FACULTY MENTOR
Gudem, Prasad

PROJECT TITLE
Wireless Tracking of Boomerang Flight Trajectory Using Ultra-Wide-Band Position Location System

PROJECT DESCRIPTION
"FCC approved the use of the 3.1 – 10.6GHz spectrum for deployment of Ultra-wideband (UWB) wireless technology. UWB has a signal bandwidth over 500MHz or at least 20% of its center frequency. An emission limit of -41.3dBm/MHz (75nW/MHz) was imposed to avoid interference with the future deployment of licensed radios. UWB technology offers several key advantages over cellular (2G/3G/4G/5G) and WiFi (802.11a/b) – greater immunity to multipath, superior penetration through materials, and tolerance to narrowband interference, etc. Consequently, UWB emerged as the dominant wireless technology in the niche market of asset tracking. Unlike GPS which is limited to 10m level accuracy under “static” conditions, UWB is capable of achieving accuracy levels below 10cm under “dynamic” conditions. The accuracy of the UWB system along with better penetration through materials such as wood and plastic makes it the ideal choice for tracking boomerangs.

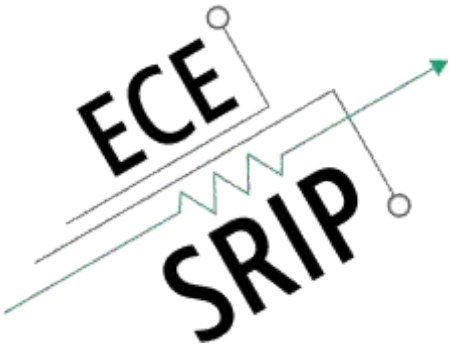
References:

[1] G. Carfano, H. Murguia, P. Gudem and P. Mercier, "Impact of FR1 5G NR Jammers on UWB Indoor Position Location Systems," 2019 International Conference on Indoor Positioning and Indoor Navigation (IPIN), Pisa, Italy, 2019.
[2] P. Gudem, M. Schütz, K. Holland, “Flight Dynamics of Boomerangs: Impact of reversal of airflow and reversal of angle of attack”, AIAA Aviation Forum and Exposition, 2019.
[3] P. Gudem, M. Laslett, G. Carfano, M. Schütz, K. Holland, H. Murguia, “Flight Dynamics of Boomerangs: Impact of Drag Force and Drag Torque”, AIAA Aviation Forum and Exposition, 2020."

This project can accommodate both remote and in-person students

INTERNS NEEDED
2 Students

PREREQUISITES
Experience working in RF lab (Signal Generators, Oscilloscope, Spectrum Analyzer, etc.) and PCB layout. ECE166 and/or other analog circuit design classes will be helpful.



FACULTY MENTOR
Gudem, Prasad

PROJECT TITLE
Design of Analog Circuits to Stabilize Ferroelectric Capacitors

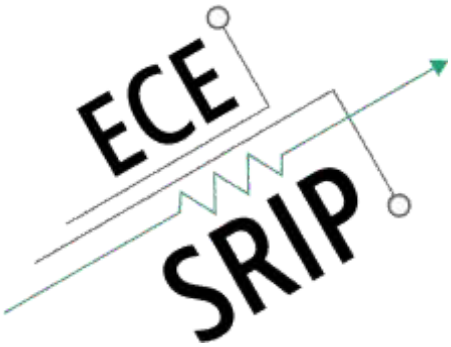
PROJECT DESCRIPTION
"Ferroelectric negative-capacitance field-effect transistors (NCFETs) realized by stacking ferroelectric material on the top of the conventional gate oxides have
recently emerged as strong candidates to continue supply voltage scaling as transistors approach their physical scaling limit. The use of ferroelectrics enables NCFETs to break the subthreshold slope (SS) barrier of 60 mV/decade set
by the Boltzmann statistics and to provide a high ON-current. Research is underway to explore the use of ferroelectric capacitance for analog/RF applications, however, ferroelectric capacitors are inherently unstable. This project will explore approaches to stabilizing ferroelectric capacitors for use in analog/RF circuits.

References:
[1] J. K. Wang, P. Gudem, T. Cam, Z. C. Yuan, M. Wong, K. D. Holland, D. Kienle, M. Vaidyanathan, "RF Performance Projections of Negative-Capacitance FETs: fT, fmax, and gmfT/ID," IEEE Transactions on Electron Devices, 2020.
[2] Z. C. Yuan, P. Gudem; M. Wong; J. K. Wang, T. B. Hook, P. Solomon, D. Kienle, M. Vaidyanathan, "Toward Microwave S- and X-Parameter Approaches for the Characterization of Ferroelectrics for Applications in FeFETs and NCFETs," in IEEE Transactions on Electron Devices, 2019."

This project will be remote

INTERNS NEEDED
2 students

PREREQUISITES
Good grades in ECE166 and ECE164. Exposure to analog circuit simulation using Cadence will be helpful.



FACULTY MENTOR
Gudem, Prasad

PROJECT TITLE
Study of N-path Filters with Arbitrary Source/Load Impedances

PROJECT DESCRIPTION
The tunable center frequency and bandwidth of N-path filters make them an ideal choice for compact software-defined radios. These filters are typically assumed to be driven by a source having a 50-Ω impedance and a load impedance that is modeled as a capacitor. However, impedances on the source side and the load side of an N-path filter may vary for multiple reasons. For example, environmental effects and user interaction with the antenna can cause a deviation in source
impedance from the standard 50 Ω and corresponding voltage standing-wave-ratio (VSWR) of 1:1 to a VSWR of 2:1. In addition, the frequency response of the load impedance (also called the baseband impedance) can be affected by nonidealities of the passive and active loads used in N-path filter design [4], [5], [6], and [7]. Such impedance variations can result in significant deviations of the center frequency and bandwidth of N-path filters. In this project, students will design and test an N-path filter with varying source and load impedance.

References:
S. Rizwan, P. S. Gudem, K. Holland, D. Kienle, and M. Vaidyanathan, "Expressions for the Harmonic Transfer Functions of N-Path Filters with Arbitrary Source and Load Impedances," IEEE Transactions on Circuits and Systems II: Express Briefs, 2020.

This project can accommodate both remote and in-person students

INTERNS NEEDED
2 students

PREREQUISITES
Exposure to analog circuit simulation using Cadence. Experience working in RF lab (Signal Generators, Oscilloscope, Spectrum Analyzer, etc.) will be helpful. Good grades in ECE166 and ECE164.