Mohamed Nour, Ph.D.

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Work Eligibility

U.S. Citizen

Summary

- Extraordinarily creative and resourceful in microelectronics performance and reliability.
- Over seven years of experience in measuring, modeling, and simulating Random Telegraph Signals (RTS), 1/f, and thermal noise in MOSFETs. An RTS statistical model is developed based on first principles that can describe the phenomenon of charging/discharging a trap(s) in the gate oxide in time and frequency domains. The model and its simulation tool have spawned a range of applications that can be extended to new technologies and a variety of microelectronic devices. RTS can be adopted as tool to provide insightful information about defects in a material, decrease early infant mortality failure rate, and improve forecasting the life cycle of a device.
- Great experience in noise reduction at the level of device and IC.
- Excellent experience in Op-Amp operation, classes, and applications.
- Outstanding knowledge of device physics and semiconductors (BJTs, FETs, PN Junctions, Flash Memories) and their failure mechanisms.
- Great knowledge of measurements and circuit simulation using different platforms and methodologies.
- Device reliability and performance.
- Self-driven and motivated individual.
- Strong skills communication and problem-solving.
- Seven years of corporate management.
- Responsible, accountable, and high capabilities of developing client relationships.

Education

- PhD, Electrical Engineering, University of Texas at Arlington, Arlington, TX, Dec. 2015.
- Master of Business Administration, University of Phoenix, Tempe, AZ, Aug. 2008.
- B.S, Electrical & Computer Engineering, Oklahoma State University, Stillwater, OK, Dec. 2002.

Honors and Awards

- Certificate in Innovation-Based Policy and Management, Korea International Agency, Seoul, Korea, September, 2017.
- The Engineering Academic Excellence Award from the UTA College of Engineering, University of Texas at Arlington.
- The UTA Graduate Studies Dissertation Fellowship for summer University of Texas at Arlington.
- Best in Session Award for TECHCON 2014, Austin, Texas.
- STEM Fellowship, Electrical Engineering, University of Texas at Arlington.
- Maverick Doctoral Scholarship, University of Texas at Arlington.
- Undergraduate Scholarship, Oklahoma State University, Stillwater, Oklahoma.

Work Experience

- Chairman of the Electrical Engineering Department, Kadoorie Technical University, Palestine, 2017-Present.
- Assistant professor in the department of Electrical Engineering, Kadoorie Technical University, Palestine, 2016- Present.
  - ✓ Conducting research on microstrip and dielectric resonator antenna.
  - ✓ Teaching several classes and labs (Digital Electronics, Digital Logic, Electronics, Electrical Circuits, Electronics Lab, Electrical Circuits lab, Software Applications using Matlab)
  - ✓ Collaborating with Illinois Institute of Technology to deliver a productive class that concentrates on Entrepreneurship from Idea to Startup.

- ✓ Improving the Electrical Engineering curriculum.

- Investigating Semiconductor / Gate Dielectric Defects in MOSFET Using Low Frequency Noise in Time and Frequency Domains, University of Texas, Arlington, 2011-2016.

