Karthik Ramani

STATUS: U.S. Citizen

DATE OF BIRTH: 2 February 1964

ACADEMIC RANK: Donald W. Feddersen Professor of Mechanical Engineering

EDUCATION:

6/87-6/91	Stanford University, Stanford, CA Ph.D. in Mechanical Engineering, Design Division
3/85-8/86	The Ohio State University, Columbus, OH M.S. in Mechanical Engineering
9/80-1/85	Indian Institute of Technology, Madras, India Bachelor of Technology in Mechanical Engineering

PROFESSIONAL HONORS:

Ruth and Joel Spira Award for Outstanding Contributions to the Mechanical Engineering Curriculum, Purdue University, 2012. (Awarded second time)
All Conference Best Paper Award, ASME International Design Engineering Technical Conference (IDETC), Computers and Information in Eng./Systems Engineering, 2011.
Donald W. Feddersen Professor of Mechanical Engineering, 2010.
Fellow of the American Society of Mechanical Engineers, 2010.
Best Student Paper Award, Computer-Aided Design and Applications, 2010.
Three of the top ten most cited paper awards, Computer-Aided Design Journal, 2005-10.
Outstanding Commercialization Award for Purdue University Faculty, 2009-10.
Best Paper Award, ASME International Design Engineering Technical Conference (IDETC), Computers and Information in Eng./CAPPD, 2009.
Most Highly Cited paper in the Journal of Computer-Aided Design for 2007 (Won the award for the second time from Elsevier)
Thomas French Award, The Ohio State University, 2007.
Purdue University, College of Engineering's only Research Excellence Award for 2007 for his *achievements in discovery, learning, and entrepreneurship and for his innovative research in information and shape sciences*.[1]
Most Highly Cited paper in the Journal of Computer-Aided Design for 2004-06.

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[1] In 2007 Professor Ramani received the College of Engineering's *Faculty Award of Excellence for Research* (one given per year for 350 or so faculty). The criteria for the Research Award include "Innovation and Impact" and "National and/or International recognition of excellence and impact".

Purdue Acorn Award, 2006.
Innovation of the Year Award (second place), Techpoint, Indiana, 2006
Discovery in Mechanical Engineering Award 2005
University Faculty Scholar, Purdue University 2002
Society for Manufacturing Engineers, Outstanding Young Manufacturing Engineer, 1999
Ruth and Joel Spira Award for Outstanding Contributions to the Mechanical Engineering Curriculum, Purdue University 1997
Faculty Study in Second Discipline Award, Vice Presidents Office, Purdue University 1997
Ralph R. Teetor Educational Award, Society of Automotive Engineers 1996
National Science Foundation CAREER Award 1996
National Science Foundation Research Initiation Award 1993
Dupont Young Faculty Award 1992
SAMPE Student Award 1991
Best Academic Record Award for Junior and Senior Year, Indian Institute of Technology, Madras, India, 1984-85

EXPERIENCE:

1/08 – 6/08	Visiting Professor, Computer Science, Stanford University
1/08 – 6/08	Visiting Scientist, Intelligent Systems Group, PARC (Formerly Xerox PARC)
8/07 – 12/07	Fellow, Institute of Pure and Applied Mathematics, UCLA
8/07 – present	Advisory Board, National Science Foundation, Industrial Innovation and Partnerships
8/05 – present	Technical Advisor, Imaginestics. [Chief Scientist 05-08]
8/07 – present	Professor (by Courtesy), School of Electrical and Computer Engineering
8/04 – present	Chair, Manufacturing Area, School of Mechanical Engineering
8/01 – present	Professor School of Mechanical Engineering, Purdue University
8/01 – 8/08	Director, Center for Information Sciences in Engineering (PRECISE), Purdue University
8/00 – 12/00	Invited Guest Research Scientist, National Institute of Standards and Technology
7/97 – 8/01	Associate Professor, School of Mechanical Engineering, Purdue University
7/91 – 7/97	Assistant Professor, School of Mechanical Engineering, Purdue University
Summer 93	Summer Faculty Intern, Dow Plastics, Advanced Materials
6/87 – 6/91	Research Assistant, Design Division, Stanford University
Autumn 89	Teaching Assistant, Mechanical Engineering, Stanford University
Summer 89	Summer Intern, Delco Products, Advanced Composite Systems
9/86 – 6/87	Visiting Scholar, Center for Design Research, Stanford University
3/85 – 8/86	Research Assistant, Mechanical Engineering, The Ohio State University
Spring 85	Teaching Assistant, Mechanical Engineering, The Ohio State University

MEMBERSHIPS: American Society of Mechanical Engineers
Society for Manufacturing Engineers
Association of Computing Machinery
Institution of Electrical and Electronics Engineers

MAJOR EDITORIAL AND ADVISORY BOARDS

Editorial Board, ASME Journal of Mechanical Design (ASME-JMD), 2008 – Present.

Editorial Board, Computer-Aided Design (CAD), Elsevier. (2005 – Present)
Advisory Board to National Science Foundation, Industrial Innovation and Partnerships (IIP/SBIR) 2007-present. (Sub-committee to engineering advisory board)
National Science Foundation – Sub-committee on Industry University Partnerships 2007-08, sub-committee on Innovation Metrics in 2009-10.
Executive Committee, ASME Computers and Information in Engineering, 2011-12.

TEACHING CONTRIBUTIONS:
Computer-Aided Design and Prototyping (70 students each semester)
Product Design and Innovation (70+ students yearly, 50 off-campus)
Intellectual Property (Initiated and now taught by John McNett)

RESEARCH

Our research is at the crossroads of mechanical engineering and computer sciences driven by geometry and design inspired areas. In particular our core areas are related to machine learning, human-computer natural interaction, computational geometry and shape representation/modeling, and design. Design as an expression of shapes and making them are among our core applications. Our group projects and vision are focused on creating the geometry inspired algorithms for natural creation, reasoning, sensing and response to both virtual and physical artifacts. Our current application areas are inspired by the future we strive to create. We build upon our past successes such as in shape-based search, developing tools for early design, and significant experiences in the making (the old manufacturing reinvented) of things.

Our current areas of closely interrelated research are computationally inspired by and through design in (1) creative and natural design of shapes using hands and natural user interfaces aided by computational algorithms, (2) understanding design and creating natural, collaborative and visual digital exploratorium's for design, (3) understanding and designing of next generation interactive gestural interactions based games, (4) development of new responsive products, artistic, and construction kits, and (5) geometry inspired machine learning kernels to understand graphs and data spaces.

An underlying theme of our research in design is closely tied to helping students learn to design using play and fun with toy design as a test-bed as well as a platform for interdisciplinary design projects. We embed sustainable and design thinking into these learning experiences and developing creative and innovative design and computational engineers.

Our past research (1985 – 2000) was deep rooted in designing and developing processes and machines for manufacturing to create affordances for new designs. We used extensive simulation and modeling to reduce the risk in the process development and design. We reinvented our labs and research by inverting our focus in creating new affordances for the new emerging manufacturing processes such as 3D printing by focusing on the design and creation related barriers. Our gesture based design of shapes and natural interfaces driven design paradigms, as well as design learning frameworks that are embedded in the collaborative construction of design knowledge using cyber-inspired frameworks are exemplars for our new research.

PROFESSIONAL ACTIVITIES

- International Editorial Board, Journal of Mechanical Design, ASME. (2008 – Present)

- International Editorial Board, Journal of Computer-Aided Design, Elsevier. (2005 – Present)
- Program Committee, Association of Computing Machinery, Solid and Physical Modeling Symposium [ACM-SPM] (2006-present)
- International Editorial Board, Concurrent Engineering Research and Applications (2006 – Present)
- International Editorial Advisory: Computer-Aided Design and Applications (2010 – Present)
- International Editorial Advisory Board: Tools and Methods for Competitive Engineering (TMCE 2006 - 2009)
- International Editorial Advisory Board: Computer-Aided Design and Applications (2006-2009)
- Program Committee, IEEE, Shape Modeling International [IEEE_SMI] (2006-2009)
- Program Committee, Sketch-based Interfaces and Modeling [SBIM] (2006-2009)
- International Advisory Board: European Configuration Workshop (ECAI 2006)
- International Advisory Board; Conference on Product Lifecycle Management (PLM 06)
- Guest Editor, Computer Aided Design, Special Issue on Computer Support for Conceptual Design, 2008.
- Guest Editor, Journal of Advanced Engineering Informatics, Special Issue on Design Informatics, 2009. [with Professor Liu, Mc Mohan and Schaefer]
- Guest Editor, ASME Journal of Mechanical Design, Special Issue on Sustainable Design, 2009. [with Professor Skerlos and Slocum]
- American Society of Mechanical Engineers, Computers in Engineering and Design Engineering Technical Conferences, Organizing Committee, 2004 – 2006.
- Chair: American Society of Mechanical Engineers, Materials Division, Polymer Committee, 1997-2001
- Chair: Internet-Aided Design, Manufacturing and E-Commerce Technical Committee, 2004– 2006. In charge of organizing a minimum of 4 sessions each year.
- Advisor, NASA, Digital Space and Universal Modeling Repository, 2005- 2007.
- Advisor, National Institute of Health, High Performance Computation for 3D Medical Imaging and Diagnostics, 2006.
- Appointed to the National Science Foundation Committee of Visitors to oversee and advise the of Small Business Innovative Research program (SBIR), 2006 – 08
- Advisory Board to National Science Foundation – Industrial Innovation and Partnerships (IIP), Subcommittee to the Engineering Advisory Committee, 2007-10
- Advisory Board to National Science Foundation – Industrial Innovation and Partnerships (IIP), Subcommittee to examine Industry University Relationships, 2007-8.
- Conference Chair, U.S.A., Product Lifecycle Management, Seoul, Korea, July 2008.
- Organizing Committee, Association of Computing Machinery (ACM), Solid and Physical Modeling (ACM-SPM), 2006.
- Organizing Committee, Association of Computing Machinery, Solid and Physical Modeling (ACM-SPM), 2007.
- Organizing Committee, Association of Computing Machinery, Solid and Physical Modeling (ACM-SPM), 2008.
- Organizing Committee, IEEE, Solid Modeling International (IEEE-SMI), 2008.

- Mini-Symposium Organizer, Association of Computing Machinery (ACM),Bio-Geometry, University of Stony Brooke, 2007.

Technical Sessions Organizer and Chairing:

- Symposium Organizer, 15th Design for Manufacturing and Lifecycle Conference, Symposium on Sustainable Design, with ASME IDETC'2010.
- Symposium Organizer, CIE-16: Design Informatics: Advances of Intelligent Information Processing and Knowledge Management in Engineering Design, a special session with the 30th Computers and Information in Engineering Conference (CIE), with ASME IDETC'2010-2013. (continuing to co-organize with Ying Liu as lead)
- Symposium Organizer, 29th Computers and Information in Engineering (CIE-18), Design Informatics: Advances of Intelligent Information Processing and Knowledge Management in Engineering Design, with ASME IDETC'2009.
- ASME, Design Engineering Technical Conference, Computers and Information in Engineering, Philadelphia, PA, 2006. (session chair 2 sessions)
- ASME, Design Engineering Technical Conference, Computers and Information in Engineering, Philadelphia, PA, 2006. (organizing 4 sessions)
- ASME, Design Engineering Technical Conference, Computers and Information in Engineering, Long Beach, CA, 2005. (organized 4 sessions)
- ASME, Design Engineering Technical Conference, Computers and Information in Engineering, Salt Lake City, Utah, 2004. (organized 4 sessions)
- ASME, Design Engineering Technical Conference, Computers and Information in Engineering, Chicago, IL, 2003.
- ASME, Materials Division, Polymeric Systems, Nashville, TN, ASME Materials Division, November, 1999.
- ASME, Materials Division, Composites and Functionally Graded Materials, International Mechanical Engineering Congress and Exposition, Dallas, Texas, ASME Materials Division, November, 1997.
- ASME, Materials Division, Processing, Design and Performance of Composite Materials, Proceedings of the 1994 International Mechanical Engineering Conference and Exposition, Chicago, Illinois, ASME Materials Division, November, 1994.
- Symposium Co-Chair, Symposium on Intelligent Processing of Materials, ASME International Mechanical Engineering Conference and Exposition, Chicago, Illinois, November 1995.
- Symposium Chair, Symposium on Product Realization Through Processing, ASME International Mechanical Engineering Conference and Exposition, Atlanta, Georgia, November 1996.

- Symposium Co-Organizer, "Processing, Design and Performance of Composite Materials," ASME International Mechanical Engineering Congress and Exposition, Chicago, Illinois, November 1994.
- Lead Symposium Organizer, "Dissimilar Material Systems: Manufacturing Processes, Design and Mechanics," ASME International Mechanical Engineering Congress and Exposition, Dallas, November, 1997.
- Symposium Co-organizer, "Polymeric Systems", ASME International Mechanical Engineering Congress and Exposition, Nashville, Tennessee, November 1999.

Reviewer:

National Science Foundation over 25 panels including Design and Manufacturing Division, Information Technology Research panels, Career Award Panel, and CISE Medium ITR Panel, CISE Information and Intelligent Systems Panels, Partnership for Innovation Panels (PFI), design and innovation panels.

Computer-Aided Design
ASME Journal of Mechanical Design
ASME Journal of Computers and Information Sciences in Engineering
ACM Transactions of Graphics
IEEE Transactions on Automation Science and Engineering
Pattern Recognition
Sketch-Based Modeling
Computer Aided Design and Application
Product Lifecycle Management
Artificial Intelligence in Engineering Design and Manufacture (AIEDAM)
Polymer Composites, Polymer Engineering and Science, Composites Part A: Applied Science and Manufacturing, Journal of Composite Materials
ASME Journal of Engineering for Industry, ASME Journal of Applied Mechanics
IEEE Transactions on Industrial Applications, Polymer and Polymer Composites
Journal of Electrostatic Technology

ENTREPRENEURIAL ACTIVITIES

Chief Scientific Officer (2005-08) and Technical Advisor (2008 – Present) Imaginestics LLC: Imaginestics is a pioneer and leader in visual shape search technology for the manufacturing supply chain to connect buyers and suppliers. Imaginestics developed a new business model centralizing on shape search technologies originating from Purdue University at Professor Ramani's group. Imaginestics is located in Purdue Research Park in Indiana. Imaginestics has also developed manufacturing communities around the search technology. Imaginestics shape search commercial platform and engine have won Indiana Entrepreneurial Award for Innovation in 2007, National Business Incubation Association's 2007 Outstanding Incubator Graduate Award in the technology category, and the Tibbets Award in 2007 named after the founder of the Small Business Innovative Research (SBIR) program at NSF. Imaginestics was the *2004 Indiana Growth 100 Awardee*. He also guided *Imaginestics SBIR Phase I and Phase II* awards from the

National Science Foundation. The shape search technology was licensed from Purdue University and the worlds first commercial shape search engine was launched in August 2006. Purdue University has a direct profit interest in the company which are convertible to shares prior to Imaginestics receiving outside investment. He also headed the team for another win for an ARMY SBIR for Phase I ($100 k) based on the licensed technology. Imaginestics has funded over $380 K of research at his labs through SBIR subcontracts, National Center for Manufacturing Sciences (NCMS) and the 21st Century matches. Imaginestics employs computer science and engineering graduates. Imaginestics now has over 30 employees in both West Lafayette and also the new office in Chicago. It has since focused its business model on the search technology for the manufacturing supply chain (www.vizseek.com).

