University of Stuttgart
Institute of Robust Power
Semiconductor Systems

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Prof. Dr. Justin King
justin.king@tcd.ie

Prof. Dr.-Ing. Ingmar Kallfass
Ingmar.kallfass@ilh.uni-stuttgart.de

Topic first announced on 01.12.2024
Valid until 30.09.25

The topic is suitable for adaptation to
- ✓ Master's thesis (6 months)
- ✓ Bachelor's thesis (3 months)
- ✓ Research proejct (3 months)

Bachelor's thesis
Research project
Master's thesis

High frequency electronics

Nonlinear Transistor Modelling for Analog Pre-Distortion of Microwave Power Amplifiers

Motivation

Linearisation of millimeter-wave power amplifiers plays a decisive role in the energy-efficient and sustainable deployment of 6th generation mobile communication networks (6G) exploiting new frequency spectrum to support the demand in continuous growth of data rates.

Scientific problem statement

Due to the multi-GHz instantaneous bandwidths of modern high-capacity millimeter-wave transceivers, the linearisation of power amplifiers through conventional digital pre-distortion (DPD) techniques becomes too power-hungry and inefficient. Analog pre-distortion (APD) p based on class-C pre-amplifiers presents an efficient, scalable alternative to DPD at high instantaneous bandwidths. However, its implementation is severly hindered by the absence of simulation models capable of accurately predicting the nonlinear characteristics of the underlying transistor technologies. This work uses state-of-the-art transistor technology and measurement instrumentation to obain compact, equivalent-circuit based models for the reliable design of APD circuits for PA linearisation at millimeter-wave frequencies in WR-10 (70…110 GHz) and WR-6 (110…170 GHz).

Work programme

The work is carried out in collaboration between University of Stuttgart, Germany, and Trinity College Dublin, Ireland. The final work programme is determined in trilateral planification between the tutors and the student and comprises

- Survey of the prevailing state of the art
- On-wafer characterisation of high-frequency transistors using linear and non-linear network analysis at millimeter-wave frequencies at ILH
- Model development, implementation in VerilogA and parameter extraction at TCD
- Model validation through millimeter-wave power amplifier characterisation at ILH