

CEE 595F – Geotechnical Engineering Seminar



Friday, April 19th, 2019 | 11:00 AM, Newmark Lab 3310

Modeling Soil-Machine Interaction

Jim Hambleton, Assistant Professor

Dept. of Civil & Environmental Engineering, Northwestern University

Abstract: Problems in soil-machine interaction (SMI) are ubiquitous on Earth, and they are beginning to play important roles elsewhere as we explore and perhaps eventually colonize the moon and other planets. Irrespective of the application, SMI problems are typically defined by the presence of large, plastic deformation as machine components come into contact with soils. While methods to simulate the machines themselves have developed rapidly, methods for predicting the forces and reactions generated through soil contact are underdeveloped and inadequate. Numerical techniques such as the material point method and the discrete element method have advanced to the stage that they can model SMI problems—and indeed they are the leading tool used by industry—but these methods suffer from significant drawbacks, particularly with respect to their prohibitive inefficiency. Focus in this presentation is on formulating, benchmarking, and validating a new numerical technique referred to as the “sequential kinematic method” for efficiently computing force-displacement histories under arbitrary tool motions and loading conditions. Early-stage work on a general, semi-analytical framework is also discussed. Theoretical predications are compared against experimental data obtained for fundamental configurations and soil types using the 6-axis robotic arm and soil test beds available in the Soil-Machine Interaction Laboratory (SMI Lab) at Northwestern University.

About the Speaker: Originally from rural Wisconsin, Jim Hambleton was educated at the University of Minnesota, where he completed B.C.E., M.S., and Ph.D. degrees in Civil Engineering. After receiving his Ph.D. in 2010, he joined the Centre for Geotechnical and Materials Modelling at The University of Newcastle, Australia, first as a Post-doctoral Research Associate and then as a Senior Lecturer. Jim joined the faculty in the Department of Civil and Environmental Engineering at Northwestern University as an Assistant Professor in October 2016. For his research in the area of engineering and computational plasticity, he is the recipient of the ARC Discovery Early Career Researcher Award, NSF CAREER Award, ASCE Casagrande Award, Neville G. W. Cook Award for Innovative Research in Geomechanics, and two best paper awards. Among various distinctions for teaching and advising, he was awarded the Alumnae of Northwestern University Award for Curriculum Development administered by the Office of the Provost. He was named a New Faces of Civil Engineering Honoree in 2014 by ASCE.