The Geo-Institute Unsaturated Soils Technical Committee will live-stream the session "*Unsaturated Soils in a Changing Climate*" on Wednesday, December 7, at 11 AM EST. The topics include:

"Spatial mapping of soil saturation levels using UAV deployable smart penetrometers," **Austin R.J. Downey, Puja Chowdhury, Joud Satme, Sadik Khan,** and **Jasim Imran**

Excessive moisture inundation into levees poses significant risks that may lead to the failure of levees and the loss of life and property located behind these geo-infrastructures. Levee monitoring using spatial and temporal mapping of the saturation level of the surface soils that make up levees offers the potential to decrease the risk of levee failure. However, the levee scale makes their monitoring using traditional wired sensors a challenging task. Moreover, the change in stressors caused by a changing climate means that levees will be stressed in an unforeseen way, thereby necessitating the use of large sensor networks to cover the near entirety of these geo-infrastructures systems. This work reports on preliminary progress in the development of and validation of UAV-deployable smart sensing nodes for soil conductivity and temperature, both of which are measurement modalities for obtaining the saturation levels of soils. The open-source smart sensor package presented in this work is designed to be dropped for a UAV and with its integrated power harvesting and onboard computing is capable of fully autonomous operations once deployed. In this work, a network of five smart sensing nodes is deployed and Gaussian process regression (i.e. kriging) is used to estimate the soil saturation between sensing nodes. Results for a lab-based study are report-ed and a discussion on the effects of temperature and sensor noise are discussed.

"Post-Wildfire Stability of Unsaturated Slopes against Rainfall-Triggered Landslides,"

Farshid Vahedifard, Ph.D., P.E., F.ASCE,

Several regions (e.g., Western U.S., Australia) globally experience higher wildfire activities and increased wildfire elevations. The worsening patterns of wildfires, partly attributed to climate change, elevate the risk of post-wildfire ground instabilities, which can threaten the integrity of communities and infrastructures in the affected areas. In this seminar, a new physics-based framework is presented to evaluate the post-wildfire stability of unsaturated hillslopes against rainfall-triggered shallow landslides. The framework accounts for antecedent conditions of soil and vegetation cover, wildfire-induced alterations in transpiration and root reinforcement, and time-varying infiltration rates. The proposed model uses measurable hillslope and wildfire characteristics and can be employed to evaluate the risk of shallow landslides in wildfire-prone areas.

"Flooded Pavement Assessment: Performance of Flexible Pavements Under Extreme Weather," **Majid Ghayoomi,** PhD, PE, M.ASCE, and **Eshan Dave,** PhD

The infiltration of water in pavement layers due to heavy precipitation, snow melting, surface water flow, or ground water fluctuation can lead to a substantial change in pavement performance. The changing climate and its drastic influence on the frequency and intensity of extreme events would impact the response of pavement systems during and after such events like flooding. The extent of this change in response depends on several complex and interdependent factors such as climatic and mechanical stressors, hydrogeological material properties, and traffic loads. Due to a very large number of variables and their interdependencies, a system-level approach can holistically capture all significant variables and provide a tool to study and visualize governing factors and their effects on pavement response under

variable initial and boundary conditions. In this presentation, results of a set of sensitivity analysis with corresponding statistical evaluation of the pavement performance will be presented. This will be followed by a demonstration of a recently developed tool for flooded pavement assessment and load restriction decisions.

"Impact of high-volume rainfall on highway embankments and risk mitigation using Vetiver Grass on Expansive Soil,"

Sadik Khan, Ph.D., P.E., **Avipriyo Chakraborty**, and **Amber Spears**

In the United States during the past 50 years, global warming has initiated significant changes in precipitation and evaporation. Summers are getting warmer causing extreme drought, and there are more frequent extremely heavy precipitation events that affect soil moisture and change the behavior of expansive soil. In addition, the rainfall pattern has shifted and increased in volume making Mississippi one of the top three states with the highest rainfall in the United States. Due to these changes in precipitation, the soil moisture balance is changing, which also impacts the behavior of expansive clay. The seasonal moisture distribution of several highway slopes built on expansive soil is monitored using series of moisture sensors and multichannel 2D electrical resistivity imaging. These measurements demonstrate the high moisture content throughout the year are affecting the performance of the highway slopes and embankment. To reduce the impact of the high moisture content of the slopes, deep rooted vetiver grass has been introduced. Vetiver works as a Bio-anchors to increase the factor of safety of the slope. Moreover, the evapotranspiration through the vetiver grass helps drain out the perched water from the slope, which enhances the safety of the slope. The vetiver has great potential to minimize the impact of the climate change and enhance the factor of safety of the slope.