Southeastern Michigan Section
"Chapter IV" Speaker Series
Wed, May 13, 2009, 5:00 pm
Appetizers and Networking at 4:30 pm
Room #1005, EECS Bldg,
North Campus, University of Michigan
1301 Beal Ave, Ann Arbor, MI

SiGe Technology: New Research Directions and Emerging Application Opportunities

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Abstract:
The silicon-germanium heterojunction bipolar transistor (SiGe HBT) is the first practical bandgap-engineered device to be realized in silicon, and effectively combines transistor performance competitive with III-V technologies with the economy-of-scale of conventional silicon IC manufacturing. Since the first demonstration of a functional transistor in 1987, SiGe technology has entered manufacturing across the world, and is currently making in-roads in a number of venues associated with the global electronics infrastructure.

In many ways SiGe HBTs represent *the* ideal mixed-signal device. SiGe HBTs possess: excellent frequency response at useful breakdown voltages, extremely large transconductance per unit area, very high gain, very low output conductance, very low broadband noise, very low 1/f noise, very low phase/jitter noise, good RF linearity, excellent power handling capability, extremely high current drive, good thermally stability, the ability to operate across very wide temperature ranges (4K to 300C), and inherent tolerance to ionizing radiation. All at very conservative lithographic nodes (typically with a two-generation advantage over CMOS at fixed performance). Importantly, SiGe HBTs can also be easily integrated into core foundry-compatible CMOS platforms to address an optimal HBT/CMOS division of labor for highly-integrated electronic systems. At the state-of-the-art, SiGe HBTs exhibit frequency response above 300 GHz at 300K (at 130 nm), and above one-half TeraHertz (500 GHz) at cryogenic temperatures, with significant untapped performance remaining.

After an introduction to the field, this presentation will focus on new research directions and emerging mixed-signal application opportunities enabled by SiGe technology, including: complementary-SiGe (C-SiGe = *npn* + *pnp* SiGe HBTs) for analog, SiGe radar systems, SiGe for high-frequency wireless and wireline communications, SiGe for extreme environment electronics, and SiGe for wideband, enhanced dynamic range systems.

Speaker's Biography:
John D. Cressler received his Ph.D. from Columbia University in 1990. He was at IBM Research from 1984 to 1992, and on the faculty of Auburn University from 1992 to 2002. Since 2002 he has been on the faculty of Georgia Tech, where he is currently Ken Byers Professor of Electrical and Computer Engineering. His research interests include: Si-based (SiGe/strained-Si) heterostructure devices and technology, mixed-signal circuits built from these devices, radiation effects, cryogenic electronics, device-to-circuit interactions, noise and reliability physics, device-level simulation, and compact circuit modeling. He has published over 450 scientific papers related to his research, and is the co-author of Silicon-Germanium Heterojunction Bipolar Transistors (2003), the author of Reinventing Teenagers: the Gentle Art of Instilling Character in Our Young People (2004), the editor of The Silicon Heterostructure Handbook: Materials, Fabrication, Devices, Circuits, and Applications of SiGe and Si Strained-Layer Epitaxy (2006), and the author of Silicon Earth: Introduction to the Microelectronics and Nanotechnology Revolution (2009). During his academic career he has graduated 25 Ph.D. students, and 23 M.S. students. He has served as associate editor for the *IEEE Journal of Solid-State Circuits*, the *IEEE Transactions on Nuclear Science*, and the *IEEE Transactions on Electron Devices*. He has been active on numerous conference program committees, including as the Technical Program Chair of the 1998 ISSCC and 2007 NSREC. He has received a number of awards for both his teaching and research, and is an IEEE Fellow.

Public Invited

Appetizers and Networking at 4:30 pm