



## Baustatik - Seminar

### Topic

### **Nonlinear Ultrasonic Methods for Nondestructive Damage Assessment in Structural Materials**

**Professor Jianmin Qu**

Department of Civil and Environmental Engineering  
Department of Mechanical Engineering  
Northwestern University  
Evanston, Illinois, USA

**Time:** Thursday, 16.04.2014, 14:00pm

**Venue:** Room PB-B 014, Paul-Bonatz-Str. 9-11, 57076 Siegen

### **Abstract**

Ultrasonic nondestructive evaluation (NDE) techniques have been used extensively for assessing various engineering structures and components. Most existing ultrasonic NDE techniques utilize the linear behavior of ultrasound. These linear NDE techniques are effective in detecting discontinuities in the materials such as cracks, voids, interfaces, inclusions, etc. However, they are less effective in assessing the state of damage before visible cracks are formed. On the other hand, our recent work has demonstrated that nonlinear ultrasonic NDE techniques offer the potential to characterize and quantify early stages of damage in structure materials under several types of loading conditions.

In this talk, I will first introduce recent models that relate the measured nonlinear ultrasonic signals to pertinent microstructural parameters such as dislocations and microcracks

that characterize the state of damage in structural materials. This will be followed by discussions of several ultrasonic measurement techniques including the generation of second harmonic and nonlinear wave mixing. The talk will conclude with several case studies involving microcracks in quasi-brittle materials, fatigue damage in high-strength superalloys, radiation damage in stainless steels, plastic deformation in aluminum alloys, etc. These studies clearly demonstrate that nonlinear ultrasound is an effective tool for nondestructive damage assessment in structural materials.

### **Bio of Professor Jianmin Qu**

Jianmin Qu, Walter P. Murphy Professor in the McCormick School of Engineering and Applied Science at Northwestern University, received his Ph.D. in Theoretical and Applied Mechanics from Northwestern University. Before joining the faculty at his alma mater in 2009, Professor Qu was on the faculty of the School of Mechanical Engineering at the Georgia Institute of Technology from 1989 to 2009.

Professor Qu's research focuses on several areas of theoretical and applied mechanics including micromechanics of composites, interfacial fracture and adhesion, fatigue and creep damage in solder alloys, thermomechanical reliability of microelectronic packaging, defects and transport in ionic solids with applications to fuel cells and batteries, and ultrasonic nondestructive evaluation of advanced engineering materials. He has authored/co-authored two books, 10 book chapters and over 180 referred journal papers in these research areas.

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(Univ.-Prof. Dr.-Ing. habil. Chuanzeng Zhang)