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**ELECTRICAL & COMPUTER
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TEXAS A & M UNIVERSITY

SEMINAR

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High-Efficiency Silicon RF Power Amplifiers (PA) for *5G Broadband Wireless Revolution*

by

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Abstract: Silicon RF power amplifiers (PAs) are in various RF front end modules (FEMs) today for handset and WLAN applications. Even though III-V semiconductor-based RF PAs can still offer superior frequency and breakdown performance with higher P_{OUT} and power-added-efficiency (PAE) and faster time-to-market, silicon-based RF PAs do have the advantages in offering higher monolithic integration with added functionalities (e.g., on-chip digital control and selection on power level, modulation, frequency band, matching, predistortion, etc.), which can translate to lower cost and smaller sizes attractive for broadband multi-mode multi-band handset transmitters. Therefore, some key techniques for designing high-efficiency 4G/5G/WLAN broadband wireless silicon PAs will be discussed. I will only be able to focus this talk on some new key design techniques that I feel have made fundamental advancement on recent high-efficient silicon PA design that are particularly appealing for 5G broadband multi-mode multi-band wireless applications. Stacked-FET SOI PA, digital-intensive or all-digital CMOS PA (DPA) with on-chip power-combiners, and dynamic supply-modulated silicon PA, etc. will be discussed in this talk. I will explain why silicon RF/mm-Wave PA design and test-beds development are two important key enablers for the exciting 5G revolution to come, especially for the fast-growing 5G small cells and/or the 5G handset markets.



Dr. Donald Lie

Dr. Donald Y.C. Lie received his B.S.E.E. degree from the National Taiwan University in 1987, and the M.S. and Ph.D. degrees in electrical engineering (minor in applied physics) from the Caltech, Pasadena, in 1990 and 1995, respectively. He has held technical and managerial positions at companies such as Rockwell International, Silicon-Wave (now Qualcomm), IBM, Microtune Inc., SYS Technologies, and Dynamic Research Corporation (DRC). He is currently the Keh-Shew Lu Regents Chair Professor in the Department of Electrical and Computer Engineering, Texas Tech University, Lubbock, TX, and also an Adjunct professor in the Department of Surgery, Texas Tech University Health Science Center (TTUHSC), supervising M.D./Ph.D. students. He is instrumental in bringing in multi-million dollars research funding and also designed real-world commercial communications products sold internationally. He was a Visiting Lecturer to the ECE Department, University of California, San Diego (UCSD) during 2002-2007 where he taught upper-division and graduate-level classes and affiliated with the UCSD's Center of Wireless Communications (CWC) and co-supervised Ph.D. students. Dr. Lie is currently serving as the General Chair of IEEE VLSI-DAT 2015-2017, and also serving on the Executive/Steering Committees of the IEEE RFIC Symp., SiRF, MWSCAS, TSWMCS (Texas Wireless Symp.), the TPC Subcommittee Chair on large-signal circuits for IEEE RFIC Symp., and also as a TPC member for IEEE RWS, PAWR, SiRF, ISCAS, BIOCAS, ASICON, ICSSE, ICBBB and IEEE-NIH LiSSA. Dr. Lie was the Conference General Chair of IEEE BCTM 2014, IEEE SiRF 2014, and the TPC Chair/co-Chair for IEEE VLSI-DAT 2013-15, IEEE BCTM 2011-13, and IEEE SiRF'11. Dr. Lie has been awarded with the US NAVY SPAWAR SSC San Diego "Center Team Achievement Award", Spring 2007, won 3 DRC Silver Awards of Excellence, 2005-2007; received IBM "FIRST" chairman patent award, 2001-2002 and Rockwell International's "FIRST" engineering awards, 1996-1998. He and his students have won 14 Best Graduate Student Paper Awards and Best Paper Awards in international conferences for 1994, 1995, 2006, 2008 (twice), 2010 (thrice), 2011, 2012, 2013, 2014, 2015 and also 2016. Dr. Lie has been serving as an Associate Editor of *IEEE Microwave and Wireless Components Letters (MWCL)* since 2010, the Associate Editor-in-Chief for the *Open Journal of Applied Biosensors* since 2012, Guest Editor of *IEEE Transaction on Microwave Theory and Techniques*, 2017, the Guest Editor for *Biosensors*, MDPI, 2016, the Special Topic Editor for *IEEE MWCL* in 2012, the Guest Editor for *IEEE Journal of Solid-State Circuits (JSSC)* in 2009, etc. Dr. Lie has consulted for several commercial IC design companies and an international research institute, and also on a couple of patents and trade secret litigation cases with some of the largest business litigation firms in the US. Dr. Lie has co-founded the *NoiseFigure Research Inc.* with his former student Dr. Jerry Lopez since 2009 at Lubbock, Texas, focusing on state-of-the-art RF-SoC technologies and the company has won numerous STTR/SBIR awards and direct contracts and creating jobs. Dr. Lie has authored/coauthored over 190 peer-reviewed technical papers and book chapters and holds seven U.S. patents. Dr. Lie's group has won 4 DARPA subcontracts in the past 5 years and published three *most downloaded TOP 100 papers* on highly efficient radio-frequency silicon power amplifier design in the IEEE *Xplore™* among millions of publications in Sept. 2012, June 2012, and Sept. 2009 (ranked #80, #88, and #21 for these 3 months, respectively). His research interests are: (1) power-efficient RF/Analog IC and System-on-a-Chip (SoC) design and test, especially on radio-frequency silicon power amplifier (PA) design; and (2) interdisciplinary and clinical research on medical electronics, biosensors, and biosignal processing.