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Experimental-Computational Mechanics Solution to Microfracture Localization and its Clinical Significance

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Abstract

Crack localization and characterization based on earthquake hypocenter localization techniques has long been of interest in the study of engineering materials. Although much has been achieved in this area over the years, acceptable solutions have not yet been found for microfracture localization in complex engineering structures that involve (a) anisotropic materials, (b) structures with multiple layers of materials, and (c) low stress levels for long periods of fatigue cycling at high sampling frequency. In the biomedical realm, development of such solutions may lead to a better understanding of the fatigue mechanisms of cemented femur stem constructs of total hip arthroplasty (THA).

This presentation reports on a methodology that can lead to experimental–computational mechanics solutions to microcrack localization. This methodology is capable of handling anisotropic materials, structures with multiple layers of materials loaded at low stress levels and high sampling frequency. It can automatically tally the number, visualize the distribution, and animate the progression of microcrack formation. The main technical characteristics of this method are its sensitivity to micro-level fracture, its noninvasive and nondestructive impact on test subjects; and its performance in real time. The presentation includes a brief introduction to cemented total hip arthroplasty; a summary of state-of-the-art research in related fields; a brief background on microfracture localization, based on earthquake hypocenter localization techniques; an introduction to experimental mechanics indicators; and a discussion of applications, experimental validations, and emerging developments.

Speaker's Bio

Dr. Gang (Gary) Qi is an Associate Professor in the Department of Mechanical Engineering at the University of Memphis. He holds a joint appointment as Associate Professor in the Department of Biomedical Engineering at the University of Memphis and University of Tennessee Health Science Center. His current research interests focus on experimental-computation mechanics as applied to the field of biomechanics.

Mechanical Engineering