Graphic Neural Network (GNN) based RF System Linearization
Linéarisation du système RF basé sur réseau neuronal graphique

Internship location: Sorbonne University, Paris, France
Period: 6 months (possible to start at any time before June 2024)

Context: This work is part of the research activities carried out within GeePs Laboratory (UMR CNRS 8507) on low power neuromorphic circuits and their extension to the artificial intelligence network. The work carried out on this theme aims to analyze the processing of information by low-power circuits inspired by biological neurons and to exploit the constraint edges on the performance of the neural networks.

Research on artificial intelligence (AI) systems are recently very popular in academia and industry. Graphic neural networks (GNN), an emerging technology for artificial intelligence (AI), are designed to process and analyze data that can be represented as graphs or networks. Unlike traditional neural networks, which operate on grid-structured data like images or sequences, GNNs excel at handling non-grid data with intricate relationships and dependencies. The network iteratively aggregates information from neighboring nodes, which allows it to capture complex dependencies and patterns within the graph structure, such as in radio telecommunication spectra processing.

The linearization of RF PA in a base station commonly employs a DPD technique which needs the characterization of the PA [Wang2023]. This research aims to investigate and to develop an innovative approach for the linearization of RF systems by leveraging GNN within the framework of edge computing. The proposed study will investigate the potential of utilizing GNNs at the user equipment (UE), such as mobile phones, to mitigate nonlinearities inherent in RF systems for enhanced performance and efficiency. The research will focus on training GNN models with datasets collected from an RF testbench to adaptively correct non-linear distortions. The outcomes of this study have the potential to revolutionize RF system design, offering improvements in energy consumption, reliability, and overall network efficiency.

Objective:
- Exploring the advantage of using GNN in DPD: Investigate and implement digital predistortion (DPD) technique for adaptive linearization of antenna array. Develop and optimize Graph Neural Network models.
- Training of GNN with low complexity: Explore the integration of GNN training algorithms from UE side.

Keywords: graphic neural networks, linearization, machine learning, signal processing, telecommunication.

Project Supervision:
This project is coordinated by Siqi Wang, Associate Professor of Sorbonne University. Siqi WANG’s research interests include artificial intelligence and spiking neural networks, RF device modeling, and energy efficiency optimization for wireless communication systems.

Candidate: For this project, the skills required in the following areas will be necessary:
- Programming in Matlab or Python.
- Digital communication.
- Signal processing.
- Reading and writing in English.

Prior knowledge of neural networks is desirable.

Contact: siqi.wang@sorbonne-universite.fr

References:
Ruan H., et al. (2024) [link]; Wang S., et al. (2023) [link]; Wang S., et al. (2022) [link]; Ferreira, P. M., et al. (2020) [link].