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## ***“Theoretical and numerical models for fracking in shale”***

By

**Zhuo ZHUANG**

*Professor of Tsinghua University*

**Date: Wednesday, 22 January 2020**

**Time: 2:30 pm to 4:00 pm**

**Venue: EA 06-02  
Faculty of Engineering,  
National University of Singapore**

### **Abstract**

Hydraulic fracture (fracking) technology in gas shale field engineering is highly developed last decades in North America and recent years in China, but the knowledge of actual fracturing process is mostly empirical and makes the mechanician wonder. Shale is a typical layered and anisotropic material whose properties are characterized primarily by locally oriented anisotropic clay minerals and naturally formed bedding planes. The debonding of bedding planes will greatly influence the shale fracking to form a large-scale highly permeable fracture network, which is the stimulate reform volume (SRV). Both theoretical and numerical models are developed to quantitatively predict the growth of debonding zone in layered shale under fracking. Some parameters are proposed to characterize the corresponding conditions of tensile and shear debonding of bedding planes. It is found that debonding is mainly caused by the shear failure of bedding planes in the actual reservoir. Then the theoretical model is applied to design the perforation cluster spacing range, which can be quantitatively calculated to guide the fracking design. These results are comparable with the data from real-time signal evolution by micro-seismic monitor in field engineering. In this work, the data-driving-based theoretical and numerical fracking models include (1) 3D XFEM fracture + fluid flow + Biot constitution coupling model; (2) Unitary fracking and stable growth model; (3) Multi-scale fracking SRV model; (4) Machine learning to predict recovery efficiency model.

### **About the speaker**



Zhuo ZHUANG, Tenure professor, Former Dean, School of Aerospace Engineering, Tsinghua University, Beijing, China. Ph.D, University College Dublin, Ireland, 1995; Honorary Doctorate Degree (EngD) of Swansea University, UK, 2017. The research interest on engineering fracture mechanics, nonlinear finite element and extended finite element, as well as crystal plasticity at micro scale and design polymer composite for shock wave energy attenuation. Published more than 300 papers, including SCI 150. Published 10 books in Chinese and 2 books in English by Elsevier. The papers and books are cited more than

10,000 times. GC Member of International Association for Computational Mechanics (IACM); EC member of Asia-Pacific Association for Computational Mechanics (APACM); President of Chinese Association for Computational Mechanics (CACM); President of Beijing Society of Mechanics; Committee Member of Beijing Association for Science and Technology.

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## Location



**\*\*\*Pre-registration is not required. All are welcome and admission is free\*\*\***