  - ✓ Conducting cross-functional disciplines to investigate Random Telegraph Signals (RTS) in microelectronic devices. As feature size is scaled down, RTS due to a single or multiple electron(s) trapping by these defects at the Si/SiO_2 interface or in the gate oxide bulk become a more pronounced problem for both analog and digital applications. RTS affects device reliability by shifting threshold voltage and fluctuating drain-source voltage which reflects on the circuit performance and integrity.
  - ✓ Taking extensive measured RTS data, flicker noise, thermal noise, IV, and CV as a function of V_{GS}, V_{DS}, and temperature (77-295K) using passive continuous flow, open cycle cryogenic system.
  - ✓ Assigning quantum trap states accurately to each switching level in a complex RTS corresponding to dependently and independently interacting traps.
  - ✓ Identifying RTS and trap characteristics such as (Average Capture and Emission Times, RTS Amplitude, Trap location Along the Channel and in the Oxide Bulk with Respect to the Si/SiO_2 Interface, Capture Activation Energy, Emission Energy, Change in Enthalpy and Entropy, Relaxation Energy, Capture Cross Section, and Screened Scattering Coefficient).
  - ✓ Identifying the origin and nature of a species that is causing fluctuations in the drain-source voltage based on the measured RTS data. For the first time a species in SiO_2 responsible for RTS has been identified through time-domain measurements and extensive analyses using four trap characteristics (ΔE_B, E_R, $E_{C_{ox}} - E_T$, σ) at the same time. Hence, RTS is a nondestructive tool that can be used to study the root cause of a deficiency in materials. RTS measurements can identify and characterize gate oxide defects with better resolution than frequency domain power spectral density, deep level transient spectroscopy, or charge pumping techniques. This elucidates that RTS can be adopted as mean to study the reliability of a device without changing the inherent characteristics of a defect. The identified trap type is Unrelaxed Neutral Oxygen Deficiency Center (V^0 ODC II).
  - ✓ The trap density in SiO_2 is found to be exponentially decreasing from the Si/SiO_2 interface to the oxide bulk.
  - ✓ Utilizing the Arrhenius, reliability, CDF, PDF, FIT, MTTF, and FMEA analyses to quantify and classify trap types. The statistical analysis showed the investigated species were 90% single acceptor, 7% two dependent acceptors, 2% independent acceptors, and 1% donor type.
  - ✓ Investigating RTS at time zero (fresh devices) and as a function of operational time (after stressing). I used a DC stress to study the behavior of a device and track the shift of device parameters (IV, V_{th}, g_m, g_d, SSF) as well as the RTS behavior. I found some of the traps after stressing became quiet. This might be explained by the possibility of injecting some of these traps with a conducting charge. Thus, they became incapable of capturing/emitting a mobile charge after stressing. Therefore, stressing a device may reduce the effect of RTS.
  - ✓ The developed RTS simulation tool uses MATLAB as a platform which has a friendly user interface environment that allows user to input all device and trap parameters in a sequential manner. A beta-version is currently being tested at TI. The software program computes and reconstructs RTS traces and associated noise in frequency domain originating from MOSFET gate-oxide defects, once these defect types are inputted to the program. The defects are experimentally identified for different technologies through variable temperature measurements, and the RTS physical mechanisms are evaluated to achieve first-principles-based accurate models. All generated RTS data and analyses can be exported automatically to MS excel files for further studies. The accuracy of predicting the RTS and trap characteristics is over 92%. RTSSIM is uploaded in the SRC site and is made available to all SRC member companies such as IBM, Intel and Global Foundries. The value and impact of this tool are evidenced by the interest shown by these companies.

- Designing measurement noise system to acquire RTS data in time and frequency domains using the following equipment:
  - ✓ Differential amplifier.
  - ✓ Bias circuitry.
  - ✓ Probing system.
  - ✓ Cryogenic system using liquid and nitrogen gas.
  - ✓ Temperature controller to maintain the temperature at the desired point.
  - ✓ Temperature sensors.
  - ✓ Several apparatuses had been used to acquire RTS signals and extract device parameters (SPA A4156C, Impedance Analyzer A4294, LCR, Dynamic Signal Analyzer, Infiniium Oscilloscope).

- Collaborating successfully with several companies such as TI and SRC. All results and analyses had been reported. So, the necessary precautionary measures can be taken by the designers and process engineers to minimize the effect of RTS in the current and next generation of technology.

- Training and Mentoring PhD Students (A.S.M. Shamsur Rouf, Tanvir Ahmed) in the Noise and Reliability Laboratory, UTA, 2014- 2015.

- Managing Businesses (2003-2012)
  - Seven years of experience in business management which helps greatly to develop a strategic plan and a potential product that add values to the companies. Utilizing the techniques, skills, and principles that I have learned and gained during the previous professional jobs and education will contribute to a company interests.

