to National Fluid Power Association on Current Opportunities for Fluid Power in the Advanced Manufacturing Sector," Chicago, IL, October, 2015.
173. Invited talk, Agency for Science, Technology and Research (A*STAR), talk entitled, "Policy Issues and Strategies for Manufacturing in the United States of America," Singapore, October 2015.

174. Invited talk, Agency for Science, Technology and Research (A*STAR), talk entitled, "Digital Manufacturing, Laying the Foundation Today for Tomorrow's Opportunities," Singapore, October 2015.
175. Keynote speaker Department of Energy, National Energy Technology Laboratory, University Turbine Systems Research (UTSR) Workshop, talk entitled "Advanced Manufacturing, Policy and Technology Opportunities for American Innovation," Atlanta, GA, November, 2015.
176. ASME IAB, Moderator for Session on the Directors discussion for all Institutes engaged in the National Network of Manufacturing Innovation (NNMI), Chicago, IL, November, 2015.
177. BMW Advanced Research and Development Team, invited talk entitled, "Long Range, Next Generation Concepts for Advanced Manufacturing," Munich, Germany, December, 2015.
178. SME Webinar, "Sensors and Data, the Untapped and Rapidly Approaching Opportunities for Manufacturing," January, 2016.
179. Keynote Address, NSF Workshop on Fluid Power Advanced Manufacturing, talk entitled, "Automation: Big Data, IoT, HPC and Lots of other Buzz Words," May 2016
180. Keynote Address, Robotics for Defense Aerospace Manufacturing Workshop, talk entitled, "A National Perspective on Robotics," June 2016.
181. Society Strategic Plan Keynote Address, ASME Spring Member Meeting, talk entitled, "Manufacturing the Future," June 2016.
182. Keynote Address, NSF CyberManufacturing Workshop, talk entitled, "Creating the Amazon Ecosystem for Manufacturing," June 2016.
183. Keynote Address, Student Shop Managers' Conference, North America 2016, talk entitled, "Manufacturing the Future," Atlanta, GA, July 2016.
184. ABET, Briefing, Policy Issues and Strategies for Manufacturing in the United States of America," Washington, DC, July 2016.
185. Congressional Briefing entitled, "Policy Issues and Strategies for Manufacturing in the United States of America," Washington, DC, July 2016.
186. NVidia Webinar entitled, "Subtractive 3D Printing (S3DP) Using Low Cost High Performance Computing. A Cornerstone of Digital Manufacturing," July 2016.
187. Denso America, technical talk entitled, "Digital Manufacturing, Big Data, and Machine Monitoring," Maryville, TN, July 2016.
188. Power Automation, talk entitled, "Subtractive 3D Printing (S3DP) Using Low Cost High Performance Computing. A Cornerstone of Digital Manufacturing," Webinar, September 2016

189. Keynote Address, Manufacturing Impacts Through Energy and Commerce, talk entitled, "Manufacturing the Future," Atlanta, GA, September 2016.
190. SISAMEX, S.A. de C.V. (Automotive Systems of Mexico), Technical talk, entitled, "Sensors, Data and HPC, the Untapped and Rapidly Approaching Opportunities for Manufacturing," Monterrey, Mexico, October 2016.
191. Bocar Group, Technical talk, entitled, "Sensors, Data and HPC, the Untapped and Rapidly Approaching Opportunities for Manufacturing," Mexico City, Mexico, October 2016.
192. Tecnológico de Monterrey, Mexico City, Seminar, entitled, "Sensors, Data and HPC, the Untapped and Rapidly Approaching Opportunities for Manufacturing," Mexico City, Mexico, October 2016.
193. Keynote Address, Austria Connect, North America 2016, talk entitled, "Manufacturing the Future," Atlanta, GA, October 2016.
194. Keynote Address, Manufacturing Tomorrow's Workforce Conference, talk entitled, "Manufacturing the Future," Atlanta, GA, October 2016.
195. Keynote Address, NSF Workshop on Low-Latency Wireless Networks, talk entitled, "Sensors, Data and HPC, the Untapped and Rapidly Approaching Opportunities for Manufacturing," Atlanta, GA, November 2016.
196. Delta Technical Operations Center, talk entitled "A Voxel Based Approach to Model Free Manufacturing for Turbine Blade Rebuilding Operations," Atlanta, GA, November, 2016.
197. Delta Technical Operations Center, talk entitled "Cloud Based Manufacturing System Monitoring and Predictive Maintenance," Atlanta, GA, November, 2016.
198. Keynote address, National Instruments – Cyber Physical Systems Round Table, talk entitled, "Sensors and Data, the Untapped and Rapidly Approaching Opportunities for Manufacturing," Lille, France, December, 2016.
199. SME Webinar, "How Connectivity, Big Data, the Internet of Things and Industry 4.0 will Change Shop Management and Operations," December, 2016.
200. Tecnológico de Monterrey, Keynote Talk on Industry 4.0 German Mexico Meeting entitled, "Sensors, Data and HPC, the Untapped and Rapidly Approaching Opportunities for Manufacturing," Monterrey, Mexico, October 2016.
201. Local Motors, invited seminar entitled, "Subtractive 3D Printing (S3DP) Using Low Cost High Performance Computing. A Cornerstone of Digital Manufacturing," Knoxville, TN, 20 January 2017.
202. Florida State, invited seminar entitled, "What do You Get When you Cross High Performance Computing and Big Data? You Get the Digital Twin," Tallahassee, FL, February 2017.

203. Huazhong University of Science & Technology, invited seminar entitled, "Sensors and Data, the Untapped and Rapidly Approaching Opportunities for Manufacturing China," Wuhan, China, March 2017.
204. International Society of Service Innovation Professionals / National Science Foundation Workshop on Industry-Academe Research Partnerships to Enable the Human-Technology Frontier for Next Generation Smarter Service Systems, "Emerging Manufacturing Services Enabled by Low Cost Sensors, Big Data, and High Performance Computing," San Jose, CA, March 2017.
205. National Academy of Engineering Regional Meeting on Data Enabled Design and Manufacturing, Keynote on Automotive Sector Opportunities, Atlanta, GA, April 2017.
206. National Academy of Engineering Regional Meeting on Data Enabled Design and Manufacturing, Moderator of Open discussion Forum, Atlanta, GA, April 2017.
207. Plenary address, American Society of Mechanical Engineers – Pressure Vessels & Piping Conference, talk entitled, "High Performance Computing and Big Data the Parents of the Digital Twin," Waikoloa, HI, July, 2017.
208. Moderated Congressional Briefing entitled, "The Department of Defense's Manufacturing Education Program," Washington, DC, July 2017.
209. Keynote address, NVidia Campus 2017 Technology Forum, talk entitled, "Bringing Graphics-Intensive Engineering Applications to Students' Laptops," Chicago, IL, July 2017.
210. Huazhong University of Science & Technology, Wuxi Institute, invited seminar entitled, "High Performance Computing and Big Data the Parents of the Digital Twin," Wuxi, China, August 2017.
211. University of Wisconsin-Madison, Lindbergh Lecture entitled, "Digital Volumetric Processing Ushering in the Age of the Digital Twin for Manufacturing," Madison, WI, September 2017.
212. Moderator and Keynote Speaker, Babbage Symposium on Production, Productivity and Competitive Advantage, session entitled, "The Role of Production in Global Economic Policy," Cambridge University, Cambridge, UK, September, 2017.
213. Bucknell University (1 of 3), Automation in Manufacturing and the Rise of the Middle Class," Lewisburg, PA, October 2017.
214. Bucknell University (2 of 3), Self-Driving Car Technologies: Who benefits and who loses," Lewisburg, PA, October 2017.
215. Bucknell University (3 of 3), Big Data, Cyber Security, and Privacy: Can we have all three?" Lewisburg, PA, October 2017.
216. Testified United States House of Representatives, Energy and Commerce Committee, Digital Commerce and Consumer Protection (115th Congress) on the Internet of Things, Manufacturing and Innovation, Washington, DC, January 2018.
217. Tecnológico de Monterrey, invited seminar entitled, "Digital Volumetric Processing Changing the Foundations of Manufacturing," Monterrey, Mexico, January 2018.

218. University of Colorado, invited seminar entitled, “IoT 4 MFG,” Colorado Springs, CO, February 2018.
219. National Institute of Standards and Technology, Model-Based Enterprise Summit 2018, opening Keynote Address for entitled, “IoT 4 MFG,” Gaithersburg, MD, April 2018.
220. Connected Everything 2018 Conference, Model-Based Enterprise Summit 2018, opening Keynote Address for entitled, “IoT 4 MFG,” Newcastle, UK, June 2018.
221. Joint International ThermProcess Summit (ITPS) and the International Finishing & Coatings Summit (IFCS), Keynote Address entitled, “MFG USA, Addressing the Missing Middle,” Atlanta, GA, July 2018.
222. 2018 Nissan Manufacturing Innovation Summit, Keynote Address entitled, “Innovation Implementation into a Manufacturing Environment Thinking / Looking Outside the Box”, Nashville, TN, October 2018.
223. Chicago Chapter of the Society of Manufacturing Engineers lecture entitled, “Innovation and Manufacturing, a Match Made in Heaven…or at Least in the Cloud,” Chicago, IL, November 2018.
224. Defense Manufacturing Conference, Keynote Panelist on Manufacturing USA and the Innovation Institutes of the United States of America, Nashville, TN, December 2018.
225. National Defense Industrial Association, Keynote Address entitled, “Manufacturing Transition,” Atlanta, GA, February 2019.
226. MxD Keynote Panelist on “The Road to Digital Manufacturing,” Chicago, IL March 2019.
227. SPIE Defense + Commercial Sensing Symposium, Keynote Address entitled, “IoT 4 MFG,” Baltimore, MD, April 2019.
228. Oak Ridge Post-doc Association Research Seminar, Invited Seminar entitled, “Industry, Government and Academia, Picking One or Doing it All,” Oak Ridge National Laboratory, April 2019.
229. Career Connections Invited Seminar entitled, “Industry, Government and Academia, Picking One or Doing it All,” Oak Ridge National Laboratory, June 2019.
230. Oak Ridge National Laboratory, Invited Talk for Energy Talk Series entitled, “A Technical Strategy Ensuring U.S. Dominance in Advanced Manufacturing,” Oak Ridge National Laboratory, July 2019.
231. Department of Energy National Laboratories Artificial Intelligence for Science Town Hall Meeting, Plenary Talk entitled, “Manufacturing the Future,” Oak Ridge National Laboratory, August 2019.
232. Oak Ridge National Laboratory, Keynote Talk at East Tennessee Economic Council Workshop on Data Analytics entitled, “The Future of Manufacturing: The Role of Data Analytics,” Knoxville, TN, September 2019.
233. Keynote at GE Edge & Controls Symposium entitled, “Manufacturing the Future,” Schenectady, NY, September 2019.

234. Plenary talk at NDIA Manufacturing Division meeting entitled, "Oak Ridge National Laboratory / Manufacturing Demonstration Facility – Industry Engagement," Knoxville, TN, September 2019.
235. ASME International Symposium Flexible Automation, opening keynote address, entitle, "Integrating Hybrid Manufacturing Processes via the Digital Thread," web conference, 8 July 2020.
236. Invited lecture for Outreach and Education Program at DoD Innovation Driven Research/Education Ecosystem for Advanced Manufacturing (I-DREAM4D) entitled, "Leveraging the Digital Thread to Integrate Next Generation Manufacturing Processes," webinar, 30 July 2020.
237. Invited seminar, University of Toledo, entitled, "Leveraging the Digital Thread to Advance Next Generation Hybrid Manufacturing Processes," Toledo, OH, webinar, 9 October 2020.
238. Keynote address for Society of Manufacturing Engineers SMX Conference entitled, "The Future of Digital Manufacturing," web meeting, 14 September 2020.
239. DOE / Office of Advanced Scientific Computing (O-ASCR) Terahertz and 6G Communications Roundtable Discussion, keynote entitled, "Smart Manufacturing IIoT and Industry 4.0," web meeting, 1 October 2020.
240. Keynote address entitled, "Leveraging the Digital Twin to Democratize Manufacturing," Prognostics and Health Management Society, web meeting, 11 November 2020.
241. Society of Manufacturing Engineers, Toledo, Houston and Seattle Chapters\, Invited Seminar entitled, "Democratizing Advanced Manufacturing – Ensuring Prosperity and Security," web meeting, 11 November 2020.
242. National Academy of Engineering Committee on and Moderator for "The Global Commercial Aviation Supply Chain a Meeting of Experts," web meeting, 19-20 November 2020.
243. Invited Seminar, Texas A&M, webinar, 29 January 2021.
244. Keynote speaker at the SAMPE 2021 Conference, Long Beach, CA, 24-27 May 2021.

Short Courses

1. National Science Foundation Faculty Development Course in Control Theory, "A Unified Classical/Modern Approach for Undergraduate Control Education," with M. L. Nagurka, Pittsburgh, PA, June 1993.
2. United Nations Development Program, presented a workshop on the "Basics of Rapid Prototyping," to the government of Malaysia as well as its industrial partners, Kuala Lumpur, Malaysia, December 1995.
3. National Science Foundation Faculty Development Course in Control Theory, "A Unified Classical/Modern Approach for Undergraduate Control Education with integrated Laboratory," with M. L. Nagurka, K. C. Craig and R. C. Dorf, Rensselaer Polytechnic Institute, Troy, NY, June 1997.

4. National Science Foundation Faculty Development Course in Control Theory, "A Unified Classical/Modern Approach for Undergraduate Control Education with integrated Laboratory," with M. L. Nagurka, K. C. Craig and R. C. Dorf, Georgia institute of Technology, Atlanta, GA, July 1997.
5. Society of Manufacturing Engineers, Workshop on Micro-Metrology, International Machine Tool Show, Chicago, IL, September 2004.
6. Society of Manufacturing Engineers, Workshop on Micro-Metrology, Micro Manufacturing Fundamentals Workshop, Minneapolis, MN, May 2005.
7. Edson Ingersoll Gaylord Education and Research Laboratory (EIGERlab), Workshop on Micro-Manufacturing, presentation on Micro-Metrology, Rockford, IL, July 2005.
8. Society of Manufacturing Engineers, Workshop on Micro-Metrology, Micro Manufacturing Fundamentals Workshop, Los Angeles, CA, April 2006.
9. Society of Manufacturing Engineers, Session on Micro-Metrology, Micro Manufacturing Fundamentals Workshop, Chicago, IL, April 2007.
10. Society of Manufacturing Engineers, Session on Micro-Metrology, Micro Manufacturing Fundamentals Workshop, Boston, MA, April 2008.
11. Society of Manufacturing Engineers, organized Workshop on Micro-Metrology Fundamentals, Minneapolis, MN, April 2009.
12. Society of Manufacturing Engineers, Session on Micro-Metrology, Micro Manufacturing Fundamentals Workshop, Minneapolis, MN, April 2009.
13. Society of Manufacturing Engineers, organized Workshop on Micro-Metrology Fundamentals, Phoenix, AZ, April 2010.
14. Society of Manufacturing Engineers, Session on Micro-Metrology, Micro Manufacturing Fundamentals Workshop, Phoenix, AZ, April 2010.
15. Society of Manufacturing Engineers, organized Workshop on Micro-Metrology Fundamentals, Chicago, IL, April 2011.
16. Society of Manufacturing Engineers, Session on Micro-Metrology, Micro Manufacturing Fundamentals Workshop, Chicago, IL, April 2011.
17. Society of Manufacturing Engineers, Session on Micro-Metrology, Micro Manufacturing Fundamentals Workshop, Minneapolis, MN, April 2013.

Other Presentations

1. ANSI Y14.5 Ad Hoc Committee on Mathematization, Speaker, Long Boat Key, FL, January, 1990.

2. International Manufacturing Technology Conference, Presented research in statistical metrology being conducted at CMU in conjunction with the Department of Statistics. Travel was funded by the Society of Manufacturing Engineers, September, 1990.
3. ANSI B89.3.2 Working Group on Measurement Procedures and Practices, presented research in statistical quantification of part geometry, Washington, DC, September, 1990.
4. American National Standards Institute, Presented current research activities in dimensioning, tolerancing and metrology to ANSI Committee on Dimensional Measurement Methods, B89.3.2 in Washington DC, October, 1990.
5. ANSI B89.3.2 Working Group on Measurement Procedures and Practices, presented standard manufacturing procedures for determination of Type I and Type II errors based on geometric sample data, Long Boat Key, FL, January, 1991.
6. Carnegie Mellon University, Engineering Design Research Center, Presented "Gain Plots: A New Generation of Control Synthesis Tools," as part of the EDRC Design Innovation Lecture Series, with M. L. Nagurka, April, 1991.
7. ALCOA, Presented Research in Quality Assurance, ALCOA Technical Center, June, 1991.
8. The Timken Company, Presented Research in Precision Engineering with M. L. Nagurka and J. Cagan, August, 1991.
9. The Timken Company, Timken Research, Invited Seminar on Research in Quality Assurance, Title: "A Unified Strategy for Optimizing Production Cost and Quality," with J. Cagan, Canton, OH, November, 1991.
10. The Timken Company, Timken Research, Invited Seminar on Research in Control Theory, Title: "A New Geometric Approach to Control System Analysis and Design," with M. L. Nagurka, Canton, OH, November, 1991.
11. IEEE Sensors and Actuators meeting, presented research on micro-actuator development for adaptive optics, Hilton Head, SC, June 1992.
12. NASA Head Quarters, presented research on the design, control and manufacture of large scale linearly segmented adaptive optics, Washington DC, July, 1992.
13. NASA Jet Propulsion Laboratory, presented research on the design, control and manufacture of large scale linearly segmented adaptive optics, Pasadena, CA, July, 1992.
14. Brown & Sharpe, presented research on metrology and quality assurance, North Kingstown, RI, October, 1992.

15. Martin Marietta, Next Generation Controller Seminar on Manufacturing, "A Unified Approach to High Precision Design, Manufacturing, Control and Quality Assurance," with J. Cagan, Denver, CO, October, 1992.
16. NASA Marshal Space Flight Center, "Actuator Stroke Requirements Based on a Zernike Decomposition of Atmospheric Turbulence," with B. M. Levine (NASA JPL), Huntsville, AL, October, 1992.
17. ALCOA, Presented Research in Quality Assurance of aluminum extrusions, ALCOA Technical Center, May, 1993.
18. Pittsburgh Tube Co., Presented research in high speed tube wall thickness measurement, May 1994.
19. Ingersol, Presented research on high speed metrology and precision grinding systems, August 1995.
20. Caterpillar, Presented research on high speed metrology and precision grinding systems, Peoria, IL, August 1995.
21. Giddings & Lewis, Presented research on high speed metrology and precision grinding systems, Detroit, MI, August 1995.
22. Torrington, Presented research on high speed metrology and precision grinding systems, Norcross, GA, August 1995.
23. General Motors, Presented research on high speed metrology and precision grinding systems, August 1995.
24. Ford, Presented research on high speed metrology and precision grinding systems, Detroit, MI, August 1995.
25. T-Tech Inc., Presented research in automatic calibration, Atlanta, GA, October 1995.
26. General Motors, Presented research on high speed metrology and precision grinding systems, Detroit, MI, January 1996.
27. Timken, Presented research on high speed metrology and precision grinding systems, Canton, OH, January 1996.
28. Ford, Presented research on dynamic stiffness implications for machine tools, Detroit, MI, January 1996.
29. Pratt & Whitney, Presented research on adaptive controlled grinding, North Haven, CT, July 1996
30. Norton Corporation, Presented research on adaptive controlled grinding, Worcester, MA, July 1996
31. Bryant Grinder Corporation, Presented research on adaptive controlled grinding, Springfield, VT, July 1996
32. Ford, Presented research on dynamic stiffness implications for machine tools, Detroit, MI, November 1996.
33. National Carbon Products, Presented research on high speed inspection systems, Greeneville, SC, July 1997.

34. General Electric, Presented research on machining of super alloys, Greeneville, SC, March 2000.
35. Rolls Royce, Presented research on machining of super alloys and metrology of complex geometries, Indianapolis, IN, April 2000.
36. Ford, Presented research on machining of super alloys and metrology of complex geometries, Detroit, MI, May 2000.
37. Bosch Automation, Presented research on advanced control of machine tools, Novi, MI, May 2000.
38. Okuma, Presented research on advanced control of machine tools, Charlotte, NC, November 2000.

VI. TEACHING AND EDUCATION

A. Courses Taught

1. Undergraduate

a) Quality Control / Quality Assurance
b) Classical Control Theory
c) System Dynamics and Modeling
d) Creative Decisions and Design
e) Advanced Elements in Manufacturing Systems
f) Senior Capstone Design

2. Graduate

a) Quality Control / Quality Assurance
b) Modern Control Theory
c) Automotive Design and Development
d) Vehicle Testing
e) Automotive Electronics
f) Real-Time Signal Processing and Control
g) Precision Systems and Manufacturing
h) Robotics and Advanced Dynamics

Semester, Year	Course Number	Course Title	No. of Students
Fall 2013	ME 6225 A	Metrology and Measurement	12
Fall 2013	ME 6225 Q	Metrology and Measurement	12
Spring 2014	ME 2110 A	Creative Decisions & Design	20
Spring 2014	ME 2110 J	Creative Decisions & Design	18
Fall 2014	ME 2110 A	Creative Decisions & Design	22
Fall 2014	ME 2110 B	Creative Decisions & Design	17
Spring 2015	ME 6225 A	Metrology and Measurement	6
Spring 2015	ME 6225 Q	Metrology and Measurement	9
Fall 2015	ME 2110 A-L	Creative Decisions & Design	228
Spring 2016	ME 2110 A	Creative Decisions & Design	20
Spring 2016	ME 2110 B	Creative Decisions & Design	20
Fall 2016	ME 2110 A-M	Creative Decisions & Design	238
Fall 2017	ME 2110 A-N	Creative Decisions & Design	280
Spring 2018	ME 2110 A-O	Creative Decisions & Design	160
Fall 2018	ME 2110 A-M	Creative Decisions & Design	148

B. Individual Student Guidance

1. Ph.D. Students

a) Kyle Saleeby, 2019 – present, passed qualifiers, proposal completed.

b) Thomas Feldhausen, 2018 – 2020, dissertation title, "Development and Evaluation of Interfacial Structures for Hybrid Manufacturing," currently employed by Oak Ridge National Laboratory.

c) Pierrick Rauby, 2018 – present, passed qualifiers.

d) Daniel Newman – 2018 – 2020, dissertation title, "Bayesian Edge Analytics of Machine Process and Health Status in an IoT Framework," currently employed by Boeing.

e) Mahmoud Parto Dezfouli, 2017 – 2019, dissertation title, "Automated Real-Time Machine Learning for IoT for Manufacturing a Cloud Architecture and API," currently self-employed.

f) Dongmin Han, 2015 – 2019, dissertation title, "Slicing of Tessellated Models for Additive Manufacturing Based on Variable Thickness Layers," currently employed by APT.

g) Roby Lynn, 2015 – 2019, "Direct Servo Control of Positional Derivatives for 5-Axis CNC Machine Tools Using Densely-Sampled Toolpaths," currently employed at OFS.

h) Aoyu Chen, 2014 – 2017, dissertation title, "Machine Tool Spindle Bearing Diagnostics under Operating Conditions," currently employed by MathWorks.

i) Masoumeh Aminzadeh, 2014 – 2016, dissertation title, "Machine Vision System for In-Situ Quality Inspection in Metal Powder-Bed Additive Manufacturing," currently employed by Google.

j) Mohammad M. Hossain, 2014 – 2016, dissertation title, "Voxel-Based Offsetting at High Resolution with Tunable Speed and Precision Using Hybrid Dynamic Trees," currently employed by Face Book.

k) Justin Milner, 2010 – 2014, dissertation title, "Advanced Bulk Processing of Lightweight Materials for the Transportation Sector," currently employed by NIST.

l) Melissa Bowler, 2009 – 2013, proposed dissertation title, "Battery Second Use: a Framework for Evaluating the Combination of Two Value Chains," currently employed by BMW AG, Munich, Germany.

m) Qin Shen, 2010 – 2013, dissertation title, "Impact-Acoustic Evaluation Methods for Internal Crack Detection in Rubber Composite Structures," currently employed by Ford Motor Company.

n) Yujie Chen, 2010 – 2013, dissertation title, "Prediction of Subsurface Damage during the Machining of Nickel-Based Superalloys," currently employed by Caterpillar.

o) Michael Arant, 2010 – 2013, dissertation title, "Stability Control of Triple Trailer Vehicles," currently employed by General Motors.

p) Dmytro Konobrytskyi 2010 – 2013, dissertation title, "Automated CNC Tool Path Planning and Machining Simulation on Highly Parallel Computing Architectures," currently employed by Mitsubishi Electronics Research Labs.

q) Andrew Henderson, 2009 – 2013, dissertation title, "Updated Force Model for Milling Nickel-Based Superalloys," currently employed by General Electric Power and Water.

r) Joshua Tarbutton, 2006 – 2011, dissertation title, "Automated Digital Machining for Parallel Processors," currently on the faculty of Mechanical Engineering at the University of South Carolina.

s) John Limroth, 2006 – 2009, dissertation title, "Real-Time Vehicle Parameter Estimation and Adaptive Stability Control," currently staff engineer at Michelin Research North America.

t) Omkar Karhade, 2005 – 2008, dissertation title, "Scanning Micro Interferometer with Tunable Diffraction Grating for Low Noise Parallel Operation," currently Staff Engineer, Intel, Phoenix, AZ.

u) Laine Mears, 2004 – 2006, dissertation title, "Geometry Estimation and Adaptive Actuation for Centering Preprocessing and Precision Measurement," currently BMW Chair of Manufacturing Systems, Department of Automotive Engineering, Clemson University, Clemson, SC.

v) Austin Chen, 2003 – 2006, dissertation title, “Integrated Inspected for Precision Part Production,” currently Staff Scientist, Applied Research Associates, Raleigh, NC.

w) Meghan Shilling, 2003 – 2006, dissertation title, “Mesoscale Edge Characterization,” currently employed by NIST, Gaithersburg, MD.

x) Kristian Krueger 2002 – 2005, dissertation title, “Bore Waviness Measurement Using an In-Process Gage,” currently senior process engineer, The Timken Company, Norcross, GA.

y) James Nichols 2001 – 2004, dissertation title, “Metrology of High Aspect Ratio MEMS,” currently Staff Scientist, Applied Research Associates, Raleigh, NC.

z) Byungki Kim 1999 – 2004, dissertation title, “Miniaturized Diffraction Based Interferometric Distance Measurement Sensor,” currently Assistant Professor of Mechanical Engineering, University of Massachusetts Lowell, Lowell, MA.

aa) Ittichote Chuckpaiwong, 2000 – 2003, dissertation title, “Development of Position Sensor Using Phase-based Continuous Wave Radar,” currently Assistant Professor of Mechanical Engineering at Mahidol University, Thailand.

bb) Wesley Stone, 1999 – 2003, dissertation title, “Thermal Effects on Subsurface Damage during the Surface Grinding of Titanium Aluminide,” currently Assistant Professor of Engineering Technology at Western Carolina University.

cc) Ty Dawson, 1999 – 2002, dissertation title, “Machining Hardened Steel with PCBN Cutting Tools” currently employed by Milliken Company.

dd) Andre Claudet, 1998 – 2001, dissertation title, “Analysis of Three Dimensional Measurement Data and Multi-Surface CAD Models,” currently Senior Member of Technical Staff, Sandia National Laboratories, Albuquerque, NM.

ee) Thomas Tucker, 1997 – 2000, dissertation title, “A New Method for Parametric Surface Registration,” currently employed by Paraform, Inc., as manager of metrology products.

ff) H. Ali Razavi, 1996 – 2000, dissertation title, “Identification and Control of Grinding Processes for Intermetallic Compounds,” currently, senior research associate, Hewlett-Packard, San Diego, CA.

gg) Hodge Jenkins, 1990 – 1996, dissertation title, “Process Estimation and Adaptive Control of a Grinding System.” currently Associate Professor of Mechanical Engineering, Mercer College, Macon, GA.

hh) Woncheol Choi – (MEG/CMU), August 1993 – 1996, dissertation title, “Computational Analysis of Three Dimensional Measurement Data,” currently employed by Align Technologies.

ii) Hubert Vasseur – (EPP/CMU) advised jointly with Prof. Jonathan Cagan, January 1991-94, dissertation title, "Manufacturing Quality and Process Precision: A Cost-Based Analysis," currently employed by Renault, Paris, France.

jj) Ssu-Kuei Wang – (MEG/CMU) advised jointly with Prof. Mark Nagurka, 1991 – 95, dissertation title, "Levitation and Guidance of a Maglev Vehicle Using Optimal Preview Control," currently employed by the Carnegie Mellon Research Institute.

2. Master's Thesis Students

a) Patrick Jung, 2018 – present, co-advised with C. Saldana.

b) Elliot Jost, 2018 – present, co-advised with C. Saldana.

c) Austen Thien, 2018 – present, co-advised with C. Saldana.

d) Jaime Berez, 2018 – 2020, thesis title, "Qualification of Laser Powder Bed Fusion Processed 17-4 PH Stainless Steel as a Function of Powder Condition," co-advised with C. Saldana.

e) Omar Elsayed, 2018 – 2020, thesis title, "The Effect of Pure and Compound Laser Incidence Angles on Bead Geometry, Microstructure and Texture in Direct Energy Deposition Processes," co-advised with C. Saldana.

f) Edward Nguyen, 2018 – 2020, thesis title, "Machine Learning for Anomalous Toolpath Identification in Subtractive Manufacturing," co-advised with C. Saldana.

g) Lance Lu, 2018 – 2020, thesis title, "Effectiveness of Various Chatter Detection Techniques Under Noisy Conditions," co-advised with C. Saldana.

h) Ivan Ren, 2018 – 2020, thesis title, "An Ensemble Machine Vision System for Automated Detection of Surface Defects in Aircraft Propeller Blades," co-advised with C. Saldana.

i) Sam Kersten, 2018 – 2020, thesis title, "Effects of Build Orientation on Components Produced Using Direct Energy Deposition," currently employed by SpaceX.

j) Kyle Williams, 2018 – 2019, thesis title, "Open Source CNC Control with CAM and Digital Twin Integration," currently employed by Sandia National Laboratory.

k) Niklas Tritschler, 2018 – 2019, thesis title, "Developing a Device for Automatic Monitoring of Rolling Element Bearing Conditions," currently employed by Daimler Benz, GMBH.

l) Eymard Prevost, 2018 – 2019, thesis title, "Detection of Bearing Defects with Approximate Bearing Configurations," Currently employed by Georgia Pacific.

m) Kyle Saleeby, 2017 – 2019, thesis title, "Development of a Low-Cost Wireless Accelerometer Sensor Platform (WASP) for Machine Monitoring Applications."

n) Wafa Louhichi, 2017 – 2019, thesis title, "Automated Surface Finish Inspection using Convolutional Neural Networks," currently employed by Wells Fargo.

o) James Collins, 2017 – 2018, thesis title, "Digital Twin Volume Registration for Voxel-Based Closed-Loop Machining Systems," currently employed by SoftWear Systems.

p) Chelsea Silberglied, 2017 – 2018, thesis title, "Extruder Dynamics and Control in Large Scale Additive Manufacturing," currently employed by Gore, Inc.

q) Roman Burkhart, 2017 – 2018, thesis title, "Adaptable Slope Estimation Module and its Application in a Coolant Monitoring System for predictive Observation," currently employed by Bosch Corporation.

r) Pierrick Rauby, 2017 – 2018, thesis title, "Developing a Smart and low Cost Device for Machining Vibration Monitoring."

s) Mahmoud Parto Dezfouli, 2016 – 2017, thesis title, "A Secure MTConnect Compatible IoT Platform for Machine Monitoring through Integration of Fog Computing, Cloud Computing, and Communication Protocols."

t) Amir Ameur, 2016 – present, proposed thesis title, "Multi-Axis Tool and Tool Path Optimization using High Performance Computing."

u) Clayton Greer, 2015 – 2017, thesis title, "Design of Replacement Structural Components for Fabrication using Metal Big Area Additive Manufacturing."

v) Stephanie Locks, 2015 – 2016, thesis title, "General Bayesian Approach for Manufacturing Equipment Diagnostics Using Sensor Fusion."

w) Boyce Richardson, 2009 – 2011, thesis title, "Vision Processing for Subsurface Damage Assessment in Superalloy Machining."

x) Koushik Aravalli, 2006 – 2007, thesis title, "Temperature Control of an Air Shower."

y) Meghashyam Panyam, 2006 – 2007, thesis title, "Least Squares Fitting of Analytic Primitives on a GPU."

z) Vedik Bobba, 2006 – 2007, thesis title, "Registration with Graphical Processor Unit."

aa) Joshua Tarbutton, 2005 – 2007, "Design of a Controller for a Precision Positioning Machine."

bb) Omkar Karhade, 2004 – 2005, thesis title, "Enhancement of Production Capability for a Micro-Interferometer."

cc) Thomas Holst, 2004 – 2004, thesis title, "Spatial Filtering in Microwave Sensor Measurements of Turbine Blades."

dd) Michael Leclerc, 2003 – 2004, thesis title, "Characterization of a Vertical Two Axis Lathe."

ee) Ian Harrison, 2003 – 2004, thesis title, "Detecting White Layer in Hard Turned Components Using Non-Destructive Methods," currently employed by SpaceX.

ff) Michael Schmittdiel, 2002 – 2004, thesis title, "Active Control of a Diffraction Grating Interferometer for Microscale Devices."

gg) Alessandro Caccialupi, 2002 – 2003, thesis title, "System Development for High Temperature, High Strain Rate Material Testing of Hardened Steels for Plasticity Behavior Modeling."

hh) Joseph Ceremuga 2001 – 2003, thesis title, "Optimizing Inspection of High Aspect Ratio Microstructures Using a Programmable Optical Microscope."

ii) Austin Chen, 2001 – 2003, thesis title, "Initial Guessing of Primitives for Minimization."

jj) Meghan Shilling, 2000 – 2002, thesis title, "Two Dimensional Analysis of Mesoscale Parts Using Image Processing Techniques."

kk) Jon Whidby 2002 – 2002, thesis title, "Precision Machining a Turbine Nozzle Segment."

ll) Gustavo Toledo, 2000 – 2002, thesis title, "High Temperature Compression Testing of Hard Steels for Plastic Behavior Modeling."

mm) James Nichols, 1999 – 2001, thesis title, "Two-Dimensional Analysis of Turbine Blades and Nozzles."

nn) Tracy Williams, 1998 – 2000, thesis title, "Remote Condition Monitoring of Rolling Element Bearings with Natural Crack Development."

oo) Chad Moore, 1998 – 2000, thesis title, "A Multi-Axis Stereolithography Controller with a GUI."

pp) John Wiggins, 1998 – 2000, thesis title, "Design of a PC-Based Open Architecture Machine Tool Controller."

qq) Joshua Rayner, 1998 – 2000, thesis title, "A Finite Element Simulation of Thermally-Induced Residual Stresses in Grinding of Titanium Aluminide."

rr) Jason Bradon, 1998 – 1999, thesis title, "Open Architecture and Calibration of a Cylindrical Grinder."

ss) Pierre Aussaguel, 1998 – 1999, thesis title, "A Simplified Finite Element Simulation for Hard Turning 52100 Steel."

tt) Ty Dawson, 1997 – 1999, thesis title, "Effects of Cutting Parameters and Tool Wear on Resulting Cutting Forces and Surface Quality in Hard Turning."

uu) Timothy Lloyd, 1997 – 1999, thesis title, “Surface Extraction from Coordinate Measurement Data to Facilitate Dimensional Inspection.”

vv) M. Xavier Ribadeneira, 1997 – 1999, thesis title, “Ball Bearing Diagnostics with Multiple Sensors.”

ww) Marc Crudel, 1997 – 1999, thesis title, “Implementation of a Fast Tool Servo with Repetitive Control for Diamond Turning.”

xx) Joel Miller, 1997 – 1999, thesis title, “Controlling Dynamic Stiffness Using Linear Drives.”

yy) Richard Cowan, 1997 – 1998, thesis title, “Adaptive Statistically Based Controller for Through Feed Centerless Grinder.”

zz) Andre Claudet, 1997 – 1998, thesis title, “Data Reduction For High Speed Computational Analysis of Three Dimensional Coordinate Measurement Data.”

aaa) Scott Billington, 1996 – 1997, thesis title, “Sensor and Machine Condition Effects in Roller Bearings Diagnostics.”

bbb) Jennifer Morrisette, 1996 – 1997, thesis title, “The use of a Piezoelectric Transducer to Improve the Precision of a CMM.”

ccc) Thomas Tucker, 1996 – 1997, thesis title, “Three Dimensional Measurement in Rapid Prototyping.”

ddd) David Longanbach, 1996 – 1997, thesis title, “Real-Time Measurement for and internal Grinding System.”

eee) Bernard Ulmer, 1996 – 1997, thesis title, “Fabrication and Calibration of an Open Architecture Diamond Turning Machine.”

fff) Sungshik Yim, 1995 – 1996, project title, “A Kalman Filter and Adaptive Controller implementation for the Centerless Grinding Process.”

ggg) Jason Shiroishi, 1995 – 1996, thesis title, “Bearing Condition diagnostics via Multiple Sensors Using the High frequency Resonance Technique with Adaptive Line Enhancer.”

hhh) Steven Bittle, 1994 – 1996, thesis title, “An Active PZT Probe for Precision Measurement on a CMM.”

iii) Christopher Gallagher, 1993 – 1995, thesis title, “Contact Force Control for Continuous Scanning Coordinate Measurement Machines,” current employer, The Timken Company, Canton, OH.

jjj) Kurt Laughlin – (CMU) Principal advisor, project involved dimensioning and tolerancing issues, 1991; and ME Project involved dimensioning and tolerancing issues specifically addressing tolerance representation, 1990-91, current employer, Westinghouse, Pittsburgh, PA.

kkk)Prakash Padmanabhan – (CMU) Principal advisor, project involved the development of mathematical models for geometric volumes described by tolerance call-outs, 1991-92, currently PhD candidate at CMU.

lll) Rebecca Anderson – (CMU) Principal advisor, project involved the development of statistical models of geometric variations for aluminum extrusions. Research was conducted in conjunction with the EDRC and Alcoa, 1991-93, current employer, Ford Motor Company, Dearborn, MI.

mmm)Julie Reyer – (CMU) Co-Advisor with Prof. Jon Cagan, project involved the development of a computer aided systems simulator and modeling package. The software developed is capable of running on low end Macintosh computers and will be used in undergraduate modeling courses, 1991-1993, currently PhD candidate University of Michigan.

nnn)Ursula Sadiq – (CMU) Principal advisor, project involved the development of an integrated metrology system linking servo driven CMM and design system at the EDRC, 1991-93.

ooo)Rosa Lopez – (CMU) Co-Advisor with Prof. Jon Cagan, project involved the investigation of advanced modeling techniques to quantify factors affecting product quality, 1992-1994.

3. Master's Project Students

a) Shawn Burns, 1996 – 1997, project title, "Development of a Hands on Manufacturing Laboratory."

b) Mona Greene, 1996, project title, "Analysis of Machine Tool Dynamic Stiffness."

