

## **David Robert Wallace**

Professor of Mechanical Engineering, MacVicar Faculty Fellow  
Massachusetts Institute of Technology

Professor David Wallace is a Professor in Mechanical Engineering at the Massachusetts Institute of Technology. He earned his Bachelor of Engineering and Bachelor of Industrial Design degrees at Carleton University in Ottawa, Canada. He received his S.M, and Ph.D. degrees in Mechanical Engineering at the Massachusetts Institute of Technology in 1994, and joined the faculty in 1995.

Professor Wallace's focus, in both research and teaching, is on innovative, socially responsible product design—ranging from computational tools and processes that increase the likelihood of successful innovation, to skills and techniques for designing and improving creativity. Through the application of his unusual background in both engineering and industrial design, Professor Wallace's goals are to develop new methods that impact upon the practice of product development and to help inspire and equip the next generation of engineering innovators, all while continuing to learn new things and have fun in the process.

### ***Research***

Professor Wallace's research group has focused on software tools to support integrated system modeling and crowd-sourced design, design methods to enhance idea generation and creativity, hardware and technology development projects, and design education methods ranging from service learning to the use of new media in the classroom. His group's work on developing an Internet-service based integrated modeling and simulation method has resulted in two startup companies and was licensed by Ford Motor Company. The work is currently being applied to create a platform for crowd-sourced technical design. Work in hardware and technology development has led to a foam launching method that has been licensed by Hasbro, and most recently a new type of acoustically driving harmonic motor. In the late 1990s, his group published early work studying how lecture time might be utilized for active learning given the rise of new-media and web-based materials. The group's work on creativity and idea generation has been adopted in a number of design courses and has also lead to short courses/training programs for industry practitioners and other academic institutions.

Professor Wallace has mentored 11 doctoral students, 60 Master's students, and 90 Bachelor's level thesis students. The majority of these students are employed at successful product development firms, work in research labs, or have started their own companies. Former students are faculty members at the University of Minnesota and the University of Perugia.

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### *Design Education*

Professor Wallace's goal is to provide students with an understanding of creative processes and design techniques that will help them to innovate more reliably, whether they ultimately choose to engage in the engineering of new products, research, or even other professions.

He teaches the senior core class 2.009, Product Engineering Processes, (extensively documented at <http://web.mit.edu/2.009>) that focuses on innovative engineering design processes, the graduate class 2.744, Product Design, (<http://web.mit.edu/2.744>) that focuses on user-centric design and design techniques, and the freshman design class 2.00b, Toy Product Design. Toy product design provides incoming students with a motivating and confidence-building introduction to product design. Nearly 1/10 of all MIT undergraduates take this elective. He has also worked with other educational institutions to help them develop design curricula.

An overarching philosophy that guides his approach to teaching is the importance of both *what* and *how* one teaches. For example, the senior course, 2.009 is framed as a story that immerses and transports students through the process of identifying product opportunities and developing new products—ending with a prototype launch that is attended by 1200 guests from industry and academia (see figure 1). Each year, after the class, a number of teams pursue intellectual property and form startup companies. The class is to be featured in the May 2012 issue of *Technology Review*.



Figure 1: The 2.009 new product launch (final presentations).

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Professor Wallace has a history of pioneering new educational approaches, ranging from early quantitative experiments on the use of new media in the classroom, to a television program intended to inspire youths to pursue science and engineering careers. Professor Wallace was the content director, challenge director, and animation designer for the Peabody Award-winning program *Design Squad* (seasons 1 and 2, 2007 and 2008). He played a key role in preproduction planning, production, and post-production, and taught and oversaw the high school-aged teams throughout the challenges.

Professor Wallace is known for the use of his innovative, engaging, active class exercises, such as the viral “Archimedes Death Ray” class estimation and concept mockup exercise (<http://web.mit.edu/2.009/deathRay.html>), which has been viewed by millions online, covered in media including *The New York Times*, *Science Magazine*, news outlets world-wide, children’s science magazines, and physics textbooks. The work resulted in students appearing on *Mythbusters*.

Professor Wallace’s teaching has been celebrated through numerous awards, including the highest teaching honor at MIT, a MacVicar Faculty Fellow, and the coveted, institute-wide, student-nominated Baker Award for Teaching Excellence. The class “2.00b Toy Project Design,” was featured in *Popular Science* in July 2010.