Chief Scientific Officer (2012 – Present): ZeroUI
ZeroUI is in a semi-stealth mode. ZeroUI (http://www.zeroui.com), is a developer of gesture applications, platforms and interfaces for 3D camera enabled devices such as Microsoft Kinect, and unveiled world's first gesture based hands free 3D modeling technology at the Techcrunch Disrupt Conference in San Francisco on September 10, 2012.

At the core of ZeroUI's technology is GENIUS, gesture enabled natural user interface (NUI) driven 3D shape creation framework. It is the convergence of state-of-the art scientific advancements in machine learning, computer vision, computational geometry and human computer interaction. It is based on National Science funded research innovation from Purdue University C-Design Labs in the School of Mechanical Engineering. ZeroUI's technology is based on award winning and patent pending National Science Foundation funded ICorps research at Purdue University. It enables people to create three-dimensional objects with their bare hands by using a depth-sensing camera and advanced software algorithms to interpret hand movements and gestures.

MEDIA RECOGNITIONS

Research in Shape Search: Profiled in Business Week. CNN, USA Today, DesignNews, Sify, Computer.org, MSNBC, YahooFinance, ReDiff, The Hindistan Times, The Hindu, INDOlink.com, CNet.com., ScienceDaily Magazine, Innovations report, NewsWise, and IEEE Computer Society (March– July 2004). Over 14,000 unique visitors that have accessed our website in 2004-2006 alone from around the world. A Special News Release by the National Science Foundation covered the "Doodle Search." Also Covered by Discovery Channel, 2006.
FEAsy: Analysis of Design From Raw Sketches: National Science Foundation News from the Field, ScienceDaily 2009.

Research in Hands-free Shape Creation:
CNET, IEEE Spectrum, Design News, Live Science (NSF), Design News, Yahoo News, Selected for TechCrunch 2012, and several others. Over 13,500 visitors for the U-Tube video in only 4 weeks since the Purdue News release was made.

OTHER

Bechtel International Center, Host Couple, Stanford University, wide programming responsibilities, 1989-91.
Badminton, Ping Pong, Tennis, Sketching (caricature and products)

REFEREED ARCHIVAL JOURNAL PUBLICATIONS

1. Ramani, K., Miller, A.K., and Cutkosky, M.R., "A New Approach to the Forming of Thermoplastic-Matrix Continuous-Fiber Composites-Part 1: Process and Machine," *Journal of Thermoplastic Composite Materials,* Vol. 5, No. 3, pp. 184-201, 1992.
2. Ramani, K., Miller, A.K., and Cutkosky, M.R., "A New Approach to the Forming of Thermoplastic-Matrix Continuous-Fiber Composites-Part 2: Experiments and Model," *Journal of Thermoplastic Composite Materials*, Vol. 5, No. 3, pp. 202-227, 1992.
3. Ramani, K., Miller, A.K., and Cutkosky, M.R., "Die-less Forming of Thermoplastic Matrix Continuous Fiber Composite Materials-Process and Demonstration," *Journal of Engineering for Industry, Transactions of the ASME,* Vol. 117, No. 4, pp. 501-507, 1995.
4. Ramani, K., Bank, D.H., and Kraemer, N., "Effect of Screw Design on Fiber Damage in Extrusion Compounding and Composite Properties," *Polymer Composites*, Vol. 16, No. 3, pp. 258-266, 1995.
5. Ramani, K., Woolard, D.E., and Duvall, M.S., "An Electrostatic Powder Spray Process for Manufacturing Thermoplastic Composite Materials," *Polymer Composites*, Vol. 16. No. 6, pp. 459-469, 1995.
6. Ramani, K., and Hoyle, C.H., "Processing of Thermoplastic Composites Using a Powder Slurry Technique. I. Impregnation and Preheating," *Materials and Manufacturing Processes*, Vol. 10, No. 6, pp. 1169-1182, 1995.
7. Ramani, K., and Hoyle, C.H., "Processing of Thermoplastic Composites Using a Powder Slurry Technique. II. Coating and Consolidation," *Materials and Manufacturing Processes*, Vol. 10, No. 6, pp. 1183-1200, 1995.
8. Ramani, K., Borgoankar, H., and Hoyle, C.H., "Experiments on Compression Moulding and Pultrusion of Thermoplastic Powder Impregnated Towpregs," *Composites Manufacturing*, Vol. 6, No. 1, pp. 35-43, 1995.
9. Ramani, K., and Vaidyanathan, A., "Finite Element Analysis of Effective Thermal Conductivity of Filled Polymeric Composites," *Journal of Composite Materials*, Vol. 29, No. 13, pp. 1725-1740, 1995.
10. Ramani, K., and Henderson, D., "Using Advanced CAD Software in Teaching Design," *International Journal of Engineering Education*, Vol. 11, No. 2, pp. 98-102, 1995.
11. Woolard, D.E., and Ramani, K., "Electric Field Modeling of Electrostatic Powder Coating of a Continuous Fiber Bundle, " *Journal of Electrostatics,* Vol. 35, No. 4, pp. 373- 387, 1995.
12. Ramani, K., Tagle, J., Devanathan, D., Nazre, A. , Swarts, D., and Lin, S., "Thin-Film Thermoplastic-Metal Joining Process for Titanium to Poly(Etherketoneetherketoneketone)," *Polymer Engineering and Science*, Vol. 35, No. 24, pp. 1972-1978, 1995.

13. Parasnis, N.C., Ramani, K., Borgaonkar, H.M., "Ribbonizing of Electrostatic Powder Spray Impregnated Thermoplastic Tows by Pultrusion," *Composites , Part A - Applied Science and Manufacturing*, Vol. 27, No. 7, pp. 567-574, 1996.

14. Duvall, M.S., Ramani, K., Bays, M., and Caillat, F., "In-situ Composite Manufacture Using an Electrostatic Powder Spray Process and Filament Winding, "*Polymer and Polymer Composites*, Vol. 4, No. 5, pp. 325-334, 1996.

15. Ramani, K., and Tagle, J., "Process Induced Effects in Thin-Film Bonding of PEKEKK in Metal-Polymer Joints, "*Polymer Composites,* Vol. 17, No. 6, pp. 879-886, 1996.

16. Ingram, C., and Ramani, K., "The Effect of Sodium Hydroxide Anodization on the Durability of Poly(Etherketoneetherketoneketone) Adhesive Bonding of Titanium," *International Journal of Adhesion and Adhesives* , Vol. 17, No. 1, pp. 39-45, 1997.

17. Chen, L., Kuang, K., and *Ramani, K., "A Linguistic Based Preliminary Procedure for Qualitative Polymer Process Design," *Materials and Design*, Vol. 17, No. 4, pp. 181-191, 1996.

18. Chen, L., Ku, K., Ramani, K., and Rao, S.S., "A Systematic Approach to Preliminary Polymer Process Development: Modeling and Design," Materials & Design, Vol. 17, No. 5-6, pp. 235-244, 1996.

19. Ramani, K., and Wenping, Z., "The Evolution of Residual Stresses in Thermoplastic Bonding to Metals," International Journal of Adhesion and Adhesives, Vol. 17, pp. 353-357, 1997.

20. Parasnis, N., and Ramani, K., "Analysis of the Effect of Pressure in Compression Molding of Ultra-High-Molecular-Weight-Polyethylene," Journal of Materials Science: Materials in Medicine, Vol. 9, pp. 165-172, 1998.

21. Ramani, K., and Miller, K., "Analysis of an Inductively Heated Compression Molding Process," Advances in Polymer Technology, Vol. 17, No 3, pp. 251-257, 1998.

22. Ramani, K., and Moriarty, B., "Thermoplastic Bonding to Metals Via Injection Molding for Macro-Composite Manufacture," Polymer Engineering and Science, Vol. 38, No. 5, pp. 870-877, 1998.

23. Borgaonkar, H., and Ramani, K., "Stability Analysis in Single Screw Extrusion of Thermoplastic Elastomers Using Simple Design of Experiments," Advances in Polymer Technology, Vol. 17, No. 2, pp. 115-126, 1998.

24. Ramani, K., Weidner, W., and Kumar, G., "Silicon Sputtering as a Surface Treatment to Titanium Alloy for Bonding With PEKEKK," International Journal of Adhesion and Adhesives, Vol. 18, pp. 401-412, 1998.

25. Miller, K., and Ramani, K., "Process Induced Residual Stresses in Compression Molded UHMWPE," Polymer Engineering and Science, Vol. 39, No. 1, pp. 110-118, 1999.

26. Parasnis, N., and Ramani, K., "Non-isothermal Crystallization of UHMWPE," Journal of Thermal Analysis and Calorimetry, Vol. 55, pp. 709-719, 1999.

27. Parasnis, N., and Ramani, K., "Numerical Simulation of Compression Molding of UHMWPE," Part I. Thermal Model, International Journal of Polymer Processing, Vol. XV, No. 2, pp. 180-193, 2000.

28. Parasnis, N., and Ramani, K., “Numerical Simulation of Compression Molding of UHMWPE,” Part II. Residual Stress Model, International Journal of Polymer Processing, Vol. XV, No. 2, pp. 194-201, 2000.
29. Wenping, Z., Ramani, K., and Mueller, B. E., “Processing and Fracture Behavior of a Polyethylene-based Thermoplastic Adhesive and a Glass-fiber Filled Epoxy Adhesive,” International Journal of Adhesion and Adhesives, Vol. 20, pp. 409-413, 2000.
30. Ramani, K., Verhoff, J., Kumar, G., Blank, N., and Rosenberg, S., “Environmental Durability of Moisture-cured Urethane Adhesive Joints,” International Journal of Adhesion and Adhesives, Vol. 20, pp. 377-385, 2000.
31. Kumar, G., and Ramani, K., “Characterization of Wood-Polypropylene Composite Sandwich System,” Journal of Composite Materials, Vol. 34, No. 18, pp. 1582-1599, 2000.
32. Nerone, J, Iyer, N., and Ramani, K., “Exploration of the Use of Advanced Aluminum Alloys for Improved Productivity in Plastic Injection Molding," The Journal of Injection Molding Technology, September 2000, Vol. 4, No. 3, Pages 137-151, 2000.
33. Chen, L. and K. Ramani, "A Subjective Design Framework for Conceptual Design of Polymeric Processes with Multiple Parameters," Research in Engineering Design, Vol. 12, pp. 220-234, 2000.
34. Wenping Zhao, Stephan Barsun , Karthik Ramani , Todd Johnson , Richard King , Steve Lin, "Development of PMMA-Precoating Metal Prostheses via Injection Molding: Residual Stresses," Journal of Biomedical Materials Research, Vol. 58, Issue 4, pp. 456-462, 2001.
35. Xu, C., Ramani, K., and Kumar, G., “Thermoplastic Adhesive Bonding of Galvanized Steel to Polypropylene Composite and Its Durability,’ International Journal of Adhesion and Adhesives, pp. 197-204, Vol. 22, Issue 3, 2002.
36. Smith, M., Dai, H., and Ramani, K., “Wood-Thermoplastic Adhesive Interface – Method of Characterization and Results,’ International Journal of Adhesion and Adhesives, pp. 187-195, Vol. 22, Issue 3, 2002.
37. Verhoff, J. and Ramani, K., “Moisture Durability of Four Moisture Cure Urethane Adhesives,” Journal of Adhesion Science and Technology, pp. 373-394, Vol. 16, No. 4, 2002.
38. Kumar, G. and Ramani, K., “Development and Characterization of an all-Olefin Thermoplastic Composite Sandwich System,” Polymer Composites, Vol. 23, No. 5, 2002.
39. Iyer, N., and Ramani, K., “A Study of Localized Shrinkage in Injection Molding with High Thermal Conductivity Molds,” Journal of Injection Molding Technology, Vol. 6, No. 2, 2002.
40. Ramani, K., and Dai, H., “Design and process for preformed woven, knitted and braided thermoplastic composite reinforced arrestor,” Journal of Composite Materials, Vol. 35, pp. 1-16, 2002.
41. Xu, C., Siegmund, T., and Ramani, K., “Rate-Dependent Crack Growth in Adhesives I. Modeling Approach,” International Journal of Adhesion and Adhesives, Vol. 23, pp. 9-13, 2003.

