Circuits and models for analog computation of artificial neural networks

Main Task Categories:
- Integrated circuit (IC) design
- Artificial neural network (ANN) modeling

Your Profile:
- Independent and goal-oriented way of working
- IC-design: