

Rami was born in Tripoli, Lebanon. He earned his B.E. and M.E. in Civil Engineering from the American University of Beirut. After working for several years in development in both the public and private sectors and teaching at AUB, he resumed his studies, enrolling at Purdue in 2008, working towards his PhD in Agricultural and Biological Engineering.



## **Dissertation Defense**

Speaker: Rami Jabakhanji

Title: Peridynamic modeling of coupled

mechanical deformations and transient flow

in unsaturated soils

Major Professor: Dr. Rabi Mohtar

Date: Monday, July 29, 2013

Time: 1:00 pm

Location: ABE 301

## Abstract:

A coupled peridynamic model for mechanical deformations and transient moisture flow in unsaturated soils is developed. The model is capable of simulating the emergence and evolution of cracks triggered by volumetric strains in the soil which are associated with changes in moisture content. The development of our model is motivated by the need for a tool to analyze and evaluate the impact of desiccation cracks on the movement of moisture and the mechanical properties of soils at the field scale. The model is based on the peridynamic reformulation of elasticity proposed by Silling for simulating the deformation of bodies with evolving discontinuities, where the classic continuum mechanics differential equation of motion is replaced by a non-local, derivative free, functional integral. The absence of spatial derivatives leads to a model that is valid everywhere in the simulation domain, including points of discontinuities. Following a similar approach, we developed a moisture flow model where the classic Richard's differential equation for moisture flow in soils is replaced by a non-local, derivative free, functional integral. The flow model is capable of simulating transient moisture flow in homogeneous or heterogeneous soils with isotropic or anisotropic hydraulic conductivities. The coupled model is obtained by combining the developed moisture flow model with the peridynamic model for solid mechanics. The validation of the flow model is carried out by comparing the results of simulations of various flow scenarios using the peridynamic formulation as well as the classic Richard's equation. In order to validate the coupled model, a simulation of a laboratory restrained ring experiment is performed, and the results are compared to the laboratory results.