



# ME Seminar



## Mathematical forms of vibration frequencies of single-walled carbon nanotubes

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### ABSTRACT

Carbon nanotube (CNT) has become popular nanomaterial in manufacture of nano-electro- mechanical devices and nano-composites due to its remarkable properties. Accurate determination of vibrational modes of CNT is important for efficient usage of such nano-devices and nano- composites. However, experimental determination of these modes is difficult, and there has been no mathematical form for these modes. This seminar presents a novel study that determines the effect of geometrical parameters on the fundamental vibration modal frequencies of single-walled CNT (SWCNT), using molecular-structural-mechanics-approach, finite element analysis, and statistical modelling. Consequently, a first-of-its-kind mathematical form of fundamental transverse vibration frequency and fundamental torsional frequency of SWCNT is proposed, and tested to accurately predict our FEA results and results published by others. Interestingly, the transverse and torsional frequencies have similar forms as of a continuum Bernoulli-Euler beam. Comparing the frequency forms of SWCNT with the continuum beam can give its respective moduli. From this, it is found that effective shear modulus of SWCNT depends only on its chirality, such that symmetrical structures have higher shear modulus than asymmetrical structures. Proposed forms open up new ways of geometrical characterization of SWCNTs, determining effective moduli, and designing SWCNT-based nano-electro-mechanical-devices.

### ABOUT THE SPEAKER

Dr. Sneha Singh is a young and enthusiastic researcher who has obtained her PhD from the University of Warwick in 2016 and B.Tech. from Indian Institute of Technology (IIT) Kharagpur in 2011, where she was a branch rank holder. Her research interests are acoustics and noise control, condition monitoring, human hearing, and applied machine learning. She is currently employed as an Assistant Professor at IIT Roorkee. Prior to this, she has done her post doctorate at IIT Kharagpur and IIT Bombay. She has authored 8 peer-reviewed journal papers, and has taught courses in the subject area of acoustics & noise control, industrial engineering, automotive engineering, electric vehicle sound quality, and engineering analysis and design, among others. Her notable awards include Young Professional award by International Institute of Noise Control Engineering, and Best student paper award on automotive sound quality in 2015.



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