MODELING PROCESSES INVOLVING SOIL-WHEEL INTERACTION

J. P. Hambleton[a] and **A. Drescher**[b]

[a]Department of Civil Engineering
University of Minnesota
Minneapolis, MN 55455, USA
hamb0025@umn.edu

[b]Department of Civil Engineering
University of Minnesota
Minneapolis, MN 55455, USA
dresc001@umn.edu

Approaches for modeling the process of a wheel rolling over soil are of interest in numerous engineering applications, including performance of earth-moving machinery and assessment of land damage caused by off-road vehicles operating in forests, parks, and wetlands. In these problems, predicting the soil deformation induced by a wheel is critical. Numerical simulations based on the finite element method (FEM) are being used increasingly to study soil-wheel interaction. Such simulations have been successful when the soil is cohesive, although difficulties arise when the material is frictional, including numerical instabilities and unrealistic material behavior. In this paper, FEM is used to simulate indenting and rolling wheels on frictional/cohesive soils, accounting for the large soil deformation. Emphasis is placed on adequately capturing the soil response using relatively simple soil constitutive models. Essential differences resulting from associated and non-associated material models are presented. Key differences between two-dimensional and three-dimensional simulations are discussed. Data from lab-scaled experiments on the soil displacement field beneath a wheel, obtained using particle image velocimetry, are presented to validate the theoretical results and enrich the understanding of soil-wheel interaction.