4. Undergraduate Projects

a) Juan Carrano, IoT 4 MFG, 2018 – 2019.

b) Sam Nelson, High performance computing for multi-axis machining, 2018 – 2019.

c) Samantha Bordy, High performance computing for multi-axis machining, 2018 – 2019.

d) Walter King, IoT 4 MFG, 2018 – 2019

e) Andres Garcia, IoT 4 MFG, 2018 – 2019

f) Ivan Ilchenko, IoT 4 MFG, 2018 – 2019

g) Max Hertlein, High performance computing for multi-axis machining, 2018 – 2019.

h) Nate Morris, High performance computing for multi-axis machining, 2018 – 2019.

i) Adeline Longstreth, IoT for manufacturing, material tracking project 2017-2018.

j) Andres Garcia, HPC applications for multi-axis machining, 2017.
k) Asimm Hirani, low cost IoT based refractometer for coolant analysis, 2017 – 2019.
l) Dominguez, 5-axis machining of complex geometries using a HPC platform for programming, 2017.
m) Leo Medrano, Cloud based HPC for 5-axis programming, 2017.
n) Trevor Daino, Mill-Turning operations using HPC, 2017.
o) Ethan Wescoat – MTConnect and SmartBox interconnectivity for Digital Manufacturing, 2017.
p) Nathan Brewton – sensitivity analysis of automatic calibration systems for two axis milling system, 1996.
q) Bernard Ulmer – refurbish and test Moore #3 jig grinder (diamond turning machine), 1996.
r) Mona Greene - calibration of strain gage force sensors 1995-1996.
s) Jennifer Morrisette – design and fabrication of three axis DC motor driven servo stage, 1995.
t) Verity Cornish – calibration of glass scales using laser interferometer, 1995.
u) Lisa Calaham – ball levitation system using analog feedback, 1995.
v) Andrew Birkedal-Hansen – control of inverted pendulum system using programmable multi-axis controller, 1995.
w) Eric Christoph – shaft turning inverted lathe, 1995.
x) Terrell Young – shaft turning inverted lathe, 1995.
y) Erasmo Leon – spindle velocity control using analog feedback, 1995
z) Vicente Reynal – calibration of glass scales using laser interferometer, 1995.
aa) Robert Kukyendall – control of inverted pendulum system using programmable multi-axis controller, 1995.
bb) Cleveland Johnston – geometric analysis of choral error on coordinate measurement machine data, 1994.
cc) Chris Gallagher – (CMU) Undergraduate Project Supervisor, Project involved development of an inverted pendulum system for use in undergraduate education, Mechanical Engineering, 1992-93.
dd) Kina Farber – (CMU) Undergraduate Project Supervisor, Project involved implementation of a non-contact measurement system. This included the design and integration of hardware necessary to measure Woodruff keys at high speed. The measurement were then used to reject parts that are out of specification, and also to conduct statistical process control. Mechanical Engineering, 1992-93.

ee) Emma Gosden – (CMU) Undergraduate Project Supervisor, Project required the student to become familiar with the MicroVal Coordinate Measurement Machine (CMM) and then to subsequently set-up the PFx CMM. Mechanical Engineering, 1992-93

ff) Stephen Ludwick – (CMU) Undergraduate Project Supervisor, Project involved implementation of a non-contact measurement system. This included the design and integration of hardware necessary to measure Woodruff keys at high speed. The measurement were then used to reject parts that are out of specification, and also to conduct statistical process control. Mechanical Engineering, 1992-93.

gg) Mark Musolino – (CMU) Undergraduate Project Supervisor, Project involved development of an inverted pendulum system for use in undergraduate education, Mechanical Engineering, 1992-93.

hh) Matthew Pielert – (CMU) Undergraduate Project Supervisor, Project involved development of a rotary servo system (a motor with a large inertia attached). The angular position of the inertia is controlled by an analog feedback controller. This project is intended for use in undergraduate education, Mechanical Engineering, 1992-93.

ii) Matthew Onaitis – (CMU) Undergraduate Project Supervisor, Project involved development of an inverted pendulum system for use in undergraduate education, Mechanical Engineering, 1992-93.

jj) Jignya Thaker – (CMU) Undergraduate Project Supervisor, Project required the student to become familiar with the MicroVal Coordinate Measurement Machine (CMM) and then to subsequently set-up the PFx CMM. Mechanical Engineering, 1992-93

kk) Kevin Marsh – (CMU) Undergraduate Project Supervisor, Project involved geometric conformance verification of manufactured objects, ME EPP & EDRC joint project, 1990.

5. Master's Students (MS Projects CMU)

a) Ming Ta Yang – MS project Mechanical Engineering, Project involved Research of Predictive Control Issues, Fall 1989.

b) Alyson Wilson – Statistics Master's Candidate, Semester Research Project involved statistical issues in metrology, Spring 1990.

c) Susan Gamble – Statistics Master's Candidate, Semester Research Project involved statistical issues in metrology, Spring 1990.

d) R. Craig Coulter – Principal advisor in Mechanical Engineering, project involved the development of a path planning system for an autonomously navigating vehicle, 1992.

e) John Sills – Manufacturing Master's Project, involved the investigation of the relationship between engineers' salaries and their levels of training and experience, Summer 1991.

f) Jeffrey Tucker– Manufacturing Master's Project, involved the development of initial quality optimization algorithms for both dimensions and tolerances, Summer 1991. (co-advisor: Prof. Jon Cagan)

g) Michael Cummings – Manufacturing Master's Project, involved development of a quality model for automotive electronic systems, Summer 1992. (co-advisor: Prof. Jon Cagan)

h) John Stuhlfire – MS Project, Mechanical Engineering, project involved the refinement of a new set of graphical controls tools for use in design and analysis of single and multivariable linear control systems, 1991-92.

i) Woncheol Choi – MS Project, Mechanical Engineering, project involved the development of fitting algorithms for non-linear surfaces sampled using a coordinate measurement machine. These algorithms were used to implement a geometric feedback system whereby extrusion system operators can be informed as to the deviations of the extrusions from nominal via a graphical display, 1991-93.

C. Other Teaching Activities

a) Redesigned first quarter design core course, ME 3110, "Creative Decisions and Design."

b) Developed undergraduate course, ME 4803D, "Elements of Manufacturing Systems."

c) Developed graduate course, ME 8103E, "Metrology and Measurement Systems."

d) Developed a joint Mechanical Engineering and Engineering and Public Policy course entitled "Quality Assurance," (19/24-269, 24-789) (CMU).

e) Helped to develop Introduction to Engineering and Public Policy Course (19-101) (CMU).

VII. SERVICE

A. Professional Contributions

1. Chief Manufacturing and Energy Officer, Cyber Security Innovation Institute, CyManII, 2020 – present.
2. Research Advisory Council, In National Alliance for Water Innovation (NAWI) Research Advisory Council, 2020 – Present.
3. Co-Chair Working Group "Exploring the Future of Sustainable Production and Consumption," U.S. Council on Competitiveness, 2020 – present.

4. *Proceedings of the Institution of Mechanical Engineering, Part I: Journal of Systems and Control Engineering*, Advisory Board, 2020 – present.
5. MxD (formerly Digital Design and Manufacturing Innovation Institute (DMDII)), Executive Council, 2019 – present.
6. Immediate Past President, the Society of Manufacturing Engineers (SME), 2019.
7. Board of Governors – the American Society of Mechanical Engineers (SME), 2019 – present.
8. President, the Society of Manufacturing Engineers (SME), 2018.
9. Member the Scientific Advisory Committee Energy and Environmental Sciences Directorate for the Oak Ridge National Laboratory, 2018 – present.
10. President-Elect, SME, 2017.
11. Vice President, SME, 2016.
12. Member at Large of the ASME Council on Standards and Certification, 2016 – 2019.
13. *International Journal of Manufacturing Research*, Editorial Board, 2016 – present.
14. Chair SME Manufacturing Policy Task Force, 2016 – 2017.
15. Chair, M. Eugene Merchant Manufacturing Medal of ASME/SME Award Committee, 2016 – 2017.
16. Chair ASME Manufacturing Public Policy Task Force, 2015 – 2019.
17. Member at Large ASME Committee on Government Relations, 2015 – 2019.
18. Digital Design and Manufacturing Innovation Institute (DMDII), Strategic Planning Committee, 2015 – 2019.
19. Digital Design and Manufacturing Innovation Institute (DMDII), Executive Committee, 2015 – 2019.
20. Digital Design and Manufacturing Innovation Institute (DMDII), Technical Advisory Committee, 2015 – 2019.
21. Chair, Center for Compact and Efficient Fluid Power workshop on Advanced Manufacturing, Atlanta, GA, July 2015.
22. Department of Energy, Advance Manufacturing Office, Program Review Panel, 2015.
23. Guest Editor Special Edition of Mechatronics on "Issues on Smart Sensing and Information Processing in Advanced Manufacturing," 0.1016/j.mechatronics.2015.06.009, 2015
24. SME Treasurer, 2015.

25. Panelist for National Academies of Engineering and Department of Defense, Defense Materials Manufacturing and Infrastructure (DMMI) Workshop on: Combat Vehicle Weight Reduction by Materials Substitution, Washington, DC, December 2014.
26. SME Member at Large, Executive Committee, 2014.
27. American Society of Mechanical Engineers, Industrial Advisory Board, Moderator for Industry Panel on "The Maker Movement and America's Economic Future," Washington, DC, October 2014.
28. National Academies of Science and Engineering, Panel member on the Advanced Manufacturing Partnership, 2.0, Washington, DC, October 2014.
29. Panelist for the General Accountability Office Forum (GAO) On Additive Manufacturing, Washington, DC, October 2014.
30. SME Board of Directors, Member at Large, 2014
31. *Journal of Surface Topography: Metrology and Properties*, Editorial Board, 2013 – 2016.
32. *Proceedings of the Institution of Mechanical Engineering, Part I: Journal of Systems and Control Engineering*, Editorial Board, 2013 – 2020.
33. *SME Manufacturing Letters*, Associate Editor, 2013 – present.
34. Board of Directors National Center for Defense Manufacturing and Machining 2013 – present.
35. Board of Trustees MT Connect Institute, 2013 – present.
36. Member, National Academies Panel on Review of Manufacturing-related Programs at the National Institute of Standards and Technology, 2012.
37. Special Editor of the *ASME Journal of Engineering Science and Manufacturing*, 2011.
38. Member, M. Eugene Merchant Manufacturing Medal of ASME/SME Award Committee, 2011 – present.
39. Chair, M. Eugene Merchant Manufacturing Medal of ASME/SME Award Committee, 2016 – 2017.
40. Chair – Society of Manufacturing Engineers (SME) Journals Committee, 2011 – 2013.
41. Officers Nominating Committee – the Society of Manufacturing Engineers (SME), 2010 – 2012, 2019, 2020 e was responsible for coordinating Federal advanced manufacturing R&D, addressing issues related to technology commercialization, identifying gaps in current Federal R&D in advanced manufacturing, and developing strategies to address these gaps.nist.
42. Area Editor, *Research in Engineering Design*, 2010 – 2017.
43. Program Committee, World Manufacturing Forum, 2010 – 2011.

