Approved by the Regents
May 20, 2010

PROMOTION RECOMMENDATION
The University of Michigan
College of Engineering

Yili Liu, associate professor of industrial and operations engineering, with tenure, Department of Industrial and Operations Engineering, College of Engineering, is recommended for promotion to professor of industrial and operations engineering, with tenure, Department of Industrial and Operations Engineering, College of Engineering.

Academic Degrees:

M.S.	1991	University of Illinois, Computer Science, Urbana-Champaign
Ph.D.	1990	University of Illinois, Engineering and Cognitive Psychology, Urbana-Champaign
M.A.	1985	Zhejiang University, Industrial Psychology, Hangzhou, China
B.Eng.	1982	Shandong University, Mechanical Engineering, Jinan, China

Professional Record:

2003 - present	Arthur F. Thurnau Professor, University of Michigan
1997 - present	Associate Professor (with tenure), Department of Industrial and Operations Engineering, University of Michigan
1991 - 1997	Assistant Professor, Department of Industrial and Operations Engineering, University of Michigan

Summary of Evaluation:

Teaching: Since joining the department in 1991, Professor Liu has been consistently recognized as the department's best classroom instructor. He has received prestigious teaching awards at the University and College level, including the Arthur F. Thurnau Professorship (2003), the Jon R. and Beverly Holt Award for Excellence in Teaching (2006 and 2009), and the CoE Faculty Education Excellence Award (2002). He has also been recognized by student societies for teaching excellence; Professor Liu is a two-time winner of the College SWE/SMES Outstanding Teaching Award, and a six-time winner of the Alpha Pi Mu IOE Professor of the Year Award.

Professor Liu has served as the anchor instructor for IOE 333, a core course in ergonomics. Since 1991, Professor Liu has taught the course 23 times, with enrollments typically ranging between 100 and 140. He has utilized active-learning teaching methods, including in-class experiments and demonstrations. Teaching evaluations have been consistently strong; the most recent ratings (4.69 for Q1 and 4.94 for Q2 in Winter 2009) are almost unheard of in a high-enrollment required class. Professor Liu's impact on undergraduate education extends beyond Michigan. He is co-author of *An Introduction to Human Factors Engineering*, a textbook that has been widely adopted. Since its introduction 1998, its annual sales have ranked first or second among introductory ergonomics textbooks, and a 3rd edition is currently in preparation.

Professor Liu is a highly-sought-after dissertation advisor, serving as chair or co-chair for 10 Ph.D. graduates. Five graduates have pursued careers as professors or research scientists at academic institutions, while five have pursued research careers in industry. Professor Liu currently serves as chair or co-chair for six current students.

Research: Professor Liu's area of research is Cognitive Ergonomics, i.e., the theoretical and empirical study of human information processing for purposes of optimizing work environments and equipment

with which people must interact to accomplish important tasks. His approach embodies a combination of theoretical novelty, formal rigor, and practical utility. He has brought his impressive scientific abilities and technical skills to bear on several major complementary areas including queuing-network modeling, engineering aesthetics, computer-aided ergonomics, and hortatory operations.

Professor Liu's queuing-network (QN) models provide a theoretical framework in which the mental scheduling of various streams of component cognitive and physical processes can be characterized precisely and used to make quantitative predictions about the speed of human performance under a variety of complex conditions. His models have yielded major conceptual treatments of the human "cognitive architecture" with important applications to activities such as data entry, driving, and multitasking. Professor Liu has likewise applied his theoretical and empirical expertise to engineering aesthetics. He has developed a comprehensive meta-theory and dual-process methodology for systematizing the steps whereby the designs of devices and jobs may be made more aesthetically appealing. Applications of this rigorous new approach are now being used for evaluation of automobiles, cell phones, cosmetic products, workplaces, and instructional technology.

Recent and Significant Publications:

Wu, C., and Liu, Y. (2008), "Queuing network modeling of transcription typing," *ACM Transactions on Computer Human Interaction*, 15(1), Article 6, pp. 1-45.