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### *Education*

Ph.D.	Massachusetts Institute of Technology	1994
S.M.	Massachusetts Institute of Technology	1991
B. Eng.	Carleton University	1989
B. Industrial Design	Carleton University	1986

### *Selected Honors and Awards*

University Medal in Industrial Design, Carleton University	1986
Chancellor's Medal for outstanding academic achievement, Carleton	1989
1967 Scholar, NSERC, Canada	1989
Carl G. Sontheimer Prize for outstanding graduate research, MIT	1991
MIT Karl Chang Fellowship	1992
Volvo Environmental Research Award	1995
Klegerman Award for Environmental Excellence in Teaching	1995
ASME International Design Engineering Division, Design for Manufacturing Committee IBM Best Paper Award for "Integrating Environmental Impact Assessment into Product Design"	1998
Keenan Award for Innovation in Undergraduate Education, MIT	2000
GECCO Best Paper Award Nominee For "Dynamic Multi-Objective Optimization with Evolutionary Algorithms: A Forward-Looking Approach"	2006
Bose Award for Excellence in Teaching	2006
Everett Moore Baker Memorial Award, Undergraduate Teaching	2006
MacVicar Faculty Fellow	2007
Peabody award for PBS show Design Squad (Content director, challenge director, animation designer)	2008
Den Hartog Distinguished Educator Award	2009

## Journal Publications of **David Robert Wallace**

1. Dighe, Rahul; Mark J. Jakiela, and David R. Wallace, "Structural Synthesis Under Manufacturability Constraints: A CAD System for the Design of Injection-Molded Product Housings," *Research in Engineering Design*, 5, 185-201, 1993.
2. Wallace, David R.; and Nam P. Suh, "Information-Based Design for Environmental Problem Solving," *Annals of the CIRP* 42, 175-179, 1993.
3. Wallace, David R.; and Mark J. Jakiela, "Automated Product Concept Design: Unifying Aesthetics and Engineering," *IEEE Computer Graphics and Applications* 13, 66-75, 1993.
4. Wallace, David R.; Mark J. Jakiela, and Woodie C. Flowers, "Multiple Criteria Optimization Under Probabilistic Design Specifications Using Genetic Algorithms," *Computer-aided Design* 28, 405-421, 1996.
5. Wallace, David R.; and Philip Mutooni, "A Comparative Evaluation of Classroom and Web-Based Teaching," *ASEE Journal of Engineering Education* 86, 211-217, 1997.
6. Jackson, Paul; and David R. Wallace, "An Analytical Method for Integrating Environmental and Traditional Design Considerations," *Annals of the CIRP* 46, 355-360, 1997.
7. Pahng, Francis; Nicola Senin, and David R. Wallace, "Distributed Object-Based Modeling and Evaluation of Design Problems," *Computer-aided Design* 30, 411-423, 1998.
8. Wallace, David R.; and Suzanne Weiner, "How Might Classroom Time Be Used Given WWW-Based Lectures? A Comparison of a Lecture-Style Second Coverage of Materials vs. Limited-Coverage Guided Experiential Activity," *ASEE Journal of Engineering Education* 87, 237-248, 1998.
9. Abrahamson, Shaun; David R. Wallace, Nicola Senin, and Peter Sferro, "Integrated Design in a Service Marketplace," *Computer-aided Design* 32, 97-107, 2000.
10. Borland, Nicholas; and David R. Wallace, "Environmentally-Conscious Product Design: A Collaborative Internet-Based Modeling Approach," *Journal of Industrial Ecology* 3, 33-46, 2000.
11. Kraines, Steven; David R. Wallace, and Hiroshi Komiyama, "Applications of DOME in Chemical Engineering", *Journal of the Chemical Engineering Society of Japan*, 64(5), 228-231, 2000.