Other Projects

- Acquiring and analysis of EKG signals using FPGA technology. Kadoorie Technical University, 2017 - 2018
- Developing Intelligent Highly Secured Storage System for clinics, courts, banks, and governmental documents, Kadoorie Technical University, 2016 - 2017.
- Designing preamplifier based on BJT (RF Bipolar Transistors NPN SiGe technology, NESG2030M16). University of Texas, Arlington, Fall 2011.
  - ✓ Designing a broadband amplifier that has constant power gain (10 dB) over prescribed frequency range between 2.5 and 3.5 GHz with NF_{min} 2 dB. Advanced Design System (ADS) software was used to simulate and extract some of the amplifier characteristics as a function of frequency such as (noise factor, minimum noise figure, gain, stability factor, determinant of the S-parameters matrix, and more).

- Designing RF Receiver and SDRAM Controller, University of Texas, Arlington, Summer of 2011.
  - ✓ The purpose of this project was to design a receiver that would be able to receive a signal at 1960 MHz with an RF bandwidth of 60 MHz and produce a signal for a demodulator at 10.7 MHz with a bandwidth of 30 kHz. The receiver system was designed to produce a total input noise figure of 5 dB, sensitivity of 3 μV, and an output signal to noise ratio of 10 dB. The equivalent antenna noise temperature is 250 K.
  - ✓ A collection of components were provided with the following specifications:
    - Low noise amplifier (Gain = 15 dB, Noise Figure = 1.5 dB, Nonlinearity IP2 = 35 dBm, and IP3 30 dBm).
    - Filters
      - For f_0 > 6 MHz, fractional bandwidth 3.5%; Loss = 2 dB.
      - For f_0 > 6 MHz, fractional bandwidth > 3.5%; Loss = 1 dB.
      - For f_0 < 6 MHz, Loss = 0.5 dB.
    - IF Amplifiers (Maximum Gain = 20 dB, Noise Figure = 3 dB, IP2 = 45 dBm, and IP3 = 30 dBm)
  - ✓ Mixers (Conversion Loss = -6 dB, Noise Figure = 6.5 dB, and IP3 = 20 dBm).

- Efficiency Optimization at American Airline Call Center, University of Phoenix, Tempe, 2008.
  - ✓ Analyzing the correlation between sales representatives' average call handling time (ACHT) and other factors such as shift, seniority, days off, number of calls handled, and full-time or part-time status at American Airlines call center. The statistical analyses suggested that American Airlines need to separate ACHT target based on seniority, shift, or days off. The result has showed the seniority does not necessary improve call handling time. One possible explanations for this trend is older employees may have been trained differently and had a focus on customer care rather than ACHT target. Another issue, customer representatives who have three days off, actually have a higher mean call time than those with more working days.

Computer Skills

- Computational and Simulation Software: MATLAB, MathCad, PSpice, Multisim, Ultiboard (PCB), Advanced Design System (ADS).
- CST visual studio, Antenna Magus, COMSOL, Quartus, VHDL, FPGA, C/C++, Some Familiarity with Java and CADENCE.
- SigmaPlot, KaleidaGraph, Microsoft Office, Mega Stat, Spark, JMP, Microsoft Project, and Keysight Easy EXPERT (B1500A), Milling and Drilling of Printed Circuit Boards (LPKF Laser and Electronics).

Publications

M. Nour, and A. Balalem "The effect of High Conductive Materials on Feeding Networks in a Dielectric Resonator Antenna Array," To be submitted to IET Microwaves, Antennas & Propagation Journal in March, 2018.

M. Nour, Z. Çelik-Butler, A. Sonnet, S. Tang, and F. C. Hou, "A Stand-alone, physics-based, measurement-driven model and simulation tool for random telegraph signals originating from experimentally identified MOS gate-oxide defects", IEEE Transactions on Electron Devices, vol. 63, no. 4, pp. 1428-1436, February, 2016, DOI: 10.1109/TED.2016.2528218.

