

PROMOTION RECOMMENDATION

The University of Michigan
College of Engineering

R. Brent Gillespie, assistant professor of mechanical engineering, Department of Mechanical Engineering, College of Engineering, is recommended for promotion to associate professor of mechanical engineering, with tenure, Department of Mechanical Engineering, College of Engineering.

Academic Degrees:

Ph.D. 1996 Stanford University, Mechanical Engineering, Palo Alto, CA
M.S. 1992 Stanford University, Mechanical Engineering, Palo Alto, CA
M.M. 1989 San Francisco Conservatory of Music, Piano Performance, San Francisco, CA
B.S. 1986 University of California, Mechanical Engineering, Davis, CA

Professional Record:

1999 – present Assistant Professor, Department of Mechanical Engineering, University of Michigan
1996 – 1999 Postdoctoral Fellow, Northwestern University
1990 – 1996 Research Assistant, Stanford University
1994 – 1995 Summer Intern, Interval Research Corporation
1994 Research Engineering, Immersion Corporation
1986 – 1990 Product Development Engineer, Optical Communication, Division, Hewlett-Packard Corporation
1985 Cooperative Pre-Professional, Mass Storage Systems Division, IBM Corporation

Summary of Evaluation:

Teaching: Professor Gillespie has a very solid teaching record. He is a dedicated lecturer and a leader in curriculum innovation. He has taught seven different courses, three required undergraduate and four graduate courses, a record which reflects his diverse capability and his good citizenship. He has proven himself to be an effective lecturer in the classroom, consistently receiving between good and excellent teaching evaluations (his overall Q1 and Q2 average are 4.0 and 4.1, respectively) and demonstrating his ability to get his students excited about learning. His contribution to undergraduate curriculum and laboratory development is outstanding. He actively participated in creating several hands-on laboratories, including the X50 lab in ME and the embedded systems lab in EECS. He has also revitalized our graduate course in robotics. His interdisciplinary contributions to enhancing the mechatronics education in the College are commendable. Professor Gillespie is also a dedicated advisor and mentor to the graduate and undergraduate students who work in his laboratory. He creates an environment in his research group where students can explore new directions, learn from each other, and debate and critique the work of others.

Research: Professor Gillespie is emerging as one of the leading researchers in the field of haptics, with emphasis on the identification of multi-disciplinary factors governing haptic feedback and control. His work is characterized by a remarkable degree of originality and deep thought and holds considerable promise for future growth and impact. He already had a strong record of accomplishment in the field of cobots when he arrived at the University of Michigan. Since joining our Mechanical Engineering Department, Professor Gillespie has made significant contributions to shared control, which advances the state-of-the-art beyond supervisory control and may become a new paradigm for designing dynamic systems that physically interact with humans. He has established a significant reputation in the areas of biodynamic feed-through cancellation of unwanted human-machine interactions, hybrid dynamic systems

for haptics simulations, and haptics for rehabilitation. The last topic represents a new multi-disciplinary research direction that holds great potential. He has been able to obtain significant funding (more than 1.4M as PI or co-PI, half of which has come from NSF and NIH, and the other half from the Automotive Research Center) to support his research activities. He has maintained a healthy research group with four Ph.D. students already graduated and another four in the pipeline. He collaborates with a large number of researchers who speak highly about him. He has published 15 journal articles, three book chapters and 32 high quality conference papers that have demonstrated a great deal of originality. His body of work is of high scholarly content and has already made impact in the community, as evidenced by his 271 citations from Google Scholar. He has received national visibility and has been recognized by the prestigious NSF Presidential Early Career Award for Scientists and Engineers.

Recent and Significant Publications:

- F. Huang, R.B. Gillespie, and A.D. Kuo, "Human Adaptation to Interaction Forces During Learning of a Visuo-Motor Task", *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, vol. 14:3, pp. 390-397, September 2006.
- R.B. Gillespie and S. Sovenyi, "Model-Based Cancellation of Biodynamic Feedthrough Using a Force-Reflecting Joystick," *Transactions of the ASME, Journal of Dynamic Systems, Measurement, and Control*, vol 128:2, pp. 94-103, March 2006.
- R.B. Gillespie, V. Patoglu, E. Westervelt, and I. Hussein, "On-line Symbolic Constraint Embedding for Simulation of Hybrid Dynamical Systems," *Multibody System Dynamics*, Vol. 14:3-4, pp. 387-417, November 2005.
- V. Patoglu and R.B. Gillespie, "Feedback Stabilized Minimum Distance Maintenance for Convex Parametric Surfaces," *IEEE Trans. on Robotics*, Vol. 21:5, pp. 1009-1016, 2005.
- P. Griffiths and R.B. Gillespie, "Sharing Control Between Human and Automation Using Haptic Interface: Primary and Secondary Task Performance Benefits," *Human Factors: The Journal of the Human Factors and Ergonomics Society*, Vol. 47, No. 3, pp. 574-590, 2005.
- K.H. Kim, R.B. Gillespie, and B.J. Martin, "Modeling the Coordinated Movements of the Head and Hand Using Differential Inverse Kinematics," *SAE 2004 Trans. Journal of Aerospace*, vol. 1, pp. 180-185, 2004.
- R.B. Gillespie, "Kane's Equations for Haptic Display of Multibody Systems," *Haptics-e, The Electronic Journal for Haptics Research*, Vol 2:3., August 2003, <http://www.haptics-e.org>.
- R.B. Gillespie, C.A. Moore, J.E. Colgate, and M. Peshkin, "Kinematic Creep in a Continuously Variable Transmission: Traction Drive Mechanics for Cobots," *ASME Journal of Mechanical Design*, Vol. 124:4, pp. 713-722, December 2002.

Service: Professor Gillespie's record of service is consistent with our expectation at this stage of his career. He has served as the co-organizer and host for the weekly Mechanical Engineering Departmental Seminar Series and the CoE Control Seminar Series. He has performed a reasonable number of external activities, including serving on NSF review panels and reviewing papers for several journals and conference presentations. He has served as the publication chair for the 2006 Haptics Symposium.

External Reviewers:

Reviewer (A): "He developed a powerful feedback linearization technique and wrote the paper 'A general framework for cobot control' (2001) that stands today as the most important publication on cobots. It is standard reading for all of my students. The haptics field is fortunate to have several outstanding [junior] contributors... There is absolutely no doubt in my mind that Prof. Gillespie is the strongest intellect among this group."

Reviewer (B): "For me the most impressive new paper is the treatment of the nearest point problem. The approach of treating the minimum distance problem as a nonlinear control problem is ingenious."

Reviewer (C): "Haptics is sometimes a technology searching for a purpose. Dr. Gillespie is making sure haptics has a purpose by conducting pioneering work in applying haptics to neurorehabilitation."

Reviewer (D): "Brent Gillespie has made significant research contributions, which in my judgment are well recognized, documented, and likely to increase in significance to the field. His record strongly suggests continued high quality productivity in the future."

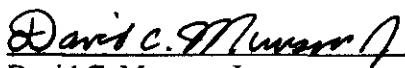
Reviewer (E): "I was particularly impressed by his paper on contact detection... The solution presented in this paper is an elegant application of control system synthesis to a difficult computational problem."

Reviewer (F): "In regards to Human Motor Control and Robot-Assisted Rehabilitation, Gillespie's work is insightful and well targeted... I believe that he has a unique perspective that is likely to yield important results, e.g., he has deeply intuitive sensibilities derived from his music and performance background that are intimately coupled with the formalities of dynamic, geometric, and kinematic modeling. I know of no one else with this combination of talents."

Reviewer (G): "This area of research [biodynamic feed-through cancellation], while it has a healthy community of interest, is not mainstream in robotics, yet. I think it is an example of Brent's leadership in the area of human-in-the-loop control..."

Reviewer (H): "The work on cobot control and the feedback stabilized minimum distance maintenance algorithms is outstanding—significant, elegant and general."

Summary of Recommendation: In summary, Professor Gillespie is a rare individual who combines an extraordinary intellect with the ability to identify and solve some very challenging and fruitful research problems in the exciting field of haptics that bridges disciplines. Thanks to his tenacity and ability to rebound, he has overcome the slow-down of his productivity in the early years of his tenure clock due to his adverse family circumstances at the time. In the past year, Professor Gillespie's productivity in publishing journal articles and mentoring Ph.D. students has continued in a trajectory commensurate with our expectations. All internal (campus-wide) and external referees state that Professor Gillespie has cleared the bar for promotion and tenure. It is with the support of the College of Engineering Executive Committee that I recommend R. Brent Gillespie for promotion to associate professor of mechanical engineering, with tenure, Department of Mechanical Engineering, College of Engineering.



David C. Munson, Jr.
Robert J. Vlasic Dean of Engineering
College of Engineering

May 2007