STEVENS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING

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Carnegie Room 315, Time 1:30 pm

THE MYSTERY OF MODULATION SIDE-BANDS OBSERVED IN MECHANICAL SYSTEMS

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Side-band structures are commonly observed in measured vibro-acoustic spectra of many mechanical elements and rotating systems such as gears, bearings, fans, motors and tires. Though the modulated spectral contents are often utilized to develop algorithms for fault detection and preventive maintenance and to trouble shoot practical noise and vibration (or sound quality) problems, several aspects of the problem (including the sources) are somewhat mysterious. Kinematic, Trigonometric, Fourier and/or Communication theories are often used to identify the existence of frequencies but they can not seem to explain the amplitude behavior, including the asymmetric nature (or disappearance) of some sidebands. A dual-domain periodic differential equation with an implicit non-linearity will be presented to plausibly explain the underlying physics. Analytical predictions, based on a force modulation concept, will be compared with dynamic (rotational) measurements on a gear pair. Finally, an acoustic duct experiment will be briefly described where two active control algorithms are employed to suppress the amplitude or frequency modulated signals. Yet the mystery continues!

DR. RAJENDRA SINGH is The Donald D. Glower Chair in Engineering and Director of the Acoustics and Dynamics Laboratory at The Ohio State University (USA). He has published more than 300 papers (including 150 journal articles), and is well recognized for research in machine dynamics, vibration, acoustics, and nonlinear dynamics with applications to many practical systems including vehicles. He is a Fellow of ASME, ASA and SAE, and has received several national awards for both teaching and research, as well many research awards at Ohio State. Dr. Singh has developed and teaches an innovative graduate course sequence in automotive noise and vibration control in partnership with General Motors. He has served as the President of the Institute of Noise Control Engineering/USA in 2003-04. He serves on several national and international boards and actively organizes conferences. Dr. Singh has led the US national delegations to the 1996 and 2001 India-USA Symposia on Vibration & Noise Engineering.

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