M. Nour, Z. Çelik-Butler, A. Sonnet, S. Tang, and F. C. Hou, "Random telegraph signals originating from unrelaxed neutral oxygen vacancy centers in SiO_2", IEEE Electronic Letters, vol. 51, no. 20, pp. 1610-1611, July, 2015, DOI: 10.1049/el.2015.2074.

M. Nour, A. S. M. S. Rouf, Z. Çelik-Butler, A. Sonnet, S. Tang, F. C. Hou, and G. Mathur "A scalable random telegraph signal simulation based on experimentally identified gate oxide physical defects", International Conference on Noise and Fluctuations, pp. 1-4, June 2-6, 2015, Xi'an, China, DOI: 10.1109/ICNF.2015.7288605.

M. Nour, Z. Çelik-Butler, A. Sonnet, S. Tang, F. C. Hou, and R., Wise "Measurements, modeling, and simulation of gate dielectric defects using random telegraph signals", TECHCON Conference, September 7-10, 2014, Austin, TX.

M. Nour, M. Iqbal Mahmud, Z. Çelik-Butler, D. Basu, S. Tang, F. C. Hou, and R. Wise, "Variability of random telegraph noise in analog MOS transistors", International Conference on Noise and Fluctuations, pp. 1-4, June 24-28, 2013, Montpellier, France, DOI: 10.1109/ICNF.2013.6578978.

M. Iqbal Mahmud, M. Nour, Z. Çelik-Butler, D. Basu, S. Tang, F. C. Hou, and R. Wise, "Individual defect characterization by multi-trap RTS measurements in analog MOS devices", TECHCON Conference, September 9-10, 2013, Austin, TX.

Relevant Courses

Low Frequency Noise Electronics	Introduction to MEMS and Devices
Silicon IC Fabrication Technology	Radio Frequency Circuit Design

Microprocessor System	Microwave System Engineering
Advanced Electronics	Semiconductor Device Theory
Bioinstrumentation I	Bionanotechnology
CMOS Analog Design Device	Electromagnetics
Principle of Photonic & Optic Engineering	Optoelectronic Devices for COMM

Financial Management	Statistical Analysis
Strategic Implementation and Alignment	Managerial Decision Making
Human Capital Development	Introduction to Finance and Accounting
Enterprise Risk	Sustainable Customer Relationships

Test & Characterization Apparatuses

LPKF (laser & electronics)	Oscilloscope
B1500A Device Analyzer	Preamplifier
Dimension 5000 AFM	4156C Semiconductor Parameter Analyzer
KLA-Tencor Alpha-Step IQ Profilometer	Dynamic Signal Analyzer
Scanning Electron Microscope	LCR and Impedance Analyzer
Manual Optical Probe Station	Four Point Probe RM3 Test Unit
Ellipsometer	Cryogenic System RC 103
Manual Ball Bonder	Mechanical vacuum pump
Temperature Controller Lake Shore 330	

Other Presentations

- Co-author for invited Presentation and Report at Korea International Cooperation Agency (Innovation-Based Policy and Management), Seoul, Korea, September 10-24, 2017.
- SRC-GRC Device Science Analog & Mixed Signal Annual Review: Oral and Poster Presentations. University of Texas at Dallas, TX, October 2013, October 2014, and October 2015.
- Monthly Teleconferences with Texas Instruments to Discuss the Project Progress and Exchange Ideas to Overcome Issues and Challenges Regarding the Research, Sept. 2012 – Dec. 2015.
- Co-author for an invited presentation (A Comprehensive Physics-Based, Measurement-Driven Random Telegraph Signals (RTS) Model for MOS System) at 2015 IEEE Conference on Electron Devices and Solid-State Circuits (EDSSC-Singapore).

Membership

- Member, IEEE.
- Member, GRC.
- Member, SRC.
- Reviewer, IEEE Transaction on Electron Devices.
- Reviewer, Scientific Reports.