Vibration-Inspired Innovations in Precision Engineering: From Structural Coloration to Non-Contact Actuation

Abstract

My research vision is to bring innovations to precision engineering by pushing the limit of and expanding the boundary of precision manufacturing. Conventionally, vibration is undesirable in any precision equipment and processes; however, when vibration is deliberately introduced with a careful design, it can bring unprecedented process capabilities and novel precision machine tool designs. In this talk, I will present two examples that apply unorthodox vibration in the precision cutting process and bearing designs. The first example introduces a vibration-assisted ultraprecision cutting method to fast pattern controllable wavelength-scale gratings for structural coloration and advanced optics. In the second example, I will introduce the design and dynamics modeling of non-contact actuation purely based on structural vibration to generate a stable air film in the near field. Finally, I will briefly share some other ongoing research projects that hopefully bring inspiration to future precision engineering.

Bio

Dr. Ping Guo is an Assistant Professor at the Department of Mechanical Engineering, Northwestern University. He received his B.S. degree in Automotive Engineering from Tsinghua University in 2009 and his Ph.D. degree in Mechanical Engineering from Northwestern University in 2014. Before joining Northwestern University in September 2018, he spent four years at the Chinese University of Hong Kong as an Assistant Professor. Dr. Guo's research interests center on the paradigm of micro/meso-scale manufacturing, including surface texturing, process micro-mechanics, miniature machine tools, metrology, micro-additive manufacturing, etc. He currently serves as the Associate Editor of the Journal of Manufacturing Processes. He is the recipient of Kornel F. Ehmann Manufacturing Medal from ASME 2021, Outstanding Young Manufacturing Engineer Award from SME 2020, Young Investigator Award from International Symposium on Flexible Automation 2018, Hong Kong Research Grants Council Early Career Award 2016. He was elected as an Associate Member of the International Academy for Production Engineering (CIRP) in 2022.