44. Board of Directors – the Society of Manufacturing Engineers (SME), 2010 – 2019.
45. Board of Directors National Center for Manufacturing Science, 2009 – 2012, 2013 – present.
46. Board of Directors International TechneGroup, Incorporated, 2009 – 2019.
47. International Journal of Engineering Education, Editorial Advisory Board, 2002 – present.
48. Executive Committee, International Symposium on Flexible Automation, 2008 – present.
49. Chair, South Carolina Centers of Economic Excellence (COEE), Council of Chairs, 2010 – 2011.
50. Vice-Chair, South Carolina Centers of Economic Excellence (COEE), Council of Chairs, 2009 – 2010.
51. Second Past President for the North American Manufacturing Research Institute of SME, 2009 – 2010.
52. Invited member of National Academy of Engineering and National Science Foundation workshop on Manufacturing, Ann Arbor, MI, May 2010.
53. Member of BMW Community Advisory Panel, 2007 – 2013.
54. Member Society of Manufacturing Engineers, Manufacturing Enterprise Council, 2009 – 2010.
55. Program Chair North American Manufacturing Research Conference, 2009.
56. Society of Manufacturing Engineers Task Force on Role in Higher Education, 2008 – 2010.
57. First Past President for the North American Manufacturing Research Institute of SME, 2008 – 2009.
58. Member National Academies Panel on Manufacturing Engineering, 2008 – 2010.
59. Division Lead for the National Academy of Engineering Panel on Manufacturing Engineering, National Institutes of Standards and Technology, 2009 – 2012.
60. *International Journal of Manufacturing Research*, Editorial Advisory Board, 2006 – 2012.
61. *Computer Aided Design and Applications*, Associate Editor, 2004 – 2017.
62. International Journal of Engineering Education, Associate Editor, 2004 – 2014.
63. President for the North American Manufacturing Research Institute of SME, 2007 – 2008.

64. International Symposium on Flexible Automation, Organizing Committee Chair, 2008.
65. President Elect for the North American Manufacturing Research Institute of SME, 2006 – 2007.
66. American Association for the Advancement of Science, Panelist for the review of Advanced Materials and Automotive for the State of Michigan 21st Century Jobs Fund, 2006.
67. Secretary for the North American Manufacturing Research Institute of SME, 2005 – 2006.
68. Japan-U.S.A. Symposium on Flexible Automation, Organizing Committee Co-Chair, 2006.
69. Senior Research Fellow of the Potomac Institute of New Zealand, 2005 – 2008.
70. Mechatronics, Editorial Board, 2004 – 2009.
71. World Technology Evaluation Center (WTEC), micro-manufacturing review team, 2004 – 2005.
72. Member of the Program Committee of the 2005 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM 2005), 2004 – 2005.
73. Member, Blackall Award Machine Tool and Gage Award Committee, ASME, 2003 – 2009.
74. Japan-U.S.A. Symposium on Flexible Automation, program Chair, 2004.
75. Member of National Research Council's Committee to Review Physical Sciences Proposals to the Wright Centers of Innovation Competition of the State of Ohio, 2003 – 2006.
76. Board of Directors North American Manufacturing Research Institute of SME, 2003 – 2010.
77. *ASME Journal of Manufacturing Science and Engineering*, Associate Editor, 1999-2005.
78. *SME Journal of Manufacturing Processes*, Associate Editor, 1999 – 2008.
79. Japan – U.S.A. Symposium on Flexible Automation, program Co-Chair, 2002.
80. Portuguese Ministry of Education and Technology Evaluation Committee member for Portuguese Research Units, 1999 – 2009.
81. ASME Journal of Dynamic Systems, Measurement, and Control, Associate Editor, 1996 – 2000.
82. NSF Committee of Visitors for the Engineering Education and Centers Division, 2000.
83. Co-Chair, NSF Workshop on the Future of Engineering Education, Engineering Education and Centers Division, 2000.

84. NSF Review and Overview Panel member for Engineering Coalition of Schools for Excellence in Engineering Education (ECSEL), 1996-2000.
85. Registered Professional Engineer, State of Pennsylvania Certificate No. PE-041315-E.
86. Member ANSI B89.3.2, Dimensional Measurement Methods, 1990-2001.
87. Member ANSI B89.3.1, Measurement of Roundness, 1993-2001.
88. SME Journal of Manufacturing Systems, Associate Editor, 1993-2008.
89. Japan-U.S.A. Symposium on Flexible Automation, organizing committee member, 1994-present.
90. ASME Division of Dynamic Systems and Control, Precision Engineering Technical Panel Chairman, 1994-2002.
91. IEEE Control Systems Society Video Committee Chairman, 1993-2000.
92. International Symposium on Automatic Technology & Automation organizing committee member, 1992-2000.
93. Reviewer for the Ohio Board of Regents Hayes Investment Fund program, 1999.
94. Organizing Committee, CIRP international Workshop on Modeling of Machining Operations, 1998.
95. Co-Chair, 1998 North American Manufacturing Research Conference, 1996-1998.
96. Member of SME Atlanta Chapter Executive Board, 1995-1996.
97. Pi Tau Sigma Student Chapter Advisor, Carnegie Mellon University, 1989 – 1994.
98. IEEE Control Systems Magazine, reviewer.
99. ASME Journal of Dynamic Systems, Measurement, and Control, reviewer.
100. ASME Journal of Engineering for Industry, reviewer.
101. ASME Journal of Mechanical Design, reviewer.
102. IEEE Transactions on Robotics and Automation, reviewer.
103. Research in Engineering Design, reviewer.
104. National Science Foundation, Division of Information, Robotics and Intelligent Systems, proposal reviewer.
105. National Science Foundation, Division of Design Manufacturing and Industrial Innovation, proposal reviewer.
106. National Science Foundation, Division of Information, Robotics and Intelligent Systems, proposal reviewer.
107. United Nations Development Programme. Special consultant to the United Nations and the country of Malaysia for the development of a state-of-the-art advanced production facility. 1995 – 1999.

B. Campus Contributions

1. Member, Committee for Reappointment, Promotion, and Tenure for the Woodruff School of Mechanical Engineering, 2013 – 2018.
2. Chair Instructional Laboratory Committee, Woodruff School of Mechanical Engineering, 2016 – 2017.
3. Chair Design and Fabrication Studio Ad Hoc Committee, Woodruff School of Mechanical Engineering, 2016 – 2017.
4. Chair, Tenure, Promotion and Reappointment Committee for Department of Automotive Engineering, 2010 – 2012.
5. Member, Tenure, Promotion and Reappointment Committee for College of Engineering and Science, 2010 – 2012.
6. Chair, Search Committee for Department of Automotive Engineering Chair, 2010 – 2011.
7. Chair, Search Committee for Timken Chair in Automotive Design, Department of Automotive Engineering Chair, 2010 – 2011.
8. Chair of Chaired and Titled Professors at Clemson University, 2009 – present.
9. Member Faculty Workload Assessment Committee for Clemson University, 2010 – 2011.
10. Chair, Awards Committee, Department of Mechanical Engineering, 2009 – 2010
11. Chair, Search Committee for Department of Mechanical Engineering Chair, 2009 – 2010.
12. Search Committee for ExxonMobil Chair, Department of Mechanical Engineering, Clemson University, 2007 – 2008.
13. Chair, Search Committee for Automotive Engineering faculty positions, Department of Mechanical Engineering, Clemson University, 2007 – 2008.
14. Chair, Review Committee for Warren H. Owen - Duke Energy Distinguished Professor of Mechanical Engineering, 2007 – 2008.
15. Chair, Search Committee for Automotive Engineering faculty positions, Department of Mechanical Engineering, Clemson University, 2006 – 2007.
16. Search Committee for Automotive Engineering faculty positions, Department of Mechanical Engineering, Clemson University, 2005 – 2006.
17. Search Committee for Chair of the School of Industrial Design, 2004 – 2005.
18. Institute Advisory Committee on Promotion of Research Faculty, 2004 – 2005.
19. Woodruff School of Mechanical Engineering, Seminar Committee, Chair, 2004 – 2005.

20. Faculty Awards Committee, Chair, Woodruff School of Mechanical Engineering, 2002 – 2004.
21. Faculty Awards Committee, Woodruff School of Mechanical Engineering, 2001 – 2004.
22. General Faculty Assembly, 2000 – 2003.
23. Instructional Lab Committee, 2000 – 2002.
24. Faculty Advisory Committee Member, Woodruff School of Mechanical Engineering, 2000 – 2002.
25. CAE, Design, Manufacturing and Materials, Academic Area Committee Chair, 1998 – 2005.
26. Undergraduate Committee Member, Woodruff School of Mechanical Engineering, 1994 – 1999.
27. Semester Conversion Committee Member, Woodruff School of Mechanical Engineering, 1997 – 1999.
28. Laboratory Committee for Semester Conversion Member, Woodruff School of Mechanical Engineering, 1997 – 1999.
29. College of Engineering Committee for Reappointment, Tenure and Promotion of Assistant Professors, 1996 – 1998.
30. George W. Woodruff Distinguished Lecture Committee, 1994 – 1997.
31. Undergraduate Committee Chair, Woodruff School of Mechanical Engineering, 1995 – 1998.
32. Faculty Advisory Committee Member, Woodruff School of Mechanical Engineering, 1995 – 1997.
33. Society of Manufacturing Engineers, Georgia Tech Chapter, Advisor, 1994 – 1996.

