THE UNIVERSITY OF TENNESSEE CHATTANOOGA

# Center of Excellence in Applied Computational Science and Engineering

presents

## "Dynamic modeling of the iron deficiency modulated transcriptome response in *Arabidopsis thaliana* roots"

*given by* **Dr. Cranos Williams**

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North Carolina State University

March 29th, 1:45 p.m., EMCS 201 (Card Auditorium)*

*Public Invited*

The iron deficiency response in plants is a complex biological process with a host of influencing factors. The ability to precisely modulate this process at the transcriptome level would enable genetic manipulations allowing plants to survive in nutritionally poor soils and accumulate increased iron content in edible tissues. Despite the collected experimental data describing different aspects of the iron deficiency response in plants, no attempts have been made towards aggregating this information into a descriptive and predictive model of gene expression changes over time. We formulated and trained a dynamic model of the iron deficiency induced transcriptional response in Arabidopsis thaliana. Gene activity dynamics were modeled with a set of Ordinary Differential Equations that contain biologically tractable parameters. The trained model was able to capture and account for a significant difference in mRNA decay rates under iron sufficient and iron deficient conditions, approximate the expression behavior of currently unknown gene regulators, unveil potential synergistic effects between the modulating transcription factors, and predict the effect of double regulator mutants. The presented modeling approach illustrates a framework for experimental design, data analysis, and information aggregation in an effort to gain a deeper understanding of various aspects of a biological process of interest.

Dr. Cranos Williams is currently an associate professor in the Electrical and Computer engineering department at North Carolina State University and is the head of the EnBiSys Research Laboratory. Dr. Williams received his B.S. in electrical engineering from North Carolina A&T State University in 2001, and his M.S. and Ph.D. in electrical engineering from North Carolina State University in 2002 and 2008, respectively. Over his 10.5 years at NC State, Dr. Williams has developed a highly collaborative, multidisciplinary research program focused on advancing the comprehensive understanding of biomolecular pathways associated with plant growth, development, and adaptation. His research lab develops methodologies familiar to other areas of electrical and computer engineering (e.g. computational intelligence, system identification, nonlinear systems analysis and control, and signal processing) to model and predict the impact that genetic and environmental perturbations have on overall plant response (e.g. biomass, cellulose content, and plant cell wall strength). Recent projects include the development of integrative computational frameworks for modeling the regulation of the iron deprivation response in A. thaliana, multiscale modeling approaches for predicting how regulation and biosynthesis of monolignols in P. trichocarpa impact lignin and wood properties, and 4D analysis and characterization of microscopy images for understanding plant morphology. The results from these works may have direct implications on key challenges associated with engineering plants for efficient biofuel production, increased adaptability to changing environments, and improved defense to biotic and abiotic stresses.

** UTC Engineering, Math, Computer Science Building, Room 201, 735 Vine St., Chattanooga TN, 37403*