42. Xu, C., Siegmund, T., and Ramani, K., “Rate-Dependent Crack Growth in Adhesives II. Experiments and Analysis,” International Journal of Adhesion and Adhesives, Vol. 23, pp. 15-22, 2003.
43. Agrawal, A., Ramani, K., Babu, M., and Hoffmann, C., "CADDAC: Multi-Client Collaborative Shape Design System with Server-Based Geometry Kernel", Journal of Computing and Information Science in Engineering, Vol. 3, Issue 2, pp. 109-175, June 2003.
44. Heming Dai and Ramani, K., “Design and Processing of a Thermoplastic Composite Reinforced Wood Structure,” Polymer Composites, Vol. 2, pp. 119-133, April 2004.
45. James Brink, Alex Lee, David Anderson, Karthik Ramani, “CAD Model Decomposition for WirePATH”, Rapid Prototyping Journal, 1 May 2004, vol. 10, no. 5, pp. 288-296(9)
46. Iyer, N., Lou, K., Jayanti, S., Kalyanaraman, Y., and Ramani, K., “Three Dimensional Shape Searching: State-of-the-art Review and Future Trends”, Computer Aided Design, Vol 37/5 pp 509-530, 2005.
47. Iyer, N., Lou, K., Jayanti, S., Kalyanaraman, Y., and Ramani, K., “Shape Based Searching for Product Lifecycle Applications”, Computer-Aided Design, Vol 37 (2005) 1435–1446.
48. Lou, K., Iyer, N., Jayanti, S., Kalyanaraman, Y., Sunil, P., and Ramani, K., "Supporting Effective and Efficient Three-Dimensional Shape Retrieval", Vol. 16, No. 2, pp. 175-194, April 2005, Journal of Engineering Design.
49. Jiantao, P. and Ramani, K.,"A 3D Model Retrieval Method Using 2D Freehand Sketches," Lecture Notes in Computer Science, vol. 3515: 343-347, 2005.
50. C.W Chung, J.K. Choi, K. Ramani and H. Patwardhan (2005) “Product Node Architecture: A Systematic Approach to Provide Structured Flexibility in Distributed Product Development” Concurrent Engineering Research & Application, 13 (3):219-232
51. J.-K. Choi, J.A. Stuart, K. Ramani (2005) “Modeling of Automotive Recycling Planning in the United States” International Journal of Automotive Technology, 6 (4): 413-419
52. Hou S., Lou K., and Ramani K., “SVM-based Semantic Clustering and Retrieval of A 3D Model Database", Journal of Computer Aided Design and Application, CAD 2005, Volume 2, pp.155-164.
53. Jiantao P., and Ramani K., “A 2D Sketch Based User Interface for 3D CAD Model Retrieval", Journal of Computer Aided Design and Application, CAD 2005, June 20-24, 2005, Volume 2, pp.717-727.
54. Jiantao P., and Ramani K., “On Visual Similarity Based 2D Drawing Retrieval,” Journal of Computer Aided Design, 38(3): 249-259, 2006.
55. Ramani, K., and Jiantao, P., “Review of a Paradigm for Freehand Sketch driven Search and Design,” "Kikai no Kenkyu ". (Kikai no Kenkyu is the title of the journal in Japanese. Literally translated, it is Researches in Mechanical Engineering) Volume 59 No.1, January 2006. (Invited Paper in Japanese)
56. Jayanti,S., Kalyanaraman, Y. , Iyer, N. , and Ramani, K., “ Developing An Engineering Shape Benchmark for CAD Models,” Computer-Aided Design, Volume 38, Issue 9, Shape Similarity Detection and Search for CAD/CAE Applications, September 2006, Pages 939-953.

57. Yu-Shen Liu, Jean-Claude Paul, Jun-Hai Yong, Pi-Qiang Yu, Hui Zhang, Jia-Guang Sun and Karthik Ramani, "Automatic least-squares projection of points onto point clouds with applications in reverse engineering," Computer-Aided Design, Volume 38, Issue 12, December 2006, Pages 1251-1263.

58. Li, Z., and Ramani, K., "Ontology-based Design Information Extraction and Retrieval," Journal of Artificial Intelligence for Engineering Design, Analysis and Manufacturing (AIEDAM), Special issue: Computational Linguistics for Design, Maintenance and Manufacturing, Vol. 20, No. 2, 2007

59. Suyu Hou, Karthik Ramani: Classifier combination for sketch-based 3D part retrieval. Computers & Graphics 31(4): 598-609 (2007)

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75. Jiantao, P., and Ramani, K., (2005), "A 3D Model Retrieval Method Using 2D Freehand Sketches," accepted for Fourth International Workshop on Computer Graphics and Geometric Modeling (CGGM'2005), Emory University, Atlanta, USA, May 22-25, 2005.

76. J.K. Choi, and K. Ramani, "Decision Support Tools for Sustainable Product Development" International Society for Industrial Ecology (ISIE) Conference Abstract & Poster Session Ann Arbor, MI July 1, 2003, pp162-163.

77. J.K. Choi, J.A.Stuart, and K. Ramani, "Decision Support Tools for Environmental Product and Process Management: Survey and Needs" International Society for Environmental Information Sciences (ISEIS) Conference, Regina, Canada, August 25-27, 2003, pp24-37.

78. J.K. Choi, and K. Ramani, "A Gap analysis of Decision Support Tools for Sustainable Product Development," S&E Information Technology and Environmental Conference, INSA de Rouen, France, June 19-20, 2003, pp56-58.

79. J. K. Choi, L. F. Nies, and K. Ramani "Mapping Environmental Impacts along Extended Supply Chain" Environmental Sciences & Engineering Institute (ESEI) Symposium, Lafayette, IN April 11, 2003.

80. J.K. Choi, L. F. Nies, and K. Ramani "Environmental Supply Chain Management" Environmental Review Research Exhibit at Purdue, West Lafayette, IN the May 8, 2003.

81. Hou, S., and Ramani, K., "A Probability-based Unified 3D Shape Search", European Commission International Conference on Semantic and Digital Media Technologies, Lecture Notes in Computer Science, Springer, Vol 4306, 124-137 (2006)

82. Hou, S., and Ramani, K., "Sketch-based 3D Engineering Part Class Browsing and Retrieval", EuroGraphics Symposium Proceedings on Sketch-Based Interfaces & Modeling, (2006), 131-138.

83. Min Liu, Karthik Ramani: Computing an exact spherical visibility map for meshed polyhedra. Symposium on Solid and Physical Modeling 2007: 367-372

84. Min Liu, Yushen Liu, Karthik Ramani: Anisotropic filtering on normal field and curvature tensor field using optimal estimation theory. Shape Modeling International 2007: 169-178

85. Yu-Shen Liu, Min Liu, Daisuke Kihara, Karthik Ramani: Salient critical points for meshes. Symposium on Solid and Physical Modeling 2007: 277-282

86. Amit Jain, Ramanathan Muthuganapathy, Karthik Ramani: Content-Based Image Retrieval Using Shape and Depth from an Engineering Database. ISVC (2) 2007: 255-264.

87. J. Pu and K. Ramani, Implicit geometric constraint detection in freehand sketches using relative shape histogram, eurographics workshop on sketch-based interface modeling (2007), Association of Computing Machinery (ACM), pp.107-113.

88. Ruth Nussinov, Tao Ju, Talapady Bhat, Jack Snoeyink, Karthik Ramani: Bio-geometry: challenges, approaches, and future opportunities in proteomics and drug discovery. Symposium on Solid and Physical Modeling 2008: 417-418.

89. Ramanathan Muthuganapathy, Karthik Ramani: SHape REtrieval Contest 2008: CAD models. Shape Modeling International 2008: 221-222.

90. Duhwan Min, Junmyon Cho, and Karthik Ramani, A method for measuring part similarity using ontology and a multi-criteria decision making method, IDETC/CIE 2009. 31 Aug - 2 Sept. 2009, San Diego, CA, USA. (Paper# DETC2009-87711)

91. Walthall, C., C. Sauter, T. Deigendesch, S. Devanathan, A. Albers, K. Ramani. Survey of Wikis as a Design Support Tool. ICED'09, 24-27 Aug. 2009, Stanford, CA, USA

92. S. Devanathan, C. Sauter, A. Albers, and K. Ramani. A working knowledge model for supporting early design through visual tools, in International conference on engineering design, ICED'09, Stanford, CA, 2009.

93. Walthall, C., S. Devanathan, L. Kisselburgh, K. Ramani, E. Hirleman. A Framework for evaluating wikis as a medium for communication within engineering design teams,. IDETC/CIE 2009. 31 Aug - 2 Sept. 2009, San Diego, CA, USA

94. Sundar Murugappan and Karthik Ramani, "FEAsy: A Sketch-based Interface Integrating Structural Analysis in Early Design", Proceedings of the ASME 2009 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (IDETC/CIE 2009), SanDiego, CA. [Best Paper Award from CIE Technical Committee]

95. Sundar Murugappan, S. Sellamani, and K. Ramani, "Towards beautification of Freehand Sketches using Suggestions", Sketch Based Interfaces and Modeling, Proceedings of the 6th Eurographics Symposium on Sketch-Based Interfaces and Modeling, Pages 69-76, 2009.

96. Srikanth Devanathan and Karthik Ramani, "Creating Polytope Representation of Design Spaces for Visual Exploration Using Consistency Technique," IDETC/CIE 2009. 31 Aug - 2 Sept. 2009, San Diego, CA, USA

97. Dongxing Cao, Karthik Ramani, Ming Wang Fu, and Runli Zhang, "Port-based Ontology Semantic Similarities for Module Concept Creation," IDETC/CIE 2009. 31 Aug - 2 Sept. 2009, San Diego, CA, USA.

98. S. Devanathan, F. Zhao, and K. Ramani, "Integration of Sustainability into Early Design through Working Knowledge Model and Visual Tools," 2009 International Manufacturing Science and Engineering Conference MSEC, West Lafayette, IN, 2009.

99. Dongxing, C., Ramani, K., and Li, Z., "Guiding Concept Generation Based on Ontology for Customer Preference Modeling," Proceedings of the TMCE 2010, April 12–16, 2010, Ancona, Italy, Edited by I. Horváth, F. Mandorli and Z.

100. Dongxing, C., Ramani, K., Liu, Y., and Zhanwei, L., "Developing Customer Preferences for Concept Generation by Using Engineering Ontologies," IDETC 2010, Aug.15-18, Montreal, Canada.

101. Dongxing, C., Ramani, K., Fu, M.W., and Zhang, R., "A port-based agent approach to guiding concept generation for customizing modular varieties," IDETC 2010, Aug.15-18, Montreal, Canada. (Accepted for publication)

102. Elizondo, L., Kisselburgh, L., Hirleman, D., Cipra, R. J., Yang, M., Carleton, T., Ramani, K., "Understanding Innovation in Student Design Projects," IDETC 2010, Aug.15-18, Montreal, Canada. (Accepted for publication)

103. Bernstein, W.Z., Ramanujan, D., Devanathan, S., Zhao, F., Ramani, K., Sutherland, J.W., Development of a Framework for Sustainable Concept Design, 17th CIRP International Conference on Life Cycle Engineering, Hefei, China, May 19-21, 2010. (Accepted for publication)

104. Bernstein, W.Z., Ramanujan, D., Devanathan, Zhao, F., Ramani, K., Sutherland, J.W., Sustainable Conceptual Design through Function-Impact Matrix: A designer's Perspective, ASME IDETC/CIE, August 15-18, Montreal, Canada. (Accepted for publication)

105. Devarajan Ramanujan , William Z. Bernstein , Fu Zhao , and Karthik Ramani, Addressing Uncertainties Within Product Redesign for Sustainability: A Function Based Framework, Proceedings of the ASME 2011 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference IDETC/CIE 2011 August 28-31, 2011, Washington, DC, USA

106. Cecil Piya , J. Michael Wilson , Sundar Murugappan , Yung Shin , and Karthik Ramani, Virtual Repair: Geometric Reconstruction for Remanufacturing Gas Turbine Blades, Proceedings of the ASME 2011 International Design Engineering Technical Conferences & Design for Manufacturing and the Life Cycle Conference IDETC/DFMLC 2011 August 29 - 31, 2011, Washington, DC, USA

107. Srikanth Devanathan , and Karthik Ramani Towards Enabling Visual Design Exploration Involving Multiple Abstractions of Design DescriptionsProceedings of the ASME 2011 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference IDETC/CIE 2011 August 28-31, 2011, Washington, DC, USA (Best Paper Award)

108. Sundar Murugappan , Vinayak , Karthik Ramani , and Maria. C. Yang, APIX: Analysis from Pixellated Inputs in Early Design Using a Pen-based Interface, Proceedings of the ASME 2011 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference IDETC/CIE 2011, Washington, DC, USA

109. Yi Fang , Mengtian Sun , and Karthik Ramani, Temperature Distribution Descriptor for Robust 3D Shape Retrieval, 4th Workshop on Non-Rigid Shape Analysis and Deformable Image Alignment (NORDIA'11). 2011 IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops (CVPR)

Books and Conference Proceedings Edited

Srivatsan, T. S., Ramani, K., and Ramulu, M. (editors), Processing, Design and Performance of Composite Materials, Proceedings of the 1994 International Mechanical Engineering Conference and Exposition, Chicago, Illinois, ASME MD-Vol. 52, November, 1994.

W. Jones, K. Ramani, S. Sitaraman, S. Yang, T.S. Srivatsan, A. Zavaliangos, K. I. Jacob, N. Katsube (editors) Composites and Functionally Graded Materials, International Mechanical Engineering Congress and Exposition, Dallas, Texas, ASME MD-Vol. 80, November, 1997.

Saigal, A. and Ramani, K., (editors) Polymeric Systems, Nashville, TN, ASME-MD-Vol. 88, November, 1999.

S, Han, R. Karthik, C. McMahon (eds.), Proceedings of PLM 2008 5th International Conference on Product Lifecycle Management, Inderscience Enterprises Ltd., July 2008.

Bouras, A., Gurumoorthy, B., McMahon, C., and Ramani, K., "Product Lifecycle Management: Fostering a Culture of Innovation," Inderscience Enterprises Limited, Special Publication 4, 2008. (ISBN 0-90776-18-3)

Choi, J.K. and Ramani, K., "A Quest for Sustainable Product Design," VDM Verlag, April 2009. [Paperback $89 available through amazon.com]

Other Conference Publications

1. Ramani, K., Cutkosky, M. R., Miller, A. K. and Vinci, R. P., "Kinematically Admissible Die-Less Forming of Long Tapered Components of Thermoplastic Composites," International SAMPE Technical Conference Series, Boston, MA, Vol. 22, pp. 98-111, November, 1990.

