Title	Introduction to Ultrasonic simulation with COMSOL
Instructor(s) and Affiliation	David W. Greve Emeritus Professor, Department of Electrical and Computer Engineering, Carnegie Mellon University Principal, DWGreve Consulting
Short biography of instructor(s)	David W. Greve became Emeritus Professor of Electrical and Computer Engineering in 2016 after 34 years at Carnegie Mellon University. Initially his research concerned semiconductor process technology. Since 2000 his research has addressed several applications of ultrasonics in structural health monitoring and sensing, including wireless harsh environment applications of surface acoustic wave devices. He has served as a member of the International Ultrasonics Symposium Group 2 Technical Program Committee and was co-chair in 2014 and 2015. He is presently a COMSOL Certified Consultant and provides consulting services for ultrasonic and electromagnetic problems.
Abstract	This course provides an introduction to COMSOL finite element simulation of ultrasonic generation, propagation, and detection. A limited-time license for the current version of COMSOL will be provided for the use of attendees during and immediately after the course. After a review of the basic equations of piezoelectricity, several example simulations will be set up and run and postprocessing will be used to extract important results. Attendees will be strongly encouraged to follow along using their own personal laptops. Examples presented during the short course will be drawn from structural health monitoring and industrial applications of ultrasonics, including launching of ultrasonic waves into fluids. At the end of the short course, several application examples will be presented in outline form to illustrate a broad range of applications of finite element simulation.
Overview of topics covered	(1) Brief review of the piezoelectric constitutive equations (2) outline of the finite element simulation process (3) when to use eigenmode, sinsuoidal steady state, and transient simulations (4) setting up a problem in COMSOL, including specification of geometry, material properties, symmetry, constraints, and boundary conditions (5) solving and interpreting and visualizing the results.
Target audience	Researchers who have a need to use finite element simulations in their work, especially for structural health monitoring, industrial, or sensing applications.