

PROMOTION RECOMMENDATION
 UNIVERSITY OF MICHIGAN MEDICAL SCHOOL
 DEPARTMENT OF RADIOLOGY
 UNIVERSITY OF MICHIGAN COLLEGE OF ENGINEERING
 DEPARTMENT OF BIOMEDICAL ENGINEERING

J. Brian Fowlkes Ph.D., Associate Professor of Radiology, with tenure, Department of Radiology, Medical School, and Associate Professor of Biomedical Engineering, without tenure, Department of Biomedical Engineering, College of Engineering, is recommended for promotion to Professor of Radiology, with tenure, Department of Radiology, Medical School, and Professor of Biomedical Engineering, without tenure, Department of Biomedical Engineering, College of Engineering.

Academic Degrees:

Ph.D.	1988	University of Mississippi
M.S.	1986	University of Mississippi
B.S.	1983	University of Central Arkansas

Professional Record:

2001-Present	Associate Professor of Radiology, University of Michigan Associate Professor of Biomedical Engineering, University of Michigan
1999-2001	Senior Associate Research Scientist, Department of Radiology, University of Michigan
1997-2001	Assistant Research Scientist, Department of Biomedical Engineering, University of Michigan
1993-1999	Assistant Research Scientist, Department of Radiology, University of Michigan
1991-1993	Research Investigator, Department of Radiology, University of Michigan

Summary of Evaluation:

Teaching: J. Brian Fowlkes, Ph.D., has been involved in numerous aspects of teaching both within the University of Michigan and at national and international levels. He has lectured in ultrasound for the "Physics of Diagnostic Radiology" course offered for radiology residents and students in the College of Engineering as Nuclear Engineering and Radiological Science (NERS) 579. Dr. Fowlkes is also the course director for the Medical Imaging Laboratory course "BiomedE510." This semester-long, comprehensive laboratory course provides hands-on experience to students from Biomedical Engineering (BME), Electrical Engineering and Computer Science (EECS), Applied Physics and other departments using research-grade imaging systems. Dr. Fowlkes coordinates the instruction and conducts the ultrasound portions. Dr. Fowlkes has chaired/co-chaired five dissertation committees (three in BME and two in Applied Physics). He directly supervised these students on a weekly basis. He has participated in 22

dissertation committees. For many of these students, he met directly with them on a weekly basis to provide teaching in medical imaging and physical acoustics. Dr. Fowlkes has mentored or co-mentored seven postdoctoral fellows where weekly one-hour meetings were combined with time together in the laboratory working on projects and instructing them in the advanced methods in medical imaging instrumentation.

On a national level, Dr. Fowlkes has been providing expert lectures on a variety of subjects in medical imaging for many years. He co-organized a categorical course series (and syllabus) for the Radiological Society of North America (RSNA) entitled "Diagnostic Radiology Physics: CT and Ultrasound Cross-sectional Imaging." This course was so successful that it was renewed for three more years for presentation at the RSNA annual meeting. (The RSNA is the largest radiology society in the world. Its annual meeting is attended by 62,000 participants.)

Dr. Fowlkes has presented numerous lectures for the American Institute of Ultrasound in Medicine (AIUM), the Acoustical Society of America (ASA) and the Institute of Electrical and Electromagnetic Engineering (IEEE). The lecture series sponsored by the AIUM on the physics of ultrasound imaging includes a two-day postgraduate lecture program. He was a guest lecturer in the course "Regulatory and Safety Issues in Biomedical Ultrasound" for the 2007 IEEE International Ultrasonic Symposium. Dr. Fowlkes has twice been invited by the Food and Drug Administration (FDA) to lecture in the Visiting Scientist Lecture Series on ultrasound contrast agent safety.

Research: Diagnostic ultrasound has suffered the lack of effective contrast media. Microbubbles injected into veins do not survive passage through the cardiopulmonary system in a bolus sufficiently intact to serve as a systemic contrast agent. Dr. Fowlkes and colleagues have developed a method to take advantage of the inherent inhomogeneity of peripheral blood. Their focused ultrasound method of heating this blood creates gas bubbles in the peripheral circulation which can then be used to determine patterns of blood flow in the target organ.

Radiologists often attempt to control regional blood flow, especially flow reduction. Dr. Fowlkes and colleagues have significantly advanced the use of super-heated droplets to form gas bubbles for diagnostic and therapeutic purposes. The process known as Acoustic Droplet Vaporization (ADV) uses ultrasound to stimulate these droplets to form gas bubbles. The liquid in the droplet has a boiling point below body temperature and therefore would normally transition to a gas. However, in droplet form the liquid is ready to boil but must be perturbed to initiate the transition. Dr. Fowlkes and colleagues have developed ultrasound methods to trigger these droplets into the formation of gas bubbles. The resulting bubbles can be used to occlude blood vessels and achieve an initial blood flow reduction of 90%. They are currently investigating the ability of ADV to occlude renal vessels as an adjunctive therapy to radio-frequency ablation of renal malignancies.

Bubble production by ADV may be sufficiently precise to allow control of ultrasound beams. In recent studies in Dr. Fowlkes' laboratory, walls of bubbles have been produced by ADV in tissue mimicking gelatin phantoms. Such walls are highly reflective for ultrasound, limiting the propagation of ultrasound beyond these boundaries. Creating walls surrounding tissues to be treated confines the ultrasound exposure and protects tissues beyond the walls from collateral damage.

These bubbles in small numbers and controlled sizes provide "beacons" that can be individually identified in the tissue. This is an extremely important attribute in the field of diagnostic ultrasound. One of the chief limitations to image resolution in ultrasound imaging is

the presence of beam distortion (phase aberration). Similar to the aberration that results in the distorted appearance of stars when viewed through the atmosphere, variations in overlying tissue layers can cause ultrasound images to be degraded. One can correct for this distortion most effectively if a known target or “beacon” is present. Dr. Fowlkes and colleagues have shown theoretically that the bubbles they produce by ADV can act as beacons for aberration correction. This could have a revolutionary impact on diagnostic imaging or in therapeutic ultrasound where aberration limits the focusing that can be achieved, potentially allowing for therapy through an intact skull.

Recent and Significant Publications:

Parsons J, Cain C, Abrams G, Fowlkes B: Pulsed cavitation ultrasound therapy for controlled tissue homogenization. *Ultrasound in Med & Biol* 32 (1) 115-129, 2006.

Lo A, Kripfgans O, Carson P, Fowlkes JB: Spatial control of gas bubbles and their effects on acoustic fields. *Ultrasound in Med & Biol* 32 (1) 95-106, 2006.

Kripfgans O, Rubin J, Hall A, Gordon M, Fowlkes JB: Measurement of volumetric flow. *J Ultrasound Med* 25:1305-1311, 2006.

Kripfgans O, Orifici C, Carson P, Ives K, Eldevik P, Fowlkes JB: Acoustic droplet Vaporization for temporal and spatial control of tissue occlusion: A kidney study. *IEEE Transactions on Ultrasonics, Ferroelectric, and Frequency Control* 52 (7) July 2005.

Kripfgans O, Fabiilli M, Carson P, Fowlkes JB: On the acoustic vaporization of micrometer-sized droplets. *J Acoust Soc Am* 116 (1) July 2004.

Service: Dr. Fowlkes provides service at both the local and national levels. He serves on the University committee on the care of use of animals. On a national level, he is an active participant and member of several committees within the Acoustical Society of America, The American Association of Physicists and Medicine, and the Institute of Electrical and Electronics Engineers. He is most active in the American Institute of Ultrasound and Medicine. This large Society includes physicians from a variety of specialties as well as non-physician scientists. Dr. Fowlkes has served as a member of several committees and has had two terms as a member of the Board of Governors. He is now Secretary of the Executive Committee.

External Review:

Reviewer A: “Dr. Fowlkes has been an outstanding contributor to the understanding of how ultrasound works and interacts with the human body. His work on Color Power Perfusion led to a major enhancement in the detection of blood flow by ultrasound. His current investigation of direct volume flow should revolutionize how blood flow rates are measured.”

Reviewer B: “The work on ultrasound being undertaken at the University of Michigan Medical School is held in very high esteem internationally. It is highly original, and of outstanding quality. This is in large part due to Brian. Brian’s work in the field of acoustic

cavitation is highly regarded, and in particular, recent work on histotripsy has been very well received, and is responsible for altering the direction of many researchers' thinking in this area."

Reviewer C: "Brian is clearly one of the top 2-3 investigators in the world on the biophysics of ultrasound contrast agents. His work is well recognized. He is also a leading investigator in therapeutic ultrasound."

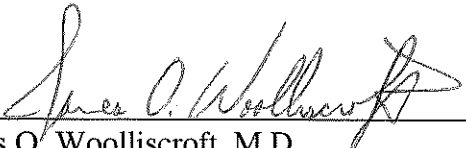
Reviewer D: "Dr. Fowlkes is a major player in the field of ultrasound bioeffects and technology. He has made seminal advances in fundamental Doppler physics, bubble dynamics, cavitations phenomena, and advanced imaging techniques. In fact, it is hard to name some topic in this area, in which he has not made a major contribution."

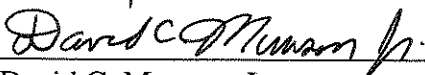
Reviewer E: "His work would place him as a valued full professor at any academic institution with an interest in addressing medical ultrasound. I would love to have him working with us at [my institution] and rank him among the top few in his generation of academic ultrasound scientists."

Reviewer F: "His most recent work I strongly believe has the potential for improving the effectiveness of treatment of cancer....In terms of his ranking relative to his peers I would place him in the top five researchers active in his areas of expertise."

Summary of Recommendation:

Dr. Fowlkes is an accomplished investigator with an extensive record of high quality publications and external funding, particularly from the National Institutes of Health. He possesses strong interpersonal skills and is an excellent communicator. This, coupled with his excellent knowledge base has made him an outstanding teacher. Despite his research accomplishments and his extensive teaching, he has found time to provide extraordinary service to the field. On three separate occasions, he has been recognized with the "Presidential Recognition Award" from his specialty society, the American Institute of Ultrasound and Medicine. We are pleased to recommend Dr. Fowlkes for promotion to Professor, with tenure, in the Department of Radiology, and Professor, without tenure, in the Department of Biomedical Engineering.


James O. Woolliscroft, M.D.
Dean
Lyle C. Roll Professor of Medicine


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

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