# NNCI Seminar Series

## June 23, 2021 | 4PM - 5PM EDT

## Computation Talk: A Case Study of Essential Physics and Technology Challenges as Revealed Trough Modeling: Quantum-Corrected Semiclassical Monte Carlo Scaling Study of Si, Ge, and InGaAs FinFETs

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**Abstract:** This presentation will address material options, channel orientations, contact geometries, and the effects of scaling on n-channel FinFETs. However, the emphasize will be on the role and requirements of modeling and what we can learn from it in a complex system as much or more so than the system itself. How prior knowledge of possible essential physics in the system(s) of interest informs the model choice—a quantum-corrected semiclassical Monte Carlo method in this case—and how the model integrates that essential physics to produce perhaps unexpected results will be considered. Here, the systems include Si, Ge, and Ino.53GaAsO.47 n-channel FinFETs; <110> and <100> channel orientations; saddle/slot, raised source and drain, and reference end-contact geometries; and channel lengths (widths) from 18 (6) nm to 9 (3) nm are considered. Essential physics includes quasi-ballistic transport; multiple effects of quantum confinement in the channel including carrier redistribution in the channel, degeneracy breaking among energy valleys, and increases scattering rates; source and drain doping limitations; and limitations on specific contact resistivities.

**Bio:** Leonard Franklin (Frank) Register is the J. H. Herring Centennial Professor in Engineering, the Department of Electrical and Computer Engineering and the Microelectronics Research Center, The University of Texas at Austin. He received undergraduate degrees in both electrical engineering and physics summa cum laude before earning his PhD in electrical and computer engineering, all at North Carolina State University. He then held a faculty research scientist position within the Beckman Institute and the University of Illinois at Urbana-Champaign before joining the faculty of the University of Texas at Austin. He is a fellow of both the Institute of Electrical and Electronics Engineers (IEEE) and the American Physical Society (APS). He was the General Chair of SISPAD 2018, the 23rd International Conference on Simulation of Semiconductor Processes and Devices, the flagship conference devoted to technology computer-aided design (TCAD) and advanced modeling of semiconductor devices (which is held in the US only every third year). He has approximately 250 refereed journal and conference papers, book chapters, and patents and disclosures. His research has focused on understanding and modeling nano-scale electronic and optoelectronic devices and the essential physics underlying their operation for improved conventional and novel applications. His current interests include not only advanced CMOS, but also magnetic and spintronic materials and devices for beyond CMOS logic and memory devices and computing paradigms, and modeling of analysis of transport within and tunneling between two-dimensional material layers, including interpretation and analysis of related experimental results.

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