Liu, Y., Feyen, R., and Tsimhoni, O. (2006), "Queueing Network-Model Human Processor (QN-MHP): A Computational Architecture for multitask performance in human-machine systems," *ACM Transactions on Computer-Human Interaction*, vol. 13, no. 1, pp. 37-70.

Wu, C., and Liu, Y. (2008), "Queuing network modeling of the Psychological Refractory Period (PRP)," *Psychological Review*, 115(4), pp.913-954.

Lim, J., and Liu, Y. (2009), "Modeling the Influences of Cyclic Top-Down and Bottom-Up Processes for Reinforcement Learning in Eye Movements," *IEEE Transactions on Systems, Man, and Cybernetics,* 39(4), pp. 706-714.

Bauerly, M., and Liu, Y. (2006), "Computational modeling and experimental investigation of effects of compositional elements on interface and design aesthetics," *International Journal of Human-Computer Studies*, Vol. 64, No. 8, pp. 670-682.

Liu, Y. (1996), "Queueing network modeling of elementary mental processes," *Psychological Review*, vol. 103, pp. 116-136.

Service: Professor Liu has a distinguished service record both inside and outside the College. His service as the program advisor to nearly 500 IOE undergraduates from 1998 to present is outstanding. He serves as associate editor of two well-respected engineering journals and is a consulting editor for a top psychology journal. In addition to serving on numerous conference committees and as a session/panel/symposium organizer, Professor Liu has helped to define "Cultural Ergonomics" as part of the profession by founding an International Ergonomics Association Technical Committee on Cultural Ergonomics and serving as its Founding Chair.

External Reviewers:

Reviewer A: "...what impresses me most … is his ability to bring a fresh, integrative perspective to the research topics that he chooses. His papers strike me as products of a long deliberative process in which the initial focus was carefully chosen and then the related approaches were thoroughly reviewed and assessed. … His papers [on engineering aesthetics] are impressive because they provide a deep philosophical, historical, and mathematical approach to the field."

Reviewer B: "I have been particularly impressed by Professor Liu's ability to bring together ergonomic, psychological, and engineering theoretical perspectives in a coherent fashion and to combine this with

meticulous empirical research. This makes his work unusual in an area which often emphasizes application at the expense of empirical rigor and is rarely theory driven. … [Liu has] ...examined the theoretical foundations of aesthetic ergonomics in a much more thorough and rigorous way than had previously been the case... It is perhaps Professor Liu's recent work on modeling dual task performance which holds the most promise for the future and, in my view, is truly outstanding."

Reviewer C: "His ability to make important contributions across these different areas really is inspiring and illustrates the scientific and engineering impact he is having."

Reviewer D: "I expect his model to continue to be one of the main contenders for a long time."

Reviewer E: "Liu's work from 2001 and beyond has not only clearly had a major impact on the field and has help[ed] define the current focus of cognitive architecture research, but Liu's integration between high-level cognitive functioning and low-level neural pathways is more impressive and convincing than any other I've seen. ...the clarity and depth of Liu's work makes it not only highly impressive, but is filled with great ideas and careful analysis that one feels compelled to consider in their own work."

Reviewer F: "The QN model tackles one of the most fundamental challenges in human performance theory: what are the time limitations of decision and choice in high workload, multi-tasking environments. … Applying quantitative analysis and computational modeling to this all important area of human judgments, particularly in consumer products is truly innovative, creative, and ground-breaking work."

Reviewer G: "There is no question but that he has contributed substantially to building machinery better able to describe psychological and brain systems and which consequently aid in determining the best models for such systems."

Summary of Recommendation: Professor Liu is a gifted researcher and inspiring teacher who contributes large amounts of time to service both internally and externally. His research brings together ergonomic, psychological, and engineering theory in novel and creative ways to produce significant contributions within a practical context. He has mentored large numbers of undergraduate and graduate students and he is an excellent colleague. It is with the support of the College of Engineering Executive Committee that I recommend Yili Liu for promotion to professor of industrial and operations engineering, with tenure, Department of Department of Industrial and Operations Engineering, College of Engineering.

David C. Munson Jr.

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

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