2. Miller, A.K., Micha, G., Ramani, K., Peled, A., Vinci, R., Teo, C.K., "Maintaining Fiber Alignment During Die-Less Forming," Seventh Industry Government Review of Thermoplastic Matrix Composites, San Diego, California, III-B1-B15, March, 1990.
3. Ramani, K., Cutkosky, M.R., and Miller, A.K., "Motion Planning for Forming of Composites," Proceedings of the ISIR International Symposium on Intelligent Robotics, Bangalore, India, pp. 604-615, January, 1991.
4. Vinci, R.P., *Ramani, K., Miller, A.K., and Cutkosky, M.R., "Die-Less Forming of Thermoplastic Composites: Experiments on the Demonstration Machine," Proceedings of the 36th International SAMPE Symposium, San Diego, California, Vol. 36, pp. 2130-2141, April 15-18, 1991.
5. Ramani, K., Tryfonidis, M., and Gentry, J., "Thermoplastic Filament Winding Using a Wet Slurry Method," Advanced Materials: Meeting the Economic Challenge, 24th International SAMPE Technical Conference, Toronto, Canada, pp. T128-T142, October, 1992.
6. Ramani, K., and Borgaonkar, H., "Pultrusion of Thermoplastic Powder Impregnated Tows," Proceedings of the ASM/ESD Advanced Composites X Conference, Dearborn, Michigan, pp. 229-240, November, 1994.
7. Ramani, K., Woolard, D.E., "Electrostatic Powder Spray Impregnation for Low-cost Thermoplastic Composite Manufacture," Proceedings of the ASM/ESD Advanced Composites X Conference, Dearborn, Michigan, pp. 213-228, November, 1994.
8. Ramani, K., Borgaonkar, H. and Hoyle, C.H., "Compression Molding and Pultrusion of Thermoplastic Powder Impregnated Tows," International Conference on Composites Engineering, pp. 417-418, August, 1994.
9. Ramani, K. and Henderson, D., "Use of PRO/Engineer and ANSYS in Undergraduate Engineering Education," Symposium on Changes in Undergraduate Engineering Education, SAE International Congress and Exposition, Milwaukee, Wisconsin, SAE Technical Paper Series 941748, pp. 1-4, September 12-14, 1994.
10. Ramani, K., Woolard, D.E., and Duvall, M.S., "In-situ Powder Impregnation in Composites Manufacture," NSF Design and Manufacturing Grantees Conference, San Diego, California, pp. 479-480, January 3-7, 1995.
11. Ramani, K., Tagle, J., and Ingram, C., "CAREER: In-situ Adhesive-less Joining of Thermoplastics and Their Composites to Metals in Net-shape Processes and an Integrated Design and Processing Education Plan," Proceedings 1996 NSF Design and Manufacturing Grantees Conference, Albuquerque, New Mexico, pp. 423-424, January, 1996.
12. Ramani, K., and Duvall, M.S., "In-situ Composite Manufacture using Electrostatic Powder Spray Processing and Filament Winding," Proceedings 1996 NSF Design and Manufacturing Grantees Conference, Albuquerque, New Mexico, pp. 424-425, January, 1996.
13. Ramani, K., and Ingram, C., "Durability of Thermoplastic Adhesive Bonding to Metals: Ti to PEKEKK," Proceedings of the American Society for Composites, Atlanta, Georgia, pp. 1069-1075, October, 1996.

14. Ramani, K., Moriarty, B., Weidner, W., and Zhao, W., “CAREER: In-situ Adhesive-less Joining of Thermoplastics and Their Composites to Metals in Net-shape Processes and an Integrated Design and Processing Education Plan,” Proceedings 1997 NSF Design and Manufacturing Grantees Conference, Seattle, Washington, pp. 307-308, January, 1997
15. Ramani, K., and Duvall, M.S., “Thermoplastic Composite Manufacturing Processes Using Electrostatic Powder Spray Impregnation,” Proceedings 1997 NSF Design and Manufacturing Grantees Conference, Seattle, Washington, pp. 305-306, January, 1997.
16. Iyer, N., Kalyanaraman, Y., Lou, K., Jayanti, S., and Ramani, K., "A Reconfigurable, Intelligent 3D Engineering Share Search System Part I: Shape Representation," Submitted to ASME DETC' 03, 23rd, 2003 Computers and Information in Engineering (CIE) Conference, Chicago, Illinois, September 2-6, 2003.
17. Lou, K., Jayanti, S., Iyer, N., Kalyanaraman, Y., Ramani, K., and Prabhakar, S., "A Reconfigurable, Intelligent 3D Engineering Shape Search System Part II: Database Indexing, Retrieval and Clustering," Proceedings of ASME DETC' 03, 23rd Computers and Information in Engineering (CIE) Conference, Chicago, Illinois, September 2-6, 2003.
18. Ramani, K. and Babu, M., Nikhil Joglekar, Aliasgar Ganiji, "Flexible Software Framework for Collaboration Systems, Collaborative Design Tools" International CIRP Design Seminar, Grenoble, France, Page 27, May 12-14, 2003.
19. Chung, C., Raj, A., Turuvekere, S., Agarwal, V., and Ramani, K., "A Customer-Supplier System for Distributed Global Product Management, Cooperation between Designers" International CIRP Design Seminar, Grenoble, France, Page 50, May 12-14, 2003.
20. Karthik, S., Chung, C., Ramani, K., and Tomovic, M., "Methodology for Metalcasting Process Selection," SAE 2003 World Congress, Detroit, Michigan, March 3-6, 2003
21. Karthik, S., Chung, C., and Ramani, K., “Development of Process Capability - Supplier Models," ASME 2003 International Design Engineering Technical Conferences, Chicago, Illinois, pp. 891-900, September 2-6, 2003.
22. Uppuluri, S., Xu, X., and Ramani, K., "Remote Services Model for Laser Micro-Machining," ASME 2003 International Design Engineering Technical Conferences, Chicago, Illinois, September 2-6, 2003
23. Lee, A, Brink J., C., Anderson, D., Ramani, K., "Wire-Path Rapid Tooling and Supporting Software Development", 8th ASME Design for Manufacture Conference, Chicago, IL, 2003.
24. Lee, A, Ramani, K., "Wire-Path: A New Method of Rapid Tooling", Moldmaking Expo, Cleveland, OH, 2003.
25. Lee, A., Anderson, D., Ramani, K., ""Toying" to Learn for 21st Century Product Development Environments", ASEE Conference, 2003.
26. Iyer, N., Kalyanaraman, Y., Lou, K., Jayanti, S., and Ramani, K., "Early results with a 3D Engineering Shape Search System", International Symposium on Product Lifecycle Management (PLM 03), Indian Institute of Science, Bangalore, India, 2003.

Seminars, Presentations and Invited Lectures

1. "Die-less Forming of Thermoplastic Composite Materials," Cincinnati Milacron, Inc., Advanced Machine Development Division, Cincinnati, Ohio, August, 1989.
2. "Thermoplastic Filament Winding Using a Wet-Slurry Method," General Motors Corporation, Advanced Composite Systems, Dayton, Ohio, August, 1989.
3. "Filament Winding of Thermoplastic Composites," Materials Science and Engineering Seminar on Mechanical Properties of Solids, Stanford University, Palo Alto, California, October, 1989.
4. "Elastic-viscoplastic Rate Dependent Model for Die-less Forming," Materials Science and Engineering Colloquium Speaker, Stanford University, California, August 1990.
5. "Die-less Forming of Thermoplastic Composite Materials," University of Arizona, Tucson, Arizona, February, 1991.
6. "Recent Advances in Composites Manufacturing," National University of Singapore, Singapore, July, 1992.
7. "Fiber Damage During Extrusion Compounding of Glass Reinforced SPS," Dow Chemical Company, Midland, Michigan, August, 1993.
8. "In-situ Composite Manufacture," Zimmer Inc., Warsaw, Indiana, May, 1994.
9. "In-situ Impregnation and Coating of Glass Fibers using Electrostatic Powder Sprays," Owens Corning Fiberglass, Granville, Ohio, August, 1994.
10. "In-situ Coating and Joining," Delco Products, Dayton, Ohio, August, 1994.
11. "Hot Inert Gas Compression Molding Process," Zimmer Inc., Warsaw, Indiana, December, 1994.
12. "In-situ Impregnation of Polymeric Powders for Net-Shape Manufacture and In-situ joining", Best of German and American Automotive Technology Conference, Dearborn, Michigan, June, 1995.
13. "Thin-Film Thermoplastic Bonding of Metals and Application to In-situ Joining," Ford Motor Company, Dearborn, Michigan, August, 1995.
14. "An Integrated Approach to Design and Manufacture with Composites and Polymers," Department of Mechanical Engineering, Indiana University-Purdue University at Indianapolis, Indianapolis, Indiana, April, 1996.
15. "Approaches to Thermoplastic Polymer Joining to Metals," Motorola Inc., Northbrook, Illinois, May, 1996.
16. "Young Faculty Experience in Using the Research Process," special lecture for new faculty, Purdue University, West Lafayette, Indiana, September, 1996.
17. "Integrated Design, Processing and In-situ Approaches to Polymer Bonded Systems," Materials Science and Engineering Seminar, Purdue University, West Lafayette, Indiana, March, 1997.
18. "From Molecules to Machines: Design and Processing with Thermoplastic Polymer Bonded Systems," Department of Mechanical Engineering and Applied Mechanics, University of Michigan, Ann Arbor, Michigan, June, 1999.

19. “Processing and Durability Comparison of Thermoplastic Hot-Melt and Polyurethane Thermoset Bonded to Galvanized Steel,” Keynote Lecture, International Conference on Composite Materials (ICCM -11), Paris, France, July, 1999.
20. “In-situ Polypropylene Composite Bonded to Wood Sandwich System,” Keynote Lecture, International Conference on Composite Materials (ICCM -11), Paris, France, July, 1999.
21. “New Paradigms for Collaborative Systems,” Invited Lecture, Volvo Concept Design Center, Los Angeles, CA, July 2001.
22. “Navigating a start-up to success: war stories,” invited panel member, Purdue Entrepreneurial Symposium, October, 2001.
23. “Technical Assistance Program: Overview of Product and Process Design,” Annual Industrial Advisory Council Meeting, October, 2001.
24. “CADDAC: Computer-Aided Distributed Design and Collaboration: A Prototype,” Computer Sciences and Engineering, Purdue University, February, 2001.
25. “Next Generation Product Development Enterprises,” Zimmer Inc., March, 2002. (Invited Speaker)
26. “Multi-client Multi-mode Architecture for Distributed Thin-client Interactions,” Massachusetts Institute of Technology, (Mechanical Engineering Seminar Series, Invited Speaker), November, 2002.
27. “PRECISE: Research at Center for Information Systems in Engineering,” GE Global, John Welch Center, Bangalore, India, (Invited Seminar Speaker), December, 2002.
28. “PRECISE: Research at Center for Information Systems in Engineering,” Babha Atomic Research Center, Bombay, India, (Invited Seminar Speaker), December, 2002.
29. “Multi-mode Distributed Thin Client Collaboration on Large Geometric Models,” I-Light Applications Workshop, Indiana’s Optical Fiber Initiative, Indianapolis, Indiana, (Featured speaker for I-Light network use in distance visualization and collaboration applications) , December, 2002.
30. "3DESS: A Reconfigurable 3D Engineering Shape Search System," Computer Science and Engineering, Computing Research Institute, Spring 2003 Invited Seminar.
31. “Shape Search with a Hierarchical Shape Representation,” University of California Berkeley, September 2003.
32. “Engineering Advisory Systems and Parts Search,” Alcoa, Pittsburgh, invited R&D seminar, September 2003.
33. “Shape Search with a Hierarchical Shape Representation,” University of Texas, Austin, California Berkeley, September 2003.
34. “Engineering Advisory Systems,” The Ohio State University, Invited Seminar, October 2003.
35. “Shape Based Information Retrieval and Engineering Advisory Systems,” Alcoa Technical Center, Invited Speaker, October 2003.
36. “Shape Based Information Retrieval and Engineering Advisory Systems,” Caterpillar Mossville Technical Center, Invited Speaker, October 2003.

37. “Shape Based Information Retrieval and Engineering Advisory Systems,” General Motors, Invited Speaker, October 2003.
38. "Similar Shape Search with a Hierarchical Shape Representation,", MEEM graduate seminar, November, 2003.
39. “Emerging Technologies: Customization and Configuration,” Panel Speaker, Purdue University, Advanced Manufacturing Summit, May 2004.
40. “Shape Search in Large Part Repositories,” Adobe Corporate Research Headquarter, San Jose, Invited Seminar, September2004.
41. “Shape Search in Large Part Repositories,” Mechanical Engineering and Applied Mechanics, Invited Graduate Seminar, University of Michigan, Ann Arbor, December 2004.
42. “Towards a Customer Driven Enterprise: Search on 3D Parts in Large Repositories,” The George W. Woodruff School of Mechanical Engineering CAE/Design Seminar, December 2004.
43. “Search by Shape: 3-D Parts in Large Networked Repositories,” Invited Plenary lecture, NexGens Technologies, TTI Vanguard, December 2004.
44. “Cyber-Infrastructure: Customer Driven Manufacturing Networks,” Invited Speaker, NSF Cyber-Infrastructure Workshop, August 2004.
45. “Cyber-Infrastructure: Design and Manufacturing,” Invited Speaker, NSF Cyber-Infrastructure – Engineering Design Workshop, January 2005.
46. “Shape Search on 3D Parts from a Reuse Perspective,” Plenary Speaker, International Symposium on Tools and Methods in Competitive Engineering, April, 2006, Ljubljana, Slovenia.
47. “Tech Transfer via Start-Up: a NSF-SBIR Case Study,” Invited panel Speaker, national Council on Entrepreneurial Tech Transfer (NCET2), Washington DC, October 2006.
48. “Engineering Ontologies,” Invited panel Speaker, U.S.-French Workshop on Information and Communication Standards for Product Lifecycle and Supply Chain Management, Washington DC, November 2006.
49. “Shape Analysis for Design, Manufacturing and Supply Chain,” Invited Plenary Speaker, International Conference on Advances in Mechanical Engineering (ICAME 2006), December 14-16, 2006 in Madras (India).
50. “Searching for Shapes: From Engineering Design to Proteomics,” Invited speaker, Department of Mechanical Engineering, University of Connecticut, February, 2008.
51. “In Search of Shapes,” Workshop on 3D Shape retrieval and Analysis, National Institute of Standards and Technology, May 2-3, 2008.
52. “Extracting Prominent-cross sections in Mesh Models,” Computer Graphics Forum, Stanford University, March 2008.
53. “Searching on 3D Content,” Plenary Speaker, Computer-Aided Design and Applications, Orlando, Florida, June 2008.
54. “On Developing Engineering Ontologies,” Ontology Workshop, KAIST, Daejon, Korea, July 2008.

55. "Towards Search Space Representations," Hanyang University, Seoul, Korea, July 2008.
56. "In Search of Shapes," University of Illinois at Urbana Champaign, Joint Seminar between Mechanical Science and Engineering and Industrial and Systems Engineering, March 2009.
57. "In Search of Shapes," Illinois Institute of Technology, Chicago, March 2009.
58. "Working Knowledge Model and Visual Tools," Tata Consulting Services, Chennai, India, August 2009.
59. "Incorporating Sustainability into Early Design," Indo-U.S. conference in Sustainable Product Design, Manufacturing and Services, August 2009.
60. "Reverse Parameterization," General Electric, Cincinnati, July 2009.
61. Invited Distinguished Speaker for United Technology Center, Design Sensing: Integrating Digital Manufacturing and Design, January 2012.
62. "Gesture based shape modeling and touch based interaction," Iowa State University, Distinguished Lecture Series in Mechanical Engineering, November 2012.
63. Invited Panelist, Internet Enabled Manufacturing, July 2012 NSF CMMI Grantees Conference.
64. Invited Science Keynote 2012 NSF Cyber-physical systems grantees meeting, Framing the CPS Issues in Manufacturing and Design, Bruce Kramer (NSF/CMMI) and Karthik Ramani (Purdue).