Service on CMU Committees

1. Faculty Member in Residence, Resnik Hall, Integration of academic and domicile life for the undergraduate community in the hall, 1990 – 1994.
2. American Society of Mechanical Engineering Carnegie Mellon Chapter, Advisor, 1991 – 1993.
3. Pi Tau Sigma, National Mechanical Engineering Honor Society, Carnegie Mellon Chapter, Advisor, 1991 – 1994.
4. Department Head Search Committee, Mechanical Engineering, 1991-1992.
5. Undergraduate Committee Department of Mechanical Engineering, addressing undergraduate curriculum issues, 1989 – 1991.
6. Student Advisory Committee Department of Mechanical Engineering, supplying a communication channel between undergraduates and faculty, 1989 – 1991.
7. Faculty Search Committee, Department of Mechanical Engineering for joint position with Robotics Institute 1990 – 1992.

8. Headed graduate admissions for Design, Manufacturing and Controls group in Mechanical Engineering 1990 – 1991.
9. Freshman Course Development, Department of Engineering and Public Policy 1990 – 1991.
10. Department of Mechanical Engineering, Graduate Seminar, 1990 – 1991.
11. Graduate Committee Engineering and Public Policy, 1992 – 1994.
12. Functional Assembly Manufacture Thrust leader at the Engineering Design Research center, 1992 – 1994.
13. University Task Force on Teaching, 1991 – 1994.
14. University Student Affairs Council, 1992 – 1994.
15. Design Minor Advisor, Mechanical Engineering and Engineering and Public Policy, 1992 – 1994.

C. Consulting

1. Metalsa, Long Range Strategic Planning Group (2010 – 2013).
2. BMW, Community Advisory Panel (2005 – 2012).
3. Expert witness for patent issues related to ultra-high precision systems and lithography devices. (2002 – 2008).
4. Expert witness for a variety of machine safety and personal injury cases involving a variety of production systems (1989 – 2004).
5. The Timken Company, consultant on high precision production and metrology system design (1989 – 1994).
6. The Government of Malaysia, provided information and guidance for the development of a manufacturing and design incubation facility.
7. The Torrington Company, consultant on high precision production and metrology system design (1994 – present).
8. Milliken Research Corporation, consultant on in process measurement for production systems (1997).
9. Applied Precision Technologies, Inc., consultant on high-speed spindle analysis and repair (1997-1999).
10. Applied Metrology, Inc., consultant on precision system design (1998 – present).
11. Paraform, Inc., consultant on precision metrology systems, also currently a member of their advisory board (1999 – 2001).
12. Sandia National Laboratories, consultant on quality control for fail safe system micro-components (2002 – 2003).

<u>Conference Sessions Chaired</u>

1. ASME, Chaired Robotics Session for Winter Annual Meeting, Dallas, TX, November, 1990.

2. ASME, Chaired Solid Modeling Session for Design Automation Conference, Phoenix, AZ, September, 1992.
3. ACC, Chaired Control Design Tools Session for the American Controls Conference, San Francisco, June, 1993
4. ASME, International Mechanical Engineering Congress and Exposition, Chaired Session on Precision Machine Control, November 1995.
5. ASME, International Mechanical Engineering Congress and Exposition, Chaired Session on Recent Advances in Machine Tools, November 1996.
6. ASME, International Mechanical Engineering Congress and Exposition, Chaired Session on Precision Machine Control, November 1996.
7. ASME, International Mechanical Engineering Congress and Exposition, Chaired Session on Sensing and Control, November 2002.
8. ASME, International Mechanical Engineering Congress and Exposition, Panelist for Current Aspects of Hard Turning, November 2002.
9. ASME, International Mechanical Engineering Congress and Exposition, Panelist for Future Directions in Machining, Sensing and Control, November 2002.
10. International Federation of Automatic Control 2nd IFAC Conference on Mechatronic Systems, Chaired Session on Education in Mechatronics, December 2002.

VIII. GRANTS AND CONTRACTS

A. As Principal and Co-Principal Investigator

Title	Organization Funding	Level of Funding	Date
Dynamic System Modeling Research (PI)	NSF/EDRC	$23,080	Aug. 91 - July 92
Geometric Dimensioning and Tolerancing Research (PI)	NSF/EDRC	$16,000	Dec. 89 - Apr. 90
Gaging Philosophy and Strategy for the Twenty-First Century (PI)	NSF / The Timken Company	$33,355	Apr. 90 - Dec. 91
Geometric Dimensioning and Tolerancing Research (PI)	NSF/EDRC	$37,587	May 90 - Apr. 91
Quality Assurance Research (PI)	NSF/EDRC / ALCOA	$43,585	May 91 - Apr. 92
Coordinate Measurement Machine Equipment Grant (PI)	Brown & Sharpe Metrology Grant Program	$22,770	July 91
Determination of Confidence Intervals for Cylindrical Components Inspected via Geometric Sampling (PI)	Research Initiation Award (Eng. Foundation)	$23,000	Aug. 91 - Oct. 92
Quality Assurance Research (PI)	Engineering Design Research Center (EDRC) and Alcoa	$25,000	May 92 - Apr. 93
Coordinate Measurement Machine Donation (PI)	Brown & Sharpe Corporation Metrology Grant Program	$34,000	July, 92 - June 93
Control Design Research (PI)	NSF/EDRC	$23,080	Aug. 91 - July 92
Research Experience for Undergraduates, in conjunction with the NYI Award (PI)	NSF	$10,000	Sept. 92 - Aug. 93

National Science Foundation Young Investigator (NYI) Award (PI)	NSF	$25,000 base $37,500 Matching	Sept. 92 - Aug. 93
Brown & Sharpe Metrology Grant (PI)	Brown & Sharpe Corporation	$1500	Oct. 92
Advanced Measurement Research (PI)	Alcoa	$25,000	Nov. 92 - May 94
Research Experience for Undergraduates, in conjunction with NSF project entitled, "Statistical Inference on Part Geometry (PI)	NSF	$10,000	Sept. 92 - Aug. 93
Statistical Inference on Part Geometry (PI)	NSF	$101,502	Sept. 92 - June 96
Doctoral Education in a Novel Approach to Design and Manufacturing (Co-PI) (J. Cagan, PI)	NSF	$111,000*	Sept. 92 - Aug. 94
Research Experience for Undergraduates, in conjunction with the PFF Award (PI)	NSF	$10,000	Sept. 93 - Aug 94
Research Experience for Undergraduates, in conjunction with the PFF Award (PI)	NSF	$10,000	Sept. 94 - Aug. 95
Research Experience for Undergraduates, in conjunction with the PFF Award (PI)	NSF	$10,000	Sept. 95 - Aug. 96
Presidential Faculty Fellow (PFF) (PI)	NSF	$400,000	Sept. 93 - Aug. 97
Research Experience for Undergraduates, in conjunction with NSF project entitled, "A Unified Classical/Modern Approach for Undergraduate Control Education (PI)	NSF	$10,000	Mar. 93 - Apr. 94
A Unified Classical/Modern Approach for Undergraduate Control Education (Co-PI) (M. Nagurka, PI)	NSF	$29,239	Nov. 92 - Nov. 93
Product Design for the Environment (Co-PI) (R. Luthy, PI)	IBM Environmental Research Program	$60,000*	Dec. 92 - Aug. 94
High Speed Non-Contact Metrology System for Statistical Quality Control of Woodruff Keys - Phase I (PI)	Standard Horse Nail Corporation	$8000	Mar. 94 - July 94
Steel Tube Thickness Measurement (PI)	Pittsburgh Tube Company	$10,000	Mar. 94 - May 95

Scanning Metrology Research (PI)	The Timken Company	$32,000	Sept. 94 - Aug. 95
Integrated Diagnostics (Co-PI) (W. Winer, PI)	ONR / MURI Program	$145,306*	Mar. 95 - Feb. 98
Laser Scanning System, Equipment Donation (PI)	Alcoa	$250,000	Jan. 95
Optimizing Dynamic Stiffness in Machine Design (PI)	Ford	$14,900	Jan. 96
Grinding Research (PI)	Torrington	$20,000	Jan. 96
A Unified Classical/Modern Approach for Undergraduate Controls Education with Integrated Laboratory (PI)	NSF	$94,995	Jun. 96 - Feb. 98
Dimensional Measurement Uncertainty and Inspection Planning (PI)	NSF	$272,254	Jun. 96 - May 99
A Rapid Tooling Test-bed for Injection Molding (Co-PI) (D. Rosen, PI)	NSF	$1,349,000	Sep. 97 - Aug. 00
Rapid Inspection for Rapid Tooling Systems (PI)	Procter & Gamble	$35,000	Sep. 97
Grinding Research (PI)	Torrington	$50,000	Nov. 97
High Speed Metrology (PI)	National Carbon Products	$1300	June 98
Enhanced Analysis for Ball Bearings (PI)	ExperTech/ Air Force	$40,000	Jan. 98 - Dec. 99
Research Experience for Undergraduates in conjunction with NSF project entitled, “Dimensional Measurement Uncertainty and Inspection Planning” (PI)	NSF	$10,000	Jan. 98
Prognostics for Roller Bearings (PI)	Honeywell / ONR	18,000	Mar. 98 - Dec. 98
Grinding Research (PI)	Torrington	$50,000	Nov. 98
Modeling and Control of Subsurface Damage During the Grinding of Intermetallic Compounds (PI)	NSF	$238,386	Sep. 98 - Aug. 01
Grinding Research (PI)	Torrington	$50,000	July 99
Course Enhancement (ME 2110)	GA Tech	$85,000	Nov. 99
Machining and Verification of N-5 Airfoils	GE Power Systems	$75,650	Mar. 00
Process Analysis for Hard Turning	GM Powertrain	$80,000	Aug. 00 - July 01
Grinding Research (PI)	Torrington	$50,000	July 00