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12. Senin, Nicola; Roberto Groppetti, and David R. Wallace, "Concurrent Assembly Planning with Genetic Algorithms," *International Journal of Product Design and Process Development* 16, volume 64, number 5, 228-231, 2000.
13. Sousa, Ines; Julie L. Eisenhard, and David R. Wallace, "Approximate Life-Cycle Assessment of Product Concepts using Learning Systems," *Journal of Industrial Ecology*, 4, no. 4, 61-81, 2000.
14. Kraines, Steven; Hitoshi Shigeoka, David R. Wallace, and H. Komiyama, "Collaboration Platform and Application to Household Waste Plastic Processing", *International Journal of Technology Transfer and Commercialisation*, 3 (2), 129-146, 2000.
15. Senin, Nicola; Roberto Gropetti, David R. Wallace, and Simone P. Ercolani, "Distributed Objects to Encapsulate Machine Tools in Integrated Design and Manufacturing Environments", *International Journal of Agile Manufacturing*, 4, No. 2, 2001, 69-84, 2001.
16. Anderson, Johan; and David R. Wallace, "Pareto Optimization Using the Struggle Genetic Crowding Algorithm", *Engineering Optimization*, 34, 623-643, 2002.
17. Park, J.H; K. K. Seo, David R. Wallace, and K. I. Lee, "Approximate Product Life Cycle Costing Method for the Conceptual Product Design," *Annals of the CIRP*, 51, (1), 421, 2002.
18. Kraines Steven; David R Wallace , Y Iwafune , Y Yoshida , T Aramaki , K Kato , K Hanaki , H Ishitani, T Matsuo, H Takahashi, K Yamada, K Yamaji, Y Yanagisawa, and H Komiyama, "An Integrated Computational Infrastructure for a Virtual Tokyo: Concepts and Examples," *Journal of Industrial Ecology*, 5(1), 35-54, 2002.
19. Senin, Nicola; David R. Wallace, and Nicolas Borland, "Distributed Object-based Modeling in Design Simulation Marketplace," *ASME Journal of Mechanical Design*, 125, 2-13, 2003.
20. Kraines, Steven; and David R Wallace, "Sustainability Technology Evaluation in a Regional Context Using Distributed Information Technology," *Computers, Environment and Urban Systems*, 27 (2): 143-161, 2003.
21. Koyama, Michihisa; Steven Kraines, Kanako Tanaka, David R. Wallace, Koichi Yamada, and Hiroshi Komiyama, "Integrated Model Framework for the Evaluation of and SOFC/ GT System as and Centralized Power Source," *International Journal of Energy Research*, 28, (1), 13-30, 2004.

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22. Evans, Mark; David R. Wallace, David Cheshire and Bahar Sener, "An Evaluation of Haptic Modeling Feedback During Industrial Design," *Design Studies*, 26, (5), (2/3), 487-508, 2005.
23. Kraines, Steven; Rafael Batres, Michihisa Koyama, David R. Wallace, and H. Komiyama, "Internet-Based Collaboration for Integrated Environmental Assessment: Using Ontologies to Share Computation Models", *The Journal of Industrial Ecology*, 9, (3) 31-50, 2005.
24. Kraines Steven; M. Koyama, C. Weber, T. Ikaga, T. Chikamoto, David R. Wallace, and H Komiyama. "A Collaborative Platform for Sustainable Building Design Based on Model Integration Over the Internet," *International Journal of Technology Transfer and Commercialisation*, 2/3, 135-161, 2005.
25. Sousa, Ines; and David R. Wallace, "Product Classification to Support Approximate Life-Cycle Assessment of Design Concepts," *Journal Technological Forecasting & Social Change*, 73, 228-249, 2006.
26. Kudrowitz, Barry and Wallace, David. "The Play Pyramid: A Play Classification and Ideation Tool for Toy Design." *The Journal of Arts and Technology*. Vol 3, Issue 1, 2010.
27. Kraines, Steven; Takeshi Ishida, David R. Wallace, "Integrated Environmental Assessment of Supply-side and Demand-side Measures of Carbon Dioxide Mitigation in Tokyo, Japan", *Journal of Industrial Ecology*, 14/5, 808-825, 2010.
28. Kudrowitz, Barry and Wallace, David. "The Play Pyramid: A Play Classification and Ideation Tool for Toy Design." *The Journal of Arts and Technology*. Vol 3, Issue 1, 2010.
29. Sangmok Han, David R. Wallace, Robert C. Miller, "Code completion of multiple keywords from abbreviated input", *to appear in Journal of Automated Software Engineering*, 2011.
30. Kudrowitz, Barry; Te, Paula; and Wallace, David. "The Influence of Sketch Quality on Perception of Product-Idea Creativity." *AI EDAM: Special Issue on Design Creativity*. To appear 2012.
31. Kudrowitz, Barry and Wallace, David. "Assessing the Quality of Ideas from Prolific, Early Stage Product Ideation." *Journal of Engineering Design: Special Issue on Design Creativity*. To appear 2012.