

May 17, 2007

PROMOTION RECOMMENDATION
The University of Michigan
College of Engineering

Edgar Meyhöfer, associate professor of mechanical engineering, without tenure, Department of Mechanical Engineering, and associate professor of biomedical engineering, without tenure, Department of Biomedical Engineering, College of Engineering, is recommended for promotion to professor of mechanical engineering, with tenure, Department of Mechanical Engineering, and professor of biomedical engineering, without tenure, Department of Biomedical Engineering, College of Engineering.

Academic Degrees:

Ph.D. 1991 University of Washington, Zoology (Biomechanics), Seattle, WA
M.S. 1985 Northeastern University, Biology, Boston, MA
B.S. 1981 Universität Hannover, Biology, West Germany

Professional Record:

2001 - present Associate Professor (without tenure), Department of Mechanical Engineering,
University of Michigan
2001 - present Associate Professor (without tenure), Department of Biomedical Engineering,
University of Michigan
1995 - 2001 Assistant Professor, Department of Molecular and Cellular Physiology, Medical
School Hannover, Germany
1991 - 1994 Senior Fellow, Department of Physiology and Biophysics, University of Washington

Summary of Evaluation:

Teaching: Professor Meyhöfer has successfully transitioned from an instructor of medical students in Germany to an effective and versatile instructor at Michigan. He is praised by his students for his energy, dedication and enthusiasm, his ability to explain difficult concepts clearly, as well as his accessibility, his personality and his good sense of humor. He has taught a large gateway class (ME 211) for undergraduate engineers, and has also introduced a senior/graduate technical elective: ME 499/ME 406 Biomechanics for Engineering Students. His instructor evaluations for ME211 are consistent with the averages for this course, while those for ME 406 are very high (Q1=4.50 and Q2=4.63). At both levels he combines academic rigor with concern for teaching and making sure that students understand the material. He is a dedicated advisor who goes well beyond normal duty in mentoring his students. He is singularly noted by his students for his accessibility and his willingness to work alongside students at any level. He has graduated seven Ph.D. students, four from his tenure at Michigan, and currently has eight more in the pipeline.

Research: Professor Meyhöfer has established the Nanomechanics Laboratory and the Bio-Systems Laboratory which have fostered 17 collaborative research projects with researchers within and outside Michigan using extramural support totaling over \$5.2M (from which \$1.96M represents his share). His research findings are summarized in 32 journal papers (29 published, three accepted) including 14 which result from research activities at Michigan. His articles have generated large impact as measured by the citation record which includes over 620 individual citations. He is internationally recognized for seminal experiments on force generation by single kinesin molecules. This work alone has been cited over 210 times. Similar praise is offered for the candidate's research on myosin which exposed how the motor step length depends on the length and rotation of the neck region. At Michigan, he has developed a truly astounding notion; namely to use nature's motor proteins as the 'prime movers' in engineered micro

devices. Leading a team of six investigators, the candidate's "transformative" research program yielded three classes of protein-actuated micro devices including: (1) molecular sorters, (2) self-powered microfluidic pumps, and (3) rotary engines. This research is highly interdisciplinary as it requires expertise in molecular biology, optics, electronics/controls, florescent microscopy, micro-fabrication and engineering design. Indeed, he collaborates with an unusually large number of researchers who speak highly of him. The new research directions that Professor Meyhöfer's arrival has catalyzed at the university are truly exciting. By capitalizing on and expanding the interests of various faculty members to emerging biological research problems and Professor Meyhöfer's specialized skills and experimental capabilities, powerful research teams have been forged that allow new interdisciplinary approaches previously not possible.

Recent and Significant Publications:

- Lin, C.T., M.T. Kao, K. Kurabayashi and E. Meyhöfer (2006). Efficient Designs for Powering Microscale Devices with Nanoscale Biomolecular Motors. *Small* **2(2)**: 281-287.
- Lakamper, S. and E. Meyhöfer (2005). The E-hook of tubulin interacts with kinesin's head to increase processivity and speed. *Biophysical Journal* **89(5)**:3223-34.
- Cheng, L.J., M.T. Kao, E. Meyhöfer, and L. J. Guo (2005). Highly efficient guiding of microtubules in imprinted nanotracks. *Small* **1**: 409-414.
- Bull, J.L. A.J. Hunt and E. Meyhöfer (2005). A theoretical model of a molecular-motor-powered pump. *Biomedical Microdevices* **7**: 21-33.
- Hoff, J.D., L. Cheng, E. Meyhöfer, L. J. Guo, A. J. Hunt (2004). Nanoscale protein patterning by imprint lithography. *Nano Letters* **4(5)**: 853-857.
- Köhler, D., Ruff, C., Meyhöfer, E., Bähler, M. (2003). Different degrees of lever arm rotation control myosin step size. *Journal of Cell Biology* **161(2)**: 237-41.
- Ruff, C., M. Furch, B. Brenner, D. J. Manstein and E. Meyhöfer (2001). Single-molecule tracking of myosins with genetically engineered amplifier domains. *Nature Structural Biology* **8(3)**: 226-229.
- Meyhöfer, E. and J. Howard (1995). The force generated by a single kinesin molecule against an elastic load. *Proceedings of the National Academy of Sciences* **92**: 574-578.
- Ray, S., E. Meyhöfer, R.A. Milligan and J. Howard (1993). Kinesin follows the microtubule's protofilament axis. *Journal of Cell Biology* **121**: 1083-1093.
- Morse, M.P., E. Meyhöfer, J.J. Otto and A.M. Kuzirian (1986). Hemocyanin respiratory pigment in bivalve molluscs. *Science* **231**: 1302-1304.

Service: Professor Meyhöfer has taken on a considerable service load for an untenured faculty member at Michigan, having served on seven committees. In particular, as a member of the Department's Graduate Program Committee continuously since 2002, he has worked hard to improve the opportunities for women and underrepresented minority graduate students, as well as to reform the Ph.D. qualifying exam to enable students with interdisciplinary interests to excel in the Mechanical Engineering program. On behalf of the College, he also worked to create the first international Michigan workshop on single molecule spectroscopy. At the national and international level, Professor Meyhöfer has been active on numerous committees, including an NIH study section and the editorial board of the journal *NanoBiotechnology*, a position of visibility and importance.

External Reviewers:

Reviewer A: "There is no question that he has an excellent ability to select important problems. He also clearly has a great interest and track record of focusing on the most important questions in the field."

Reviewer B: "He demonstrates a unique perspective with a deep appreciation of the biologically relevant issues combined with the ability to utilize the most powerful experimental methods and physical measurement techniques required to elucidate the molecular action."

Reviewer C: "[The (PNAS,1995)] paper on the force generated by a single kinesin molecule was remarkable in its use of glass microneedles as force transducers, then, as now, a rarity in the west. Meyhofer is someone built for collaboration, and the interdisciplinary environment presented by your department is clearly energizing [sic] for him."

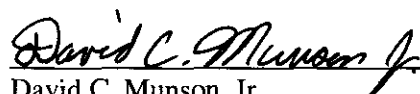
Reviewer D: "Without doubt [(*Nat. Struc. Biology*, 2001)]...represents one of the most important papers in this field over the last decade. ...Edgar's designs for kinesin-based nano-scale actuators are inspired. When he first presented his work to me during his visit to [my institution], I could barely keep still in my chair."

Reviewer E: "His work with genetically engineered myosin lever arms of different lengths was an excellent combination of the techniques of genetic expression of different molecules and the ability to analyze the mechanics of those molecules. He has continually worked on scientific questions of great interest and significance and promises to continue this."

Reviewer F: "I hold Dr. Meyhofer's scholarship in the highest regards and consider him to be among the most rigorous scientists I know. He has consistently chosen to focus on precise quantitative experiments that get to the heart of important scientific questions."

Reviewer G: "He has developed microscopic techniques to attack important question [sic] on the mechanism of molecular motors. Especially, he has constructed a unique single molecule measurement system. His techniques and experiments have been proved [sic] excellent in his publications."

Summary of Recommendation: In summary, Professor Meyhöfer is a world-recognized scholar working at the interface of mechanical engineering and molecular biology, with a solid and well-rounded record in teaching, research and service. He is unraveling the chemo-mechanical principles that control motor proteins and, further, pioneering their use as nano-scale actuators in micro-scale engineered devices. He is serving our University at large as a major collaborator in nano-scale science and engineering initiatives in the areas of biotechnology, biomedicine, and health sciences. He has established a strong foundation for what promises to be a fruitful career at the University of Michigan. All the external and internal referees have recommended that Professor Meyhöfer be granted promotion to professor, with tenure. It is with the support of the College of Engineering Executive Committee that I recommend Edgar Meyhöfer for promotion to professor of mechanical engineering, with tenure, Department of Mechanical Engineering, and professor of biomedical engineering, without tenure, Department of Biomedical Engineering, College of Engineering.



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

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