## Modeling, Analysis and Control of High-Speed Precision Gear Dynamics

Teik C. Lim, Ph.D., P.E., Fellow(ASME, SAE)
Dean, College of Engineering and Applied Science
Herman Schneider Professor of Mechanical Engineering
University of Cincinnati

## Abstract

Gear dynamics is one of the most critical factors affecting the noise (whine), vibration and durability performances of gearbox, drivetrain and power transmission systems employed in automotive, aerospace, naval and industrial applications. The source of the transmission error excitation emanates from the sensitivity of the gear pair to its tooth profile errors, shaft misalignment, and the overall structural dynamics. The resulting vibratory motion can be very complex and difficult to control due to the strong coupling between the gear pair and its supporting structures. Therefore, gaining a more thorough understanding of the underlying physics governing the gear pair dynamics is essential in the design and development of quieter and more durable geared rotor systems. The initial part of this presentation will focus on the dynamic modeling of gear pairs that covers the various gear mesh models presently in use. The discussion then moves on to a class of harmful out-of-phase gear pair torsion modes that have been theorized as the primary cause of excessive gear response. The effects of the design parameters on this class of modes are then explored, which can lead to less sensitive design that attempts to achieve a balance between mesh force and vibration transmissibility. Geared systems with dominant time-varying and nonlinear mesh characteristics and their effects on dynamic response are discussed as well. Finally, the presentation will briefly touch on some advanced topics in gear dynamics including the development of coupled multi-body dynamics-vibration model and active vibration control of gear pair systems.

Teik C. Lim
Dean, College of Engineering and Applied Science
University of Cincinnati

Professor Teik Lim received his B.Sc., M.Sc. and Ph.D. degrees in Mechanical Engineering from the Michigan Technological University, University of Missouri-Rolla and Ohio State University, respectively. Prior to joining the University of Cincinnati in 2002, he held positions at SDRC, the University of Alabama and the Ohio State University. At UC, he previously held

the positions of Associate Dean for Graduate Studies and Research, and Department Head of Mechanical Engineering. He was appointed Dean of the College of Engineering and Applied Science in 2012. He is the founding director of the highly successful and enduring Hypoid and Bevel Gear Mesh and Dynamics Modeling Consortium, and UC Simulation Center. His research interest is in power transmission systems, vehicle NVH, structural dynamics, vibro-acoustics, sound quality and active control. Professor Lim is a Fellow of both the ASME and SAE, and a registered Professional Engineer.