Fundamental Development of Mathematical Techniques and Computational Metrology for Coordinate Metrology (PI)	NSF	$282,941	Aug. 00 - July 04
Research Experience for Undergraduates in conjunction with NSF project entitled, "Fundamental Development of Mathematical Techniques and Computational Metrology for Coordinate Metrology" (PI)	NSF	$30,000	Dec. 00 Dec. 01 Nov. 02
Enabling Technologies for Lean Manufacturing of Critical Hardened Steel Applications ($11M total)	NIST - ATP	$1.012M (GT Portion)	Nov. 00 - Oct. 04
Micro-Metrology (PI)	Siemens	$16,000	Sep. 01
Micro-Metrology (PI)	Sandia	$64,637	Sep. 01
Machining and Verification of N-5 Airfoils	GE Power Systems	$49,950	Jan. 02
Grinding Research (PI)	Torrington	$35,000	Jan. 02
Travel Support for Japan – USA Symposium on Flexible Automation	NSF	$59,400	June 02 - Dec. 02
In-Line Optical Measurement of MicroElectroMechanical Systems (MEMS) Devices During Production	NSF	$284,992	July 02 - June 05
Micro-Metrology (PI)	Sandia	$78,000	Jan. 03
Grinding Research	Timken	$35,000	Jan. 03
Research Experience for Teachers in conjunction with NSF project entitled, "n-Line Optical Measurement of MicroElectroMechanical Systems (MEMS) Devices During Production" (PI)	NSF	$20,000	June 03 June 04
Equipment Donation	National Instruments	$40,000	Nov. 03
SBIR Phase I: Microscale Interferometric Sensor for High Speed MEMS Metrology	NSF	$87,282	July 03
Radar Inspection of Turbine Blades	RadaTech	$40,000	May 03 - Dec. 04
Metrology Research	National Instruments	$32,050	Jan. 04
Micro-Metrology	Sandia	$20,994	Jan. 04
Metrology Research	Timken	$74,147	Feb. 04
Machining Research	Y-12	$300,025	Feb. 04 - Jan. 07

Metrology Study	American Machine Tool Association	$5000	Jan. 04
Travel Support for Japan – USA Symposium on Flexible Automation	NSF	$15,000	June 04 - Dec. 04
Metrology Research (Equipment)	National Instrument	$95,000	
Radar Inspection of Turbine Blades	RadaTech	$18,500	Aug. 04
US – Turkey collaborative research: Optical metrology of MEMS	NSF	$32,300	Aug. 04 - Feb. 06
Grinding Research	Timken	$10,000	Oct. 04
Metrology Research	Timken	$40,000	Nov. 04
Grinding Research	Timken	$25,000	Jan. 05
Educational Research (Equipment)	National Instruments	$25,000	Jan. 05
Educational Research	National Instruments	$13,333	Jan. 05
Using Graphical Processing Units for Enhancement of Metrology Systems	NSF	$300,292	Aug. 05 - July 08
Metrology Research	Timken	$34,000	Nov. 05
Controls Research / Equipment Grant	National Instruments	$19,026	June 07
Controls Research	National Instruments	$16,000	June 07
Zeiss Equipment Grant, Contoura CMM	Zeiss	$150,000	Dec. 07
Okuma Equipment Grant	Okuma	$1.1 M	June 08
Controls Research / Equipment Grant	National Instruments	$17,023	June 08
Michelin Energy Efficient Non-Pneumatic Tire and Wheel (Tweel™ Assembly)	NIST - ATP	$1.9 M (Clemson Portion)	Jan 08 - Dec. 10
Co-Simulation of Heavy Truck Tire Dynamics and Electronic Stability Control System	DoT / NTRCI / Michelin / National Instruments	$120,000	Mar. 08 – Feb. 09
Process Monitoring on Superalloys, Phase A	GE Energy	$92,303	June 09 - Dec 09
Integrating Light-Weight Automotive Materials	NCMS / DoE	$169,331	Sep. 09 – Sep. 10

In Process Non-Contact Measurement	BMW	$60,000	Sep. 09 – May 10
Efficiency Concepts in X5/X6 Body Shop	BMW	$67,453	Sep. 09 – May 10
Co-Simulation of Heavy Truck Tire Dynamics and Electronic Stability Control Systems (Phase B);	National Transportation Research Center	$119,400	Feb. 09 – Jul. 10
Process Monitoring of Superalloys, Phase B	GE Energy	$116,233	Jan 10 – July 10
Heavy Truck Rollover Characterization (HTRC) Phase C	National Transportation Research Center	$2,846	May 10
Detection of Internal Voids and Separations in Used Truck Tire Casings	Michelin	$135,000	Aug. 10 – July 11
Process Monitoring of Superalloys, Phase C	GE Energy	$133,686	Aug. 10 – Jan. 11
Investigation of the Accumulative Roll Bonding ARB of Thick Titanium Sheets	Army Research Labs	$103,017	Aug. 10 – Aug. 11
Heavy-duty Commercial Vehicle Stability (HCVS) Phase A	National Transportation Research Center	$255,077	Jan. 11 – Aug 11
Longer Combination Vehicles	National Transportation Research Center	$60,737	Jan. 11 – Aug 11
Process Monitoring of Superalloys, Phase D	GE Energy	$119,697	Mar. 11 – Sept. 11
Paint Shop Poka Yoke: Prevention of Future Defects	BMW	$88,195	Sep. 11 – May 12
Process Monitoring of Superalloys, Phase E	GE Energy	$125,690	Sept. 11 – Jan. 12
Process Monitoring of Stainless Steel Alloys, Phase A	GE Energy	$45,000	Sept. 11 – Jan. 12
Detection of Internal Voids and Separations in Used Truck Tire Casings – Phase 2, Option II	Michelin	$183,991	Aug. 10 – July 11
Process Monitoring of Superalloys, Phase F	GE Energy	$130,691	Mar. 12 – Sept. 12

Power Generation Blade Manufacturing Process Optimization	General Electric Power and Water	$172,858	Jun. 2013 - Dec. 2013
Cyber Physical Systems: Synergy: Converting Multi-Axis Machine Tools into Subtractive3D Printers by using Intelligent Discrete Geometry Data Structures designed for Parallel and Distributed Computing	NSF	$969,557	Sep. 2013 - Aug. 2016
Metrology Systems for Additive Manufacturing	National Additive Innovation Institute (America Makes)	$300,000	Oct. 2013 - Sep. 2015
Power Generation Blade Manufacturing Process Optimization, Phase 2	General Electric Power and Water	$286,445	Jan. 2014 - Dec. 2014
Virtual Defect Simulation	Edison Welding Institute	$150,000	Nov. 2013- Sep. 2015
MTConnect Strategic Roadmap	Natl Ctr for Defense Mfg. and Machining	$15,000	Jun 2014 - Mar 2015
Connecting Georgia Tech and Cambridge University in the Manufacturing Sector	British Consulate General	$4750	Sep 2014- Aug 2015
Automation Apps in Control	Siemens	$130,985	Sep 2014 - Aug 2015
Machine Monitoring	Moog	$131,768	Mar 2015- Mar 2016
EAGER/Collaborative Research/Cybermanufacturing: Just Make It: Integrating Cybermanufacturing into Design Studios to Enable Innovation	NSF	$100,001	Aug 2015- July 2016
Manufacturing Process Driven Design	SCRA	$90,000	Sep 2015- Sep 2016

Faculty Exchange Program	Tecnologico De Monterrey/ Nuevo Leon, Mexico	$135,000	Oct 2015-Oct 2016
Hybrid Manufacturing Systems	Oak Ridge National Laboratory	$450,000	Feb. 2016-Feb 2018
Full-Volume Metrology for Additive Manufacturing	Sandia National Laboratories	$60,387	May 2016
CPS: Synergy: CNC Process Plan Simulation, Automation and Optimization	NSF	$701,336	Aug. 2016-July 2019
PFI:BIC Next Generation Real-Time Distributed Manufacturing Service Systems Using Digital Process Planning and GPU-Accelerated Parallel Computing	NSF	$1M	Aug. 2016-July 2019
EDM Testing of Nickel Based Super Alloys	General Electric Power and Water	$8,000	Aug. 2016-Dec. 2016
Data Sensing and Total Preventative Maintenance	Delta Airlines Technical Operations	$100,000	Nov. 2016-Oct. 2017
Multi-Axis Machining for Aerospace Blade Repair (Kurfess Co-PI)	Delta Airlines Technical Operations	$185,000	Nov. 2016-Oct. 2018
Bottom-Up Plug-and-Play Hardware/Software Toolkit for Monitoring, Diagnostics and Self-Correction	DMDII Sub-Contract	$166,289	Jan. 2017-Dec. 2017

Reconfigurable Retrofit Kit for Legacy Machine Sensing in Secured Data Environments	DMDII Prime-Contract	$274,673	Feb. 2017-Jan. 2018
Data Sensing and Total Preventative Maintenance – Phase 2	Delta Airlines Technical Operations	$125,000	Nov. 2017-Dec. 2018
Improvements to Screw Rotor Machining Through the Industrial Internet of Things (IIoT)	Ingersoll Rand	$116,500	Jan. 2018 – Dec. 2018
Fog-based Data Analytics and Embedded Sensors for Predictive Maintenance and Process Control	Ford Motor Company	$200,000	Jan. 2018 – Dec. 2019
Future Factory Manufacturing Software Architecture and Supporting Applications – Phase 1	The Boeing Company	$200,000	Feb 2018 – Dec. 2018
Enhanced Preparation for Intelligent Cybermanufacturing Systems (EPICS)	U.S. Department of Energy	$2.5 M	Aug. 2018 – July 2023
CPS: Synergy: CNC Process Plan Simulation, Automation and Optimization (Supplement)	NSF	$140,000	Aug. 2018-July 2019
Systems Monitoring Platform for Manufacturing Operations	Georgia Pacific	$300,204	Aug 2018 – Feb 2020
Future Factory Manufacturing Software Architecture and Supporting Applications – Phase 2	The Boeing Company	$200,000	Jan. 2019 – Dec. 2019
Data Sensing and Total Preventative Maintenance – Phase 3	Delta Airlines Technical Operations	$155,000	Jan. 2019 – Dec. 2019
Fog-based Data Analytics and Embedded Sensors for Predictive Maintenance and Process Control Phase 2	Ford Motor Company	$200,000	Jan. 2020 – Dec. 2021
Data Sensing and Total Preventative Maintenance – Phase 3	Delta Airlines	$155,000	Jan. 2020 – Dec. 2020

	Technical Operations		
Systems Monitoring Platform for Manufacturing Operations	Georgia Pacific	$150,000	Feb 2020 – Jan 2021
Future Factory Manufacturing Software Architecture and Supporting Applications – Phase 3	The Boeing Company	$200,000	Jan. 2020 – Dec. 2020

* Amount allocated to Professor Kurfess' research.