



# SEMINAR

## Department of Mechanical Engineering



### Vibro-Impact Behavior of Drivetrains: Modeling, Experiments, and Design Implications

#### SPEAKER

Ata DÖNMEZ, Ph.D., Research Scientist

Department of Mechanical and Aerospace Engineering, The Ohio State University, Columbus, OH, USA

#### ABSTRACT

Mechanical systems are subjected to varying levels and types of nonlinearities, ranging from non-smooth, clearance-type discontinuities in machine elements to friction- and damping-induced nonlinearities, as well as smooth geometric and material nonlinearities. The study of such nonlinearities often requires computationally expensive models and specialized measurement techniques. This poses a significant challenge to the analysis, control, and design of these mechanical systems.

This seminar will focus on a specific class of such nonlinear behavior, vibro-impacts in geared systems, which are prevalent in various automotive drivetrains and lead to durability concerns and excessive noise issues. The first objective of this study was to develop a methodology along with novel measurement systems to quantify the vibro-impact dynamics in a laboratory environment in a tightly controlled and repeatable manner. This experimental methodology will be presented first, including its application to address various design aspects. A new vibration-based design metric, vibro-impact severity index, will be defined, and its correlation to the resultant impact noise levels will be demonstrated.

The second objective of this study was to develop a family of reduced-order nonlinear dynamic models at varying levels of complexity and validate them through comparisons with the measurements. These validated models implemented by a computationally efficient solution methodology will be used to characterize and map periodic and non-periodic impacting motions, providing insights into the mechanisms governing their complex bifurcations.

This study offers a comprehensive experimental and theoretical framework to investigate a complex design problem from a nonlinear dynamics perspective, aimed at enhancing drivetrain design. The seminar will conclude with a discussion of various theoretical and experimental research extensions, potential proposal ideas, funding opportunities, and collaborative prospects.

#### ABOUT THE SPEAKER

Dr. Ata Donmez is a Research Scientist at the Gear and Power Transmission Laboratory (GearLab) within the Department of Mechanical and Aerospace Engineering at The Ohio State University. He received his B.Sc. and M.Sc. degrees in Mechanical Engineering from Middle East Technical University, Türkiye. During his M.Sc. studies, he worked as a research engineer at Roketsan, taking on responsibilities in motion and vibration control systems. Dr. Donmez earned his Ph.D. from The Ohio State University in 2022, specializing in the nonlinear dynamics of non-smooth geared systems. In his current role as a research scientist at Ohio State has focused on understanding complex nonlinear phenomena in mechanical structures complimentary experimental and theoretical means with targeted applications ranging from electric vehicle drivetrains and high-speed aerospace gearboxes to microbeam resonators. In his current position, he serves as a co-PI on several industrial and federal grants and co-advises a number of M.S. and Ph.D. students. He is a member of ASME Industry Liaisons Subcommittee of TCVS, responsible for organizing conference sessions. He is the awardee of the TUBITAK 2232B International Fellowship for Early Stage Researchers.



#### CONTACT

Onur Özcan, Mechanical Engineering Department, Bilkent University, [Email](#)

**APRIL · 18 · 2025**  
**FRIDAY 13:30**  
**EA-101**