

Abstract for 29 October 2016, Taichung, Taiwan

Generation of High Intensity Focused Ultrasound by Carbon Nanotube Optoacoustic Lens

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A model of high-intensity, focused ultrasound generation by irradiation from a composite nano-thin film made of carbon nanotubes (CNTs) and elastomeric polymer is presented in this work. The composite nano-thin film is deposited to the surface of a concave lens and the performance of focused ultrasound generated by an incident pulsed laser onto the lens is analyzed. The analysis and results are verified by comparing with published experimental data and very good agreement is recorded. The optoacoustic pressure on the symmetric axis and the lateral focal plane are investigated analytically and the result indicates that excellent acoustic performance is found to be present in the vicinity of the focus region. The temporal performance of the focused lens is also investigated both at the focal point and the pre-focal zone and very good agreement comparing with experiment is obtained. Conclusively, it is demonstrated theoretically that there exists an optimal input frequency for a pulsed laser at which the performance of the focused lens can be tremendously enhanced. In general, this new analytical model provides new guidelines in the design of high intensity ultrasound lens, hence opening up promising applications to medical ultrasonography treatment.

About the Speaker

Currently a registered professional engineer (RPE), Ir Professor Lim received a first degree from Universiti Teknologi Malaysia, a Master's Degree and PhD from National University of Singapore and Nanyang Technological Univ., respectively. Prior to joining CityU, he was a post-doctoral research fellow at Department of Civil Engineering, The University of Queensland and Department of Mechanical Engineering, The University of Hong Kong. Professor Lim is also a visiting professor at various universities including the University of Western Sydney, Dalian University of Technology, Huazhong University of Science and Technology, etc. He has expertise in vibration of plate and shell structures, dynamics of smart piezoelectric structures, nanomechanics and symplectic elasticity. He is the Editor for Journal of Mechanics of Materials and Structures, Associate Editor (Asia-Pacific Region) for Journal of Vibration Engineering & Technologies, Associate Editor for International Journal of Bifurcation and Chaos, International Subject Editor for Applied Mathematical Modeling, etc. and also on the editorial board of a few other international journals. He has published a book in Engineering Mechanics entitled "Symplectic Elasticity" and co-authored with W.A. Yao and W.X. Zhong from Dalian University of Technology, as recorded in April 2010 by the publisher, World Scientific as one of the best-selling titles then. He has published more than 240 international journal papers, accumulated more than 3700 independent citations, and one of the papers was granted the IJSS 2004-2008 most cited article award. He was also awarded Top Referees in 2009, Proceedings A, The Royal Society. Professor Lim is a fellow for American Society of Mechanical Engineers (ASME) and also a fellow of American Society of Civil Engineers (ASCE).