DISSERTATION, THESIS AND PROJECT SUPERVISION

Ph.D. Students

1. Mark S. Duvall, Ph.D., "In-situ Composite Manufacture using an Electrostatic Powder Spray Process and Filament Winding," January, 1998. (Program Manager, Electric Transportation, Electric Power Research Institute (EPRI)).
2. Narasinha Parasnis, Ph.D., "Compression Molding Simulation of UHMWPE," August,1998. (Manager, Bayer Healthcare)
3. Borgaonkar H., Ph.D., "Processing and Rheology in Thermoplastic and Composites," August, 1998. (Manager, American Medical Systems; Past Principal Engineer, Boston Scientific; Senior Engineer, Guidant)
4. Natraj Iyer, Ph. D., "Three Dimensional Shape Search," 2004. (Engineering Manager, Stryker, before he passed away)
5. Chan Woo Chung, Ph. D., "Distributed Product Lifecycle Informatics Agents," December 2004. (Samsung)
6. Kuiyang Lou, Ph.D., "An Intelligent Three-Dimensional Shape Search System: Effectiveness and Efficiency," May 2004. (General Electric)
7. Alexander Lee, PhD., "Wire-Path ™: Modular and Flexible Tooling for Rapid Product Development," December 2005. (Schlumberger)

8. Wenping Zhao, Ph.D., "Thermoplastic Composite Bonding to Metals in Filament Winding and Injection Molding," June, 1999. (Raybestos)
9. Chongchen Xu, Ph.D., "Durable Thermoplastic-Metal Interphases," August, 2001. (IBM) [Co-Advised with Professor Siegmund]
10. Dai Heming, Ph.D., "Process Design for Continuous Thermoplastic Composite-Wood Bonding," January, 2001. (Tyco International)
11. Jun-Ki Choi, Ph.D., "Environmental Considerations in Early Product Design," June, 2006. (Goldhaber Distinguished Fellow, Energy Sciences and Technology, Brookhaven National Laboratory; Assistant Professor University of Dayton)
12. Jayanti Subramaniam, Ph.D., "Clustering Using Shape Similarity for Large Engineering Repositories," June, 2006. (Division Manager, Third Wave Systems, Inc.)
13. Zhanjun Li, PhD, "Ontology-based Shape Retrieval," December, 2007. Suyu Hou, Ph.D., "Intelligent Interfaces for Shape Searching," August 2007. (Alibre)
14. Min Liu, Ph.D., "Reverse Engineering using Faced Models and Feature Search," April, April 2003. (Assistant Professor, Tsinghua University)
15. Suyu Hou, Ph.D., "A Framework for Engineering Shape Search with Semantics," April 2007. (General Electric)
16. Srikanth Devanathan, Ph.D., "Large Scale Product Architectural Optimization using Physics Based Configuration, April, 2009. (Dassault, Engeneous/Simulia)
17. Noel Titus, Ph.D., "Explanation Systems for Conceptual Design", December 2008. (Biomedical Design at Becton Dickinson)
18. Yagna Kalyanaraman, Ph.D., "Search and Navigation in Large Engineering Repositories, December 2008. (General Motors, India)
19. Fang Yi, "Clustering Protein Structures and Complexes," October 2011. (Riverain Medical Systems)
20. Sundar Murugappan, Ph.D. "Sketch Parameterization and its applications," October 2012. (General Electric, Industrial Internet Initiative, San Ramon, CA)
21. William Benjamin, Ph.D., "Sketch based Design," started September 2007. (Candidate)
22. Senthil Chandrasegaran, Ph.D., "Working knowledge Model and Visual Tools" Started August 2009. (Candidate)
23. Cecil Piya, Ph.D., "Combining 2D and 3D spatial interactions using gestures and constraints," Started August 2009. (University Fellowship/Candidate)
24. William Bernstein, Ph.D., "Design for Sustainability: Methodology Development for Early Design Stages," Started August 2009. [Candidate, Joint Student with Prof. Fu Zhao]
25. Joran Booth, Ph.D., "Design Abstraction Models through Understanding how things work and sketching," started August 2011. (candidate)
26. Devarajan Ramanujan, Ph.D., "Function-Impact and Function-Process Methods with Uncertainities," Started January 2010.

27. Fnu Vinayak, Ph.D., "Gesture based shape modeling of free form shapes," Started October 2011. (candidate)
28. Sujin Jang, Ph.D., "Spatial Analystics for gesture based modeling," Started October 2012. (candidate)
29. Yu Liu, Ph.D., "Hand Models for Gesture Based Modeling," Started October 2012. (candidate)
30. Wei Gao, Ph.D., "Kinetogami: Folded Metamorphic Design," Started October 2011. (Candidate)
31. Ayan Sinha, Ph.D., "Muti-scale network and shape analysis using graph-based and learnt representations," Started October 2011. (Candidate)

Post Doctoral Researchers and Visiting Scholars

1. Dr. Kumar Ganesan, "Processing of New Dissimilar Polymeric Interphases: Polymer-Polymer and Polymer-Polymeric Composite Interphases," April, 1997 – August, 2000. (Wabash National)
2. Dr. Thais H. Sydenstricker Costa, "Searching Large Material Databases based on Process Needs," Universidade Federal do Parana – UFPR, Brazil.
3. Dr. Kuiyang Lou, "Scaling up a Reconfigurable Search System," January, 2004 – January, 2005. (General Electric)
4. Dr. Mimi Boutin, "Weighted Graphs for Shape Representations," April 2005 – August 2005. (Associate Professor, Electrical and Computer Engineering, Purdue University)
5. Dr. Pu Jiantao, "New Methods for Decomposing, Representing and Searching," August 2004 – December 2005. (Associate Professor, University of Pittsburgh)
6. Dr. Yu Shen Liu, "Protein Search Algorthms," August 2006 – August 2009. (Accepted Associate Professor, Tsinghua University).
7. Dr. M. Ramanathan, "New Decomposition Methods of 3D objects Using Morse Theory," August 2006 – August 2008. (Assistant Professor, Indian Institute of Technology, Madras)
8. Dr. Subramani Sellamani, "Topo-Geometric Methods for Decomposition using Virtual Scanning," 2006-2009.
9. Dr. Dongxing Cao, "Computational Support for Early Design," February 2009 – February 2010. (Visiting Professor from Heibei University of Technology)

A number of graduate and undergraduate students have taken independent study project courses (ME 497 and ME 597) directed by Dr. Ramani. Many of them utilized his laboratory facilities and contributed to his research projects. The indicated undergraduates were supported through a National Science Foundation Research grant for Experiences for Undergraduates.

M.S. Students

1. Mike Smith, M.S., "Thermoplastic Composite Bonding to Wood: Manufacturing Process and Machine Design", June, 1999.
2. Verhoff Jon, M.S., "Durability of Thermoset Composite-Steel and Aluminum Interphases," August, 1999. (Owens Corning)
3. Iyer Natraj, M.S., "High Performance Aluminum Alloy Production Tooling for Injection Molding: Mold and Process Design," April, 2000.
4. James Nerone, M.S., "High Performance Aluminum Alloy Production Tooling for Injection Molding: Mold and Process Design," April, 2000.
5. Abhishek Agarwal, M.S., "CADDAC: Multi-Client Collaborative Shape Design System with Server-Based Geometry Kernel," (Jointly supervised with Professor Christoph Hoffman, Computer Science Department), August, 2002. (MBA Wharton, Consultant at Health and Life Sciences at Accenture)
6. Shrimanth Uppuluri, M.S., "Laser Micro-Part Manufacture," (Jointly supervised by Professor Xu), December, 2002.
7. Karthik Sitaram, M.S., "A Tooling Advisory System," 2003. (Industrial Engineering). (Oracle, India)
8. Aliasgar Ganiji, M.S., "Sketch-Based Design Interface," 2003. (Software developer, Epics Systems Corporation)
9. Mahendra Babu, M.S., Computer Science, , Project: "ToolingNET System Architecture: Information Flow," 2003. (Computer Science, Non Thesis, Co-Advisor Chris Hoffmann) (Senior Software Engineering, Imaginestics)
10. Nikhil Joglekar, M.S., "Engineering Advisory System Architecture: Integrating Net Shape Part Geometry," May 2004. (Parametric Technology Corporation/PTC).
11. Vineet Agarwal, M.S., "ToolingNET: Database Architecture," 2003.
12. Ajoy Radhakrishnan Raj, M.S., "ToolingNET: System Architecture: Customer-Supplier Interactions," 2003.
13. Joon Hong, M.S., "Net Shape Part Tooling Feature Recognition for Early Design Advice," May 2004. (Samsung)
14. Harshal Patwardhan, M.S., "Managing Product Interfaces in Distributed Enterprises," 2004. (Industrial Engineering)
15. Manish Agarwal, M.S., "Signature based representation and similarity searching for protein binding sites," December 2004. (Co-Advised By Professor Kihara) (Founder PicsSquare)
16. Srinivasan Tiruvekere, M.S., "Geometric Methods and Algorithms for Binding Site Identification and Alignment in Proteins," August 2004. (Amazon)
17. Christopher Hoyle, M.S., "Manufacture of Thermoplastic Powder Impregnated Composites," March, 1994. (Manager Motorola/Ph.D. NWU)

18. Aparna Vaidyanathan, M.S., "Microstructure based Determination of Thermal Conductivity of Composite Materials," May, 1995. (MBA University of Chicago, Consultant ZS Associates)
19. John Tagle, M.S., "Characterization of Poly(EtherKetoneEtherKetoneKetone) (PEKEKK) as a Thermoplastic Adhesive in Metal-to Metal Joints," December, 1995. (Gore Tex).
20. Daniel E. Woolard, M.S., "Design and Development of an Electrostatic Powder Spray Process for Manufacturing Fiber Reinforced Thermoplastic Composites," December, 1995. (Lexmark)
21. Cynthia Ingram, M.S., "Thin Film Thermoplastic Joining with Induction Heating and Anodization," August, 1996. (Lexmark)
22. Keith Miller, M.S., "Inductively Heated Compression Molding Process and Tooling," August, 1997. (Applied Materials)
23. Bill Weidner, M.S., "Durability Issues and Surface Modifications in Thermoplastic Bonding of Metals," December, 1997.
24. Brendan Moriarty, M.S., "In-situ Joining of Thermoplastics to Metals in Injection Molding," December, 1997.
25. Vinayak Labade, M.S., "Classification of Large Shape Databases," 2006. (Business Intelligence Consultant at Fair Isaac)
26. Kaushik Mantri, M.S., "Supply chain integration in early design," 2006.(Ernst and Young)
27. Amit Jain, M.S., "Indexing 3D parts using view-based methods," 2008. (Yahoo)
28. Manish Goyal, M.S., "Robust Determination of Salient Loops on Meshed Objects," started August 2008.
29. Luis Elizondo, M.S., "Innovation and is Dimensions in Design," September 2010.
30. Elkin Toborda, M.S., "Sketch-based design thinking," October 2011.
31. Vinh Vinh, M.S., "Gestronics: gesture controlled electronics," Started October 2012.

Graduate Student Projects Directed

1. Brian Hood, ME 597 Project, "Polymer Bonding to Metals," Spring 1993.
2. Doug Schneider, ME 597 Project, "Anodization to Improve Thermoplastic-Metal Bond Durability," Summer 1994.
3. Vincent Lenoir, ME 597 Project, "In-situ Measurement of Displacement during Polymer Bonding," Fall 1994.
4. David Stone, ME 597 Project, "Accelerated Testing of Ultra-High-Molecular-Weight-Polyethylene," Fall 1994.
5. David Cole, ME 597 Project, "Advanced Design for Manufacture," Spring 1995.
6. Dan Vandersluis, ME 597 Project, "Parametric Design," Spring 1995.
7. Charles Adam, ME 597 Project, "Solid State Processing," Fall1995.

8. Kareem Rasmy, ME597 Project, "Polymer Bonded Systems," Summer 1997.
9. Cory Sauls, ME597 Project, "Manufacturing Polymeric Systems," Fall 1997.
10. Eric Hernandez, ME597 Project, "Manufacturing Polymeric Systems," Fall 1997.
11. Charlie Baxter, ME597 Project," Advanced Computer-Aided Design,"Fall 1997.
12. Bayyari, M. K., ME597 Project, "Climbing Wheel-chair Design," Fall 2000.
13. Henry Robinson, ME597 Project, "Climbing Wheel-chair Design," Fall 2000.
14. Anand Raj Krishnammurthy, ME587 Project, "Stair Descending Wheel Chair," Fall 2002, Spring 2003.
15. Srivatsan, ME597 Project, "Haptics Review for Synthetic Environments," Fall 2002.

Continuing Engineering Education

Off-Campus Students' Plan of Study Advisory Committee and Chair Activity. He has also been on the chair of the advisory committee of over 200 students since 1998. A short list is included below.

Andrew Brown, Brian V Castillo, Reena Datta, Genevieve Fabela, Alfred E Green, Eric E Hallberg, Ryan Harrington, Matthew Johnston, Darla Kroeger, Anthony Lyscio, John F Moore, Jeanette Pfefferle, Kevin T Quinn, Randal E Riebel, Daniel E Rivera, John J Salvato, Marco Scodeller, Gheorghe Serbanescu, Johnny Williford, Phillip C Storck, Charles B Totten, Jason C Treece, Patrick Webster, Robert J Joseph, Christine Kong, Robert D Sharpe, Scott Wanamaker.

Undergraduate Student Projects Directed

1. Mike Tryfonidis, ME 497 Project, "Impregnation of Thermoplastic Powder in a Filament Winding Process," Spring 1992.
2. Ku-Kuang, ME 497 Project, "Data Acquisition for Composites Manufacture using Lab-View," Fall 1992.
3. Fouzi Al-Essa, ME 497 Project, "Development of Micro-fiber Forms for Enhanced Properties," Fall 1992.
4. Mike Gaines, ME 497 Project, "Use of CAD Techniques for the Design of the Solar Car," Spring 1993.
5. Matthew Gagliardi, ME 497 Project, "Composite Machine Design," Spring 1993.
6. Dean Geiger, ME 497 Project, "Shape Optimization Using Parametric Design Software and Finite Element Method," Fall 1993.
7. David Offenberg, ME 497 Project, "Design and Manufacture of a Die to Process Long Glass Fiber Tapes," Fall 1993.
8. Tim Stone, ME 497, "Parametric Design and Analysis using ANSYS and Pro/Engineer," Fall 1993.
9. Mark Bays, ME 497 Project, "Design and Fabrication of In-situ Consolidation Device," Fall 1994. (NSF-REU)

10. Frederic Caillat, ME 497 Project, "Design, Fabrication of In-situ Consolidation Device," Fall 1994. (NSF-REU)
11. Mark Bays, ME 497 Project, "Processing using Electrostatic Spray and In-situ Consolidation Device," Fall 1995. (NSF-REU)
12. Frederic Caillat, ME 497 Project, "Processing using Electrostatic Spray and In-situ Consolidation Device," Fall 1995. (NSF-REU)
13. Chris Stringer, ME 497 Project, "Injection Mold Design and Manufacture for In-situ Joining," Spring 1995. (NSF-REU)
14. Nana Tzeng, ME 497 Project, "Design of Chopper for Coated Tows and Injection Molding," Fall 1996. (NSF-REU)
15. Ramakrishna Arvind, ME497 Project, "Computer-Aided Industrial Design," Fall 1997.
16. Eddie Chou, ME497 Project, "Inductively Heated Rivet Insertion and Testing," Fall 1997.
17. Jon Anderson, ME497 Project, "Inductively Heated Rivet Insertion and Testing," Fall 1997.
18. Felipe Roman, MARC/AIM Student, "Rapid Prototyped Tooling for Injection Molding," Summer 1998.
19. Jason Todd Bauer, "Rapid Prototyping for Reverse Engineering," Spring 1998.
20. Barret, ME497, "Prototyping Experiments for Injection Molding Tooling," Summer 1998.
21. Krishnamurthy., P., "Process Design," Spring 1999.
22. Brian Joseph Butrico, "Product Prototyping," Fall 1999.
23. Melvin Kimhoong Lee, "Computer-Aided Design," Fall 1999.
24. Joule Ouyong Sze, "Polymeric Tooling Design," Fall 1999.
25. Halil Berberoglu, ME498 Honors Thesis, "Micro-part Manufacture: Preliminary Prototyping," Spring 1999 – Fall 1999.
26. Balamurugan Ganesan, "Advanced CAD," Spring 2000.
27. Matt Holmes, ME Honors Thesis, "Rapid Tooling Design," started Fall 2001.
28. The Jun, ME Honors Thesis, "Rapid Tooling Cases Studies," started Fall 2001.
29. Hui, ME Honors Thesis, "Micro-Mold and Part Prototyping," started Fall 2001. (Jointly supervised by Professor Xu)

RESEARCH AND EDUCATION CONTRACTS AND GRANTS

Dr. Ramani has secured a total research funding of over $10.0 million as Principal Investigator. His share of funding has been over $6.5 million. He has been associated with securing over $20 million of research including those with others as the co-PI. The sponsors include National Science Foundation, Los-Alamos National Labs, Zimmer, Bell Helicopter, Sika Corp., Wabash National, Kemlite, Dow Plastics, Alcoa, Proctor and Gamble, St. Vincent's Hospital, U.S. Army, Defense Logistics Agency, National Center for Manufacturing Sciences, Imaginestics, PLM center at Purdue (Boeing, IBM, EDS, PTC, Siemens, Honda, Satyam), General Electric, and National Institute of Health.

1. "Micro-fiber Form for Enhancing Through Thickness Conductivity of Ultra-thin Composite Laminates," Los-Alamos National Laboratory, Los-Alamos, New Mexico, $18,000, July 1992 - January 1993.

2. Co-principal investigator with Prof. K. Kokini, "Video Image Analysis System for Creative Undergraduate Instruction Project," Purdue University Dean's Club, $4,570 (Dr. Ramani's share), February 1992 - January 1993.

3. "In-Situ Impregnation of Thermoplastic Powder in a Pultrusion Process," Purdue University David Ross Grant, $19,000, August 1992 - August 1994.

4. co-principal investigator with Profs. C. T. Sun and J. Caruthers, "Intelligent Manufacturing Systems for Thermoplastic Composites," National Science Foundation Engineering Research Center for Intelligent Manufacturing Systems, $180,476 (Dr. Ramani's share), October 1993-June 1996.

5. "Reduced Fiber Damage in Injection Molding and Extrusion," Dow Plastics and National Science Foundation, Engineering Faculty Internship, $24,000, July 1993 - January 1994.

6. "In-situ Impregnation of Polymers and Ceramics in Composites Manufacturing," National Science Foundation, Research Initiation Award, $100,000, August 1993 - September 1996.

7. "Concurrent Design of Polymer Bonding Process and Joint Design," Zimmer Inc., $24,500, May 1994 - December 1995.

8. "In-situ Impregnation of Polymers and Ceramics in Composites Manufacturing: Research Experiences for Undergraduates," National Science Foundation, $20,000, January 1995 - January 1997.

9. "In-situ Coating for Prototyping," Bell Helicopter Textron, Inc., $6,970, January 1995-June1995.

10. "Preliminary Analysis of Compression Molding Process," Zimmer Inc., $900, August, 1994- December 1994.

11. "Design of a Rapid Resin Impregnation Gun to Manufacture Flexible Composite "Prepregs" for Net-Shape Manufacturing," Purdue Research Foundation, Summer Faculty Grant, $5,000, May1995 - August 1995.

12. "Hot Inert Has Compression Molding Process," Zimmer Inc., $20,000, January 1995 - August 1995.

13. "Scale-up of Electrostatic Powder Spray Process," Purdue Research Foundation and TRASK, $15,000, January 1995 - December 1995.

14. "In-situ Joining of Thermoplastics and Their Composites to Metals in Net-shape Processes: Hot-melt, Filament Winding, Injection Molding, Shrink Fitting," National Science Foundation, Research Equipment Grant, $60,000, July 1995 - June 1996.

15. "In-situ Joining of Thermoplastics and Their Composites to Metals in Net-Shape Processes and an Integrated Design and Processing Education Plan," National Science Foundation CAREER Award, $300,000, August 1995- August 1999. ($100,000 of the $300,000 has been provided by NSF for matching industrial funds, $25,000 each year. Dr. Ramani has obtained four years of matching increments for $100,000.)

16. "Induction Heated Compression Molding Process," Zimmer Inc., $27,000, January 1996 – October 1996.

17. "In-situ Joining in Injection Molding: Research Experiences for Undergraduates," National Science Foundation, $10,000, January1996 - January 1997.

18. "Fiber Placed Fiber-Reinforced Thermoplastic (FRTP) Anti-torque Structure," Bell Helicopter Textron Inc., $6000, June 1996 - August 1996.

19. "High-Rate Thermoplastic Composite Manufacture using Electrostatic Powder Spray Coating and In-situ Filament Winding: Cross-roads to Technology Transfer", Purdue Research Foundation, $11,040, March 1996 - February 1997.

20. "Test Method Development for Polymer-Ceramic Bonding," $3,600, November 1996 - January 1997, TP Orthodontics.

21. "Highly Durable Thermoplastic Metal Interfacial Bonding Process," Zimmer Inc., $30,000, March 1997 - April 1998.

22. "Joining of PMMA to Cobalt Chromium via Injection Molding and Post Induction Joining," Zimmer Inc., $40,000, April 1997 - October 1997.

23. "Highly Durable Polymer-Metal Interphases for Multiple Industrial Applications," Chang Memorial Fund, $120,000 (Dr. Ramani's share), Co-PI Xu, X., April 1997 - April 1998.

24. "Joining and Durability of Composite Sheets Bonded to Metal," Sika Corporation, $42,000, April, 1997 - April 2000.

25. "Joining and Durability of Composite Sheets Bonded to Metal," Kemlite, $41,000, April 1997 - until April 2000.

26. "A Collaborative Manufacturing Environment for Integrated Design and Processing of Polymer Bonded Systems," National Science Foundation Engineering Research Center for Collaborative Manufacturing Systems, $18,299, May 1997 - September 1997.

27. "An Integrated High Speed Bonding Process for Thermoplastic Composite to Wood," Wabash National Corporation, $150,000, October 1997 - November 1998.

28. "Inductively Heated Rivet Insertion Process," Landis & Gyr, $10,000, December 1997 - January 1998.

29. "How to skin the cat? New Low-Cost High-speed Manufacturing Processes for Thermoplastic based Impact Enclosure," Joslyn Manufacturing a Division of Danahur Corporation, $170,000, February 1998 - June 2000.

30. "Dynamic Mechanical Characterization of Specialty Foams," $5,000, August 1997- May 1998.

31. "Dynamic Mechanical Characterization of Specialty Polymer Blends," $1,500, August 1997- May 1998.

32. "Faculty Study in Second Discipline: Surface Science and Interphase Behavior," $3,500, August 1998- January 1999.

33. "Producing and Evaluating Durability of New Thermoplastic Polymer/Composite-Metal Interphases for Multiple Industrial Applications," $105,000 (Dr. Ramani's Share), Co-PI Lauterbach, J., and Kokini, K., May 1998- June 1999.

34. "Web-editor ASME Materials Division," $2,500, January 1998- January 1999.

35. Alcoa, "Aluminum QE-7 Production Tooling for Injection Molding: A Strategic Polymer, Process and Tooling Analysis," $95,000, January 1999 - December 1999.

36. TAP Projects, "Various," $30,000, January 1999 - August 1999.

37. Development of Composite Disc Brake Rotors. JL French Automatic Castings, Inc., $7,903, June 2002- May 2003.(Dr. Ramani's share $0, Co-PI)

38. Metal casting Related Information Technology, American Foundry Society, Inc., $2,000, April 2002 – September 2003.(Dr. Ramani's share $0, Co-PI)

39. Proctor and Gamble, "Hands-on Innovation in Product and Process Design," $150,000, June 1999 – June 2002.

40. State of Indiana, "21st Century Computer-Aided Rapid Tooling Design and Digital Manufacture," 1,085,000, August 2000 – September 2002. (PI and Project Director.)

41. Advanced Technology Institute, "Short Run Tooling Advisor," $452,000 (Co-PI: Dr Ramani's share $223,734, this funding source is the Defense Logistics Agency), December 2001 – December 2004.

42. National Science Foundation, "ToolingNET: A Partnership for Enhancing the Tooling Industry in Indiana through the use of Information Technology in the Advanced Manufacturing Sector," $600,000, September 2002 – December 2004. (Dr. Ramani is the PI))

43. State of Indiana ToolingNET: Foundations for a Multiclient Platform for Industrial Tooling Customer-Supplier Resource Management form Concept Through Design and Manufacture: $1,654,197. (Dr. Ramani is the PI, Project Includes other Co-Pi's and more than 10 Industry Partners)

44. Imaginestics, LLC, "Shape query and representation methods for early design advice." $133,620. 1/1/05-12/31/06

45. U.S. ARMY, "Complete Reverse: Remanufacturing Legacy Parts, $1,200,000, 7/1/2005-6/30/2006. (Co-PI with 5 others, Dr. Ramani's share is $140,000)

46. National Science Foundation, Sketch-based Computer-Aided Design, $299,990, 03/15/2006 - 2/28/2009.

47. U.S. ARMY, "Complete Reverse: Remanufacturing Legacy Parts, $1,200,000, 8/1/2006-8/30/2007. (Co-PI with 5 others, Dr. Ramani's share is $140,000)

48. National Center for Manufacturing Sciences, "Dynamic Shape Advice for Casting, $90,000, 1/1/07 – 6/1/08.

49. Imaginestics, Supply Chain Optimization and Product Explorer (SCOPE), $133,000, 8/1/06 – 8/30/07.

50. St. Vincents Hospital (Ascension Group), Decomposition based Interaction for Craniofacial Surgery, $50,000, 8/1/07 – 6/30/08. (with Bill Peine)

51. National Science Foundation, GOALI Supplement, Sketch Understanding, $75,000, 1/1/08 – 8/30/08. (Partner with PARC-Palo Alto Research Center – formerly Xerox PARC).

52. Product Life-Cycle Management Consortium, Computer Support for Conceptual Design, $60,000, 8/1/07 – 8/1/08. (IBM, Boeing, EDS, Siemens, Satyam).

53. Product Life-Cycle Management Consortium, Computer Support for Conceptual Design, $60,000, 1/1/10 – 8/1/10.

54. National Institute of Health, Surface Shape Based Screening of Protein Structure Databases, $1,500,000 (Co-PI with one other PI, Dr. Ramani's share $750,000). 8/1/2005 – 7/31/2010.

55. General Electric, From Point Clouds to Parameterized Models, 8/1/08 – 12/30/10, $240 K.

56. National Science Foundation, "3DHub: A Geometric Kernel and Infrastructure for Community-based Rapid Application Development and Deployment", Recommended for Award, 4/1/09 – 4/31/12, $600 K. (PI, with Mark Lundstrom, George Adams, Leah Jamieson, Ramani's share $480 K).

57. National Science Foundation, "Enabling Project-Based Learning of Ecodesign: Method Development and Curriculum Reform," Innovations in Engineering Education, Curriculum, and Infrastructure (IEECI), $150 K, 8/1/09 – 7/31/12. (with F. Zhao)

58. Purdue University, E2020 Seed Grant, $40 K, "Enabling Innovation through Design of Student Projects," $40 K. (4/1/10 – 12/31/10) (PI, with Kisselburgh, L., Visser, S., Cipra, R., Clement, N., Handwerker, C., and Hirleman, D.)

59. National Science Foundation, IGERT: Global Traineeship in Sustainable Electronics, NSF, 07/01/2012-06/30/2017, $3,373,674. (Co-PI, with Handwerker, C., Hua, I., Iyer, A., Hosur, M.)

60. National Science Foundation, "Integration of Design and Manufacturing for Sustainability," $410 K, Materials Processing and Manufacturing/Design Innovation. (Pi, with Zhao, F., and Sutherland, J.)

61. NSF, Eager: A Prototype Network Architecture For Advanced Manufacturing Built With Manufacturinghub.org And Us Ignite!, $100,000.00 10/01/2011 - 09/30/2012. (Co-PI with Adams, G.)

62. A-DRIVE: Affordable Design by Realistic Interactions for Virtual Explorations, CMMI, 09/01/2012-2015; $340,164.00.

63. Integrating Design and Manufacturing Considerations Towards Sustainable Decision Making (Principal Investigator:Karthik Ramani; Co-Principal Investigator:John Sutherland, Fu Zhao) CMMI Award Date:05/01/2011-2014, 418,284.00.

64. EAGER: skWiki - A Sketch-based Wiki (Principal Investigator:Niklas Elmqvist; Co-Principal Investigator: Karthik Ramani; IIS Award Date:08/01/2012-1014; Award Amount: $200,000.00.

65. DIP: V-ICED Visually-Integrated Cyber Exploratorium for Design, Principal Investigator: Karthik Ramani; Co-Principal Investigator: Niklas Elmqvist, Lorraine Kisselburgh; Kylie Peppler (Indiana University), IIS Award Date:10/01/2012-2015; Award Amount: $750,000.00.

66. I-Corps: Zero-UI: Translation of Purdue Gesture-based Creative Interaction Technologies into the Real World Award Number:1243868; Principal Investigator:Karthik Ramani; Mentor: ZeroUI; IIP Award Date:07/01/2012; Award Amount: $50,000.00.

Recommended for Award:

One NSF proposal on accelerating innovation research with ZeroUI has been recommended for an award.

Another NSF proposal on transforming undergraduate engineering education for sketch-based finite element analysis for developing design intuition with tablets and pen interfaces has also been recommended for an award.

Pending Proposals:

1. NSF, EFRI-ODISSEI Preliminary Proposal: GOALI: Self reconfigurable and origami inspired functional topological structures, $1,999,989.00 10/01/2013 -09/30/2017 (Invited for final submission)
2. NSF-HCC: SMALL: Magic-Hands: Creative 3D Shape Exploration in 3D Space with Natural Gestures enabled by Depth Camera, $499,070.00 07/01/2013 - 06/30/2016.

Engineering Professional Education Course Income:

Professor Ramani's course on Product and Process Design has had significant increase in enrollments. The course enrollments have been on the average about 70 students for each offering over the past decade.

This brings the total income to the University to ~$1.5 million and the School of Mechanical Engineering to > ~$200 k.

Senior Personnel:

1. National Science Foundation, $2,530,874, "IGERT: Innovation Realization Laboratory: Integrating Science and Engineering with Economics and Management." PI: Dan J. Kovenock (one of the senior personnel involved in the proposal preparation).
2. National Science Foundation, $862,011, "MRI: Acquisition of Equipment for Purdue Envision Center for Data Perceptualization." PI: Christoph Hoffmann. (one of the senior personnel named in the proposal).

TAP Projects:

1. Rieke Corporation, Auburn, Cost reduction of a polymer part, 6/1/98.
2. Shadow Cruiser Corporation, Bristol, Development of a low cost composite lamination process for large panels, 8/26/98.
3. Lafayette Plastics, Lafayette, Analysis of material properties of reprocessed polymer materials, 9/29/98.
4. Crown Abrasive Company, Inc., Hebron, Development of composites to replace fiberglass reinforced compounds, 12/1/98.
5. Ventura Group, Inc., Fort Wayne, Solution to a color deterioration problem in polymer parts, 12/2/98.
6. Ventura Group, Inc., Fort Wayne, Development of imitation bones for use in orthopedic surgical training, 12/4/98.
7. Indiana Precision Plastics, Williamsport, Modify a polymer composite to meet a conductivity standard, 2/17/99.
8. Bio Innovation Inc., Fort Wayne, Development of polymer orthopedic products, 2/19/99.
9. Stone City Products, Inc., Bedford, Saw guide redesign, 3/9/99.
10. CEO Visions, W. Lafayette, Development of a internet braille display, 3/12/99.
11. Stone City Products, Inc., Bedford, Saw clamp redesign, 4/5/99.
12. Med Institute, W. Lafayette, Measurement of the molecular structure of a polymer, 4/9/99.
13. Bio Innovation Inc., Fort Wayne, Assistance with an experiment on a polymer based orthopaedic prototype, 6/9/99.
14. CEO Visions, W. Lafayette, Assistance with the development of an internet braille display prototype, 6/9/99.
15. Seymour Manufacturing Company, Seymour, Solve a failure problem with a plastic handle, 7/20/99.

Other Projects:

Professor Ramani directed a team for writing proposals to Purdue University for an additional $108,000 for academic computing for the School in 1997, $97,000 for academic computing for the School in 1998, and $210,000 for Product/Process Design within the Design Center in 1998.

"Academic Computing and Multimedia Delivery for Instruction in Mechanical Engineering," Purdue University, $108,000, December 1997 - November 1998. (with C. Krousgrill, A Bajaj, R. Evans, F. P. Incropera)

"A Hands-on Design Environment for Product and Process Design using Information Technologies in the Mechanical Engineering Curriculum," Purdue University, Special Allocation of the Engineering Student Differential Fees, $210,000, July 1998 - November 1998. (with R. Cipra, F.P. Incropera)

"Instructional Computing for Concurrent Computer-Aided Product and Process Realization in Mechanical Engineering Curriculum," Purdue University, Instructional Computing Proposal, $48,500, July 1998 - November 1998. (with K.H. Hawks, R. Cipra, R. Evans, F.P. Incropera)

DISSERTATIONS:

Ramani, K., "Die-Less Forming of Thermoplastic-Matrix Continuous-Fiber Composite Materials," Doctoral Dissertation, Stanford University, June 1991 (Advisor: A.K. Miller, Materials Science; Co-Advisor: M.R. Cutkosky, Design Division, Mechanical Engineering).
Ramani, K., "Off-line Programming and Calibration of Robots," Master's Dissertation, Ohio State University, June 1987 (Advisor: K. J. Waldron, Head, Mechanical Engineering).

PROFESSIONAL STUDENT SUPERVISION:

Professor Ramani was the founder and faculty advisor for the Society for the Advancement of Materials and Process Engineering (SAMPE) student chapter at Purdue University. The Purdue SAMPE chapter was the largest chapter in the country with a membership of 50 students from several schools of engineering (ME, MSE, CHE, IE, AA) and technology. SAMPE has broad goals that serve graduates and undergraduates to expose them to materials and process engineering through various activities. Such activities have included industrial seminars (Intel, Zimmer, Allied Signal, EG Composites, etc.), technical presentations (Rapid Prototyping, Effective Technical Presentations, Unusual Behavior of Composites, Chargeable Battery Technology, etc.) and industrial visits. SAMPE's homepage presented job opportunities, useful material processing links, as well as courses offered by the various schools in Purdue that are related to materials processing. SAMPE had also successfully organized a design competition through sponsorship with industry (Better Way Products). The Undergraduate Awards in all the Schools of Engineering for SAMPE students in the yearly national competition has totaled over $10,000. Sampe has since been working with aviation technology leadership at Purdue. He also has been supervising senior design projects for teams in ME463 since 2011. One of the teams mentored by him won the Malott Innovation Award. He is also an advisor for the Purdue Makers club.

TEACHING CONTRIBUTIONS AND IMPACT:

Dr. Ramani has a strong track record integrating learning and discovery. Over the years, he has received multiple teaching awards, has published in the International Journal of Engineering Education, and has spoken at multiple engineering education conferences. He developed new courses such as Computer-Aided Design and Prototyping (ME444), Product and Process Design (ME553), and co-developed Intellectual Property (ME554). These courses draw upon his unique blend of expertise in product design, manufacturing processes, intellectual property and information science and technologies. These technical electives have been a core part of the Purdue University curriculum over the past decade.

Both ME444 and ME553 use the internet and support different modes of learning including hands-on, experiential, team-based, and web-based collaboration. ME553), which is also offered via the internet and television, integrates engineering design and innovation with the market positioning of the product. ME553 includes an off-campus body of students. In ME444, the students learn CAD, then design and develop marketable complex toys using modern laser-based prototyping methods, finally developing a working prototype. This class is very popular is offered every semester as a technical elective. Both ME553 and ME444 together have a total

enrollment of 180 students each year. For developing ME 444, Dr. Ramani won the Ruth and Joel Spira Award for Outstanding Contributions to the Mechanical Engineering Curriculum. In 2012 he won this award again, and the only faculty to win it twice, for transforming ME444 course with workshops involving sketching and play with toys.

Dr. Ramani also co-developed a course in intellectual property for its first offering with a corporate attorney. Professor Ramani then was instrumental in bringing another corporate attorney (John McNett) and his nomination as an adjunct professor in the School of Mechanical Engineering. The course focuses on invention definition and claim writing. For his educational contributions, he won the Society of Automotive Engineers Ralph R. Teetor Educational Award (1996). He has now started developing a new course in shape analysis, which is a graduate level course combining mathematics and geometry with shape representation and analysis. This course is now embedded in the knowledge of his research group.

His students have been able to combine advanced research experiences with entrepreneurship through unique opportunities he created for them during their education. He was also involved on a senior level in the NSF-IGERT (Integrated Graduate Education in Research and Training) Innovation Realization Laboratory that paired business students with Ph.D. students. The pairing provided a business framework for students with advanced research experiences. Dr. Ramani's M.S. and Ph.D. student teams have won three entrepreneurship competitions at the Burton Morgan Center. Following graduation, two students created global startups (http://www.picsquare.com/). Some of his students have also gone on to top business schools (Kellogg, University of Chicago, Wharton and MIT) to earn MBAs. Several of his students are in technology management positions in large corporations (such as IBM and W.L. Gore), and small business/entrepreneurial companies (such as Imaginestics and Picsquare). More recently he was a Co-PI in a winning IGERT on sustainable electronics that is having fundamental impact on the education of students in multiple cross-disciplinary fields.

Computer-Aided Design and Prototyping (ME 444) is a popular elective that combines fundamentals of CAD and finite element analysis with hands-on use of commercial software to teach the use of modern computer tools for engineering design, analysis and manufacturing. The goals for this course are: a) To help students learn multi-dimensional aspects of advanced product design and b) Allow practice it in a collaborative environment while prototyping a working toy. The learning environment combines (1) hands-on use of intranet for computer-based learning through the usage of a browser, (2) team-based project to prototype a real product, (3) full virtual design and assembly of the student created toy using CAD, (3) realistic budget and constraints, and (4) advanced prototyping techniques. ME444 was developed about 20 years ago as an innovative approach for teaching Computed-Aided Design (CAD) and prototyping to students in Mechanical Engineering. Around 2400 students have seen the benefits of this experience. The evolution of the course in the past was directed especially towards developing a "self-paced" CAD learning content for students, as well as towards using the instructors' knowledge to integrate CAD based methods into the course. The course was application-oriented in that the students learned CAD concepts, and applied them to a course project to design an "action toy" with significant geometric and mechanical complexity. Both these complexities of the toys have continued to increase during the evolution of the course. With a strong need to address innovation proactively in both, the economy and students' capabilities, we have been transforming ME444. We are embedding new learning on "design

thinking" and "doing", enabling students to be creative and innovative designers with strong engineering skills.

The i8™ framework is the engine for innovative design thinking combined with engineering being embedded in ME444 to actively support the learning and experience in the design innovation process. i8™ stands for Inspiration, insight, ideation, imagination, iteration, implementation, impact for INNOVATION. In a globalized and competitive world, new engineers need better frameworks that can make use of tools such as CAD. But CAD tools alone cannot make innovative designers. This is why new engineers cannot ignore the importance of innovation and experience and practice design thinking, combining play and imagination with engineering design. Albert Einstein said: "We can't solve problems by using the same kind of thinking we used when we created them". If current problems have been created by over-structured design processes, and tools like CAD, we should probably look for solutions by injecting child-like thinking through flexible processes and imaginative tools, in the form of PLAY. Play used as a part of I8 framework is critical for imagination and creating a future that does not exist and for being innovators using engineering as a creative problem solving process in their careers.

Our students are aware that CAD has become a fundamental tool for engineers in industry. This is one of the reasons for the popularity of the class. However, almost every engineering school, not only in the country but around the world, are providing students with this important knowledge. Also, CAD has to be used at the right time in the design process. Researchers have pointed out some potential risks of using CAD software, for example circumscribed thinking, premature fixation, and bounded ideation. In other words: CAD could become an innovation killer if designers are not trained carefully to avoid these risks and if they do not have other skills to complement the CAD process. This means being proficient in CAD is not enough to become an outstanding engineer for the future, the "Imagineer".

Divergent and convergent thinking is also important for design thinking. Divergence and convergence cycles form the basis for ideation and iteration — both part of the i8™ concept. It has been suggested that careless use of CAD software can stop the divergent process, restraining the possibilities for innovation. Play and an appropriate timing for implementation of CAD tools in the design process can prevent these problems and boost the potential of both tools: Play and CAD. This will lead to innovative high-quality products and grow engineering students to be "imagineers", professionals ready to overcome the biggest challenges with innovative solutions.

The challenge is now to provide students with modern computational tools, avoid the potential risks of their inappropriate use, and yet add value to design through innovation. Our design team decided to re-design the ME444 course, applying the i8™ principles, and in turn informing the i8™ framework. Inspiration from other courses on innovation and results from research on engineering education, design education and cognitive sciences was an important starting point. Our approach empowers the students with frameworks for play, value-based innovation, and creation of concepts using the language of the designer: freehand sketching, at the appropriate times in the design process. This basic approach in developing a new language for design for engineering, using free-hand sketching, has the capacity to address the potential problems of CAD, and to create an imaginative thinking using better spatial visualization of designs that do not exist.

Although well known and recognized as a basic tool for engineers, freehand sketching or the "mind's-eye" is an ability poorly developed in engineering students. It is taught in contexts that do not allow them to see this as a way of thinking about designing, but only as a way to learn current CAD frameworks better, such as in technical graphics. However, in disciplines such as Architecture and Industrial Design, freehand sketching is taught as a means for problem solving, idea generation and concept generation. For engineers, most of the time, concepts such as perspective sketching have become just an old fashioned way taught before CAD. Thus, the engineers' creativity can be increased by helping them learn a new way of freehand sketching, build it into their experiential design process, such as toy design, so they have hands-on experience for designing and thinking. This new imaginative engineering and design learning space for all of the i8™ processes to 'flow', along with sketching, is the new ME444.

In the process of rediscovering freehand sketching, some aspects have been identified and tied together in an easy to understand way. Application of perspective, expression of motion, understanding of "soft pencil" sketching, construction of complex shapes in one's mind using primitives, and high-speed shape construction, are a short list. Dedicated workshops have been designed to provide these tools to students and the contents have been carefully interwoven into the class timeline. The goal is to create a complete and sound set of methods and frameworks that are abstract, but also connected to toy design, in the i8™ environment. This way of situated learning will cultivate in them an imagination that can be applied in new contexts much beyond toy design. Our course is a flow of experiences that will enable students to transform their imaginations in service of innovation, thus transforming their ideas to have impact. A previous pilot experience suggested this was the way to go, but the complete approach is currently being implemented for the first time. We are glad to show you what are we doing now and expecting for having feedback and data which validates those hypothesis by next year.

Redesigning a successful course is based on the principles of how we can create affordances for better learning. Motivation in its different forms is key in earning the attention of students. Retention cannot be guaranteed, but it is most likely to happen once people are motivated and drawn to pay attention to new points of view. Finally, reproduction of this new knowledge and application of the i8™ framework is expected to be visible in the final outcome of the class: the toy. The flow of topics, workshops and laboratories are designed to make learning based on the above concepts fun.

Product Design and Innovation (ME553): The Innovation: The core contributions to help students learn design broadly are embedding of innovation and creativity in a novel dual level technical elective for product and process design (ME553) which includes an engineering professional continuing education distance component. This initiative has continuously infused design thinking to conceptualize, develop, and prototype high impact concepts into students design capabilities and practice. This course has a very high impact both on and off-campus and built innovation capacity among his students. A particular contribution is methods for opportunity identification and problem definition, which is a very important skill for innovation. The impact of these ideas have so far reached over 600 students, with roughly 60 students taking this elective each year.

The current efforts are directed towards building a team that is engineering design innovation centered within the School of Mechanical Engineering for senior design projects. Over the past few years, academic institutions have become aware of the importance of innovation in

education, as well as its broader role in strengthening the economy. Both creativity and innovative thinking are not easy to teach in the classroom, but they can be developed by practice and experience. Evaluating innovation as a part of product design courses has thus become very important to increase the probability of students becoming innovators in the real world.

Rationale: Innovation has been the key to America's success for more than a century. Scientific and technological innovations have fostered our economic and social prosperity for the previous two centuries, accounting for nearly half of the economic growth in the U.S. in the last 50 years. Innovation is now recognized as "the single most important ingredient in any modern economy". Global competition is redefining the process of innovation, and the competitive advantage that the U.S. had over the world is being challenged. There has never been a clearer imperative to improve the innovative and entrepreneurial mindset of U.S. college graduates, particularly in engineering. Unfortunately, creativity - an important precursor to innovation - appears to be on the decline in the U.S. In addition, many students do not view engineering as a field of study for "creative types". This is especially true considering how engineering is "marketed". We need to rethink how we attract and educate engineers to support the technological and social innovations that are needed to address the many complex global challenges and problems.

VISION

To address these challenges, we created a platform for building innovative capacity in students while they are learning and having fun.

Objectives: Our approach to developing a series of successful and entrepreneurial initiatives are informed by a strong framework we have developed over the past two decades. They are described below in understanding, studying and developing strategies for making them innovative through implementation and assessment. The operational definition of innovation for the purposes of student design projects we used is: "Innovation is a new match between a need and a solution. The novelty can be in the solution or the need; or in a new marriage between both existing need and solution".

1) Understand what makes engineers innovative: Our educational research in the School of Mechanical Engineering was enabled by the encouragement and support of ME alumnus Tom Mallot through the innovation awards. The collaborative findings suggest that engineering specific skill development may be overemphasized and in addition providing more breadth of knowledge is more valuable for engineering innovation. However, some interpret the breadth as "watering-down," which in our view is not a trade-off. Such differences suggest that what the faculty perceive as critical may differ from what the "real world" needs, and there are opportunities to engage industry and students differently about what is essential in the world of innovative work.

ME553, which is also a distance component vastly successful in industry, supports distributed infrastructure partly using a Wiki to help students develop opportunities into viable, feasible and desirable product concepts. We have published our research on mechanisms that are operative when the social distance is higher in teams with non-collocated students such as reflective thinking and shared understanding. We also have developed a global component for ME553 projects where the teams work with others in Netherlands (Delft), Colombia (EAFIT), South

Africa, and India (IIIT) in distributed teams. The teams develop product concepts at the interfaces of ubiquitous computing and a social context and also a prototype for testing.

2) Study how engineers learn to be innovative, which will help identify the pathways students take to become innovative as well as the barriers that hinder innovation in academia. Recent work by our collaborators has shown that everyone rated intrinsic motivation and divergent thinking ability among the top five attributes of innovators, and all groups considered early stage creativity skills essential. This strongly suggests that educators should emphasize problem and opportunity recognition in their courses. By holding innovation tournaments, we are striving to develop innovative design thinking in students and while they gain practical application experiences in the context of design projects. Understanding design innovation at a deeper level in the context of student project is critical to develop a realistic perspective of it among students. Determining the appropriate dimensions for understanding and measuring innovation is one of the objectives of his current efforts.

3) Develop strategies to make engineers more innovative, which will create robust and reliable corridors via educational synergies with industry and local, state, and national partners. The overall strategy is to use the emerging platform of 6400 square feet of design project space in the new Gatewood Wing of Mechanical Engineering as a platform for research in design innovation. As part of this work, they have paired engineering design (ME553 and senior design projects) with social science/organization behavior and communication studies courses, respectively, to examine the impact of innovation networks on the process of innovation. Taking an interdisciplinary research approach, the teams sociologically focused work will complement the research in engineering design processes by exploring the consequences and capabilities of the social and organizational contexts surrounding the design and development of products and services.

Intellectual Property (ME554): He partnered with a corporate attorney and developed a course in 2000 that was timely and requires significant attention. From the second offering the course was handled by Dr. John McNett who was then appointed as an adjunct professor in the school of mechanical engineering. This course was well subscribed and covered the basics of patent, patent systems, case studies, utility, inventorship, ownership, assignment and licensing. The enrollment of this course has ranged from 20 to 30 students when it is offered once each year. This course is synergistic with the design curriculum in engineering and especially suited to design students.

Composites and Polymer Processing (ME 555) provides students with interdisciplinary experiences in processing and design aspects of polymers and their composites. Students work on semester-long projects, many of which are industry supported problems that involve making prototypes in his laboratory. This course is reflective of Dr. Ramani's earlier research.

Principles, Analysis and Control of Manufacturing Processes (ME 363) was initially co-developed by Dr. Shin and assisted by Dr. Ramani. ME363 is a hands-on course that provides students with experiences in design and manufacturing processes and a basic understanding of manufacturing with metals, polymers and composites. It integrates their experiences in earlier core courses with fundamentals of polymers in engineering applications. The Composites and Polymer Processing Laboratory was utilized extensively for the hands-on complement of ME555 and ME363. This course is now being taught by Professor Shin.

Laboratory Development:
Professor Ramani has developed a unique Composites and Polymer Processing laboratory that has the capability to develop and test new processing concepts in a variety of processes. An electrostatic powder coating line has been developed that can handle continuous fibers and a variety of polymeric powders. This line includes a fiber tensioner (minimum of 5 gms tension), fiber spreader, metered powder supply, tunnel oven and a filament winder. A significant portion of the equipment including a new corona wire charging apparatus and consolidation apparatus in filament winding were designed and constructed by graduate and undergraduate students (NSF-REU). Three computer-controlled compression molding presses (two 20 ton and one 12 ton), a 50 ton computer-controlled injection molding machine, a 5 kW computer controlled induction heating unit, Polylab Extrusion System from Haake, and custom built joining apparatus to make controlled polymer-metal and polymer-ceramic joints allow for developing and testing a variety of manufacturing processes. A 20 kips tensile testing machine, diamond saw, polishing unit, Polarized Optical Microscope (POM) with computer image analysis system, Differential Scanning Calorimeter (DSC), Dynamic Mechanical Analyszer (DMA), Environmental chamber with fatigue testing capability, allow testing and characterization. Significant equipment were donated by industrial partners of sponsored research. This laboratory was used for sponsored research as well as hands-on laboratories earlier in his career. He acquired a precision wire elecro-discharge machine to support rapid tooling design and development. The equipment was donated to other labs within Purdue University when professor Ramani transitioned his research to computational design and shape analysis.

Professor Ramani has developed significant computational infrastructure for web-based software development. Most of the infrastructure in his labs is now computational infrastructure for software design, development and prototyping. The infrastructure was used to conduct the annual Shape Recognition Competition for IEEE and maintaining the shape benchmark. He has also embarked on an initiative to combine his research in 3D search and discovery of structure and knowledge in data with infrastructure from the NSF NCN infrastructure for a new 3D Hub that was supported by the National Science Foundation.

Current infrastructure and platforms in his lab are related to the sketch-wiki, visual Exploratorium for design, gesture enabled shape creation, and design learning; all of which are currently supported by the National Science Foundation.

Short Courses

1. “Introduction to Maple,” Engineering Computer Network, Purdue University, West Lafayette, Indiana, September 1992.
2. “Composites Manufacturing Short Course,” Naval Air Warfare Center, Aircraft Division, Indianapolis, Indiana, September 1996.
3. “Integrated Design and Processing for Surgical Device Design,” Valleylab, formerly a Division of Pfizer, Boulder, Colorado, 1997.
4. "Process and Product Design," through Pentafour Communications for 40 participants from Industry in Asia, Madras, India, 1998.

Professional Society Memberships

Society for Advancement of Materials Process Engineering (past)

Society for Automotive Engineers (past)

Society for Plastics Engineers (past)
American Society of Mechanical Engineers (present)
Association of Computing Machinery (present)
Society of Manufacturing Engineers (present)

SERVICE ACTIVITIES

Professor Ramani has also taken on an extensive leadership role in service activities at the National levels. Dr. Ramani's services on a national level include serving on the Committee of Visitors at the National Science Foundation for the Industrial Innovation and Partnerships (IIP, 2006-07), and more recently has been serving on the National Science Foundation Advisory board for Small Business Innovation Research (SBIR/STTR program) of IIP (2007-present). IIP now manages the Industry University Centers, the Partnership for Innovation, the Grant Opportunities for Academic Liaison with Industry, and Small Business Research programs. He was on a sub-committee for enhancing Industry University relations at NSF and currently serving on another sub-committee for developing Innovation Measures in small businesses. He played an important role in development frameworks and performing a gap analysis for the flow of knowledge from early discovery through small business innovation programs. In this capacity he also served on a sub-committee on University Industry Partnerships. He served on a sub-committee that is developing innovation metrics for assessing the progress of research to realization in the small business research programs. His sub-committee appointed by NSF Engineering Directorate, reviewed NSF's role in knowledge transfer and assessed the need for a more proactive approach. The statutory landscape for industry-university partnerships were analyzed, especially the regulations on how licensing rights to federally funded inventions can be transferred for purposes of commercialization. Specifically the team identified structures and processes that Engineering can implement in order to increase access by industry and other research customers to NSF-supported discoveries.

He has served Purdue extensively by his service on the Graduate Committee, Advisory Committee to Mechanical Engineering, chairmanship of the Materials and Manufacturing area since 2004, Design Committee, Mechanical Engineering Leadership Task Force, Web Task Force, Graduate Committee and Internal Award Committees. In addition he has also served on several search committees including recent searches in sustainable industrial systems, and information and cyber-infrastructure related search committees. Professor Ramani is also actively involved in mentoring undergraduate students including through the Summer Undergraduate Research Fellowship program and senior design projects each year on a voluntary basis. He is also serving as a mentor for three junior faculty recently hired in Mechanical Engineering. He firmly believes that advanced thinking is necessary nationally and within Indiana in Design and Manufacturing. He has been involved extensively in completing several projects in Manufacturing and Production for Indiana Small Businesses through the Technical Assistance Program. He engaged in professional development of students through the Society for Advancement for Materials and Process Engineering.

He has been extensively involved in professional societies in leadership roles and more recently serving at the national level advisory boards. His involvement with the American Society of Mechanical Engineers has been extensive. He has served on the Polymer processing group of the

Materials Division as chair and conducted several symposia. In addition in the past 5 years he served in the Computers and Information in Engineering Division, organizing several sessions through his chairmanship of the Internet-Aided Design, Manufacturing and Commerce committee. He then continued his active involvement in ASME International Design Engineering Technical Conferences in Computer-Aided Product and Process Design (CAPPD), Design for Manufacturing and Lifecycle (DFMLC), Systems Engineering & Information and Knowledge Management (SEIKM) Technical Committee and hence more broadly through the computers and information in engineering division (CIE). He co-organized several sessions in Design Informatics from 2009-13 (continuing, Ying Liu and others), He also served on the executive committee for CIE 2010-11 in his quest to make broader contributions to ASME. He also contributed to the design automation committee by bridging the gaps created between CIE and DAC divisions. He has been involved through organization of several symposia and conferences in IDETC.

His major recent contributions were in helping organize several sessions in the sustainable design and manufacturing areas, bringing together researchers outside the community into ASME. He also co-organized a special issue in ASME Journal of Mechanical Design in a synchronous manner actively help creating an entire community in ASME-IDETC which is growing. This special issue with co-organizers (Skerlos and Slocum) has made ASME JMD known for its proactive involvement in sustainable design area.

Service activities within the Purdue community are listed below:

Coordinator Product Engineering and Realization Laboratory, Proposals and Acquisitions (1997-1999)

Graduate Committee, School of Mechanical Engineering (1994-1997)

Advisory Committee, School of Mechanical Engineering (1995-1996)

Design Committee, School of Mechanical Engineering (1991-present)

Materials and Manufacturing Processes Committee, School of Mechanical Engineering (1993-present)

Deans Research Advisory Committee (1997 - 1998)

Search Committee, Federson Chaired Professor in Information Technologies (1998 - 1999)

Search Committee, Faculty in Design/Mechanics (1997-1998)

Search Committee, Faculty search (2001 – 2002)

Web Task Force, (2001- 2002)

Involved in two cluster proposals and in the search committees for:

Search Committee, Global Sustainable Industrial Systems (GSIS) (2003-2006)

Search Committee, Information, Communications and Perception Technologies (ICPT) (2003-onging)

Manufacturing Area Chair, Mechanical Engineering, 2004 – present.

Search Committee Chair, Cyber and Information Systems, 2006 – 2007

Search Committee Chair, Design Search, 2009 – ongoing

Deans Strategic Plan Execution Team on “Creativity/Innovation Development,” 2009

Design-Innovation Development, School of Mechanical Engineering, 2009 – present

Deign Area Development Initiative, School of Mechanical Engineering, 2009 – present (chaired committee that hired four faculty in the design area)