MECHANICAL ENGINEERING & ENGINEERING SCIENCE GRADUATE SEMINAR SERIES

Thursday, October 29th
11:30 am – 12:30 pm
Zoom
https://uncc.zoom.us/j/96241063106?pwd=U1dsby9Wd211MzlzL2QzQURaRG83QT09
Meeting ID: 962 4106 3106
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Highly tunable stress waves in one-dimensional granular chains

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Stress wave propagation in granular materials subjected to dynamic loadings is of general interest for new physical phenomenon and their potential applications. One-dimensional (1D) granular chains, composed of closely packed particles, are demonstrated to support new types of stress waves owing to their unprecedented properties. By tuning the properties of particles (e.g., material and geometric properties) or modifying the initial conditions (e.g., impact velocity and pre-compression), it is possible to design the critical characteristics of the 1D granular chains (e.g., the nonlinearity), which offers insights for various engineering applications, including non-destructive testing, acoustic switch, impact mitigation, actuating devices, and sound scramblers. Therefore, we fundamentally investigated the propagation and tunability of stress waves in various 1D granular chains via theoretical analysis, experimental study, and numerical simulation (finite element analysis). Firstly, the universal design of equivalent systems supporting highly nonlinear solitary waves is introduced and analyzed based on 1D spherical granular chains. Secondly, highly tunable stress waves in 1D hollow cylindrical granular chains are demonstrated, where a variety of governing factors, including the impact velocity, impactor-to-particle mass ratio, thickness ratio, and particle number, are considered. Afterward, various quantitative solitary wave tuning strategies, consisting of mass mismatch, modulus mismatch, and thickness mismatch, are proposed to meet specific requirements for impact mitigation. Finally, an extended tunability is demonstrated in 1D composite cylindrical chains with different configurations (i.e., core-shell and sandwich structures).

Ms. Wen Zhang received her bachelor's degree in Transportation Engineering from Beihang University, China in 2016. Wen graduated as a top scholar and received awards being among the top 1% of all the graduates. Currently, she is pursuing a Ph.D. in Mechanical Engineering at the University of North Carolina at Charlotte. Owing to her research work, Wen also received graduate awards including Thomas L. Reynolds Graduate Research Award in 2019 and Metro Mary N. Clayton Honorary Scholarship in 2020. Her research interest is impact dynamics, granular crystal, and bio-inspired structures. Wen has published six journal papers in Extreme Mechanics Letters, International Journal of Mechanical Sciences, International Journal of Impact Engineering, Granular Matter, etc. under the supervision of Dr. Xu. Wen has three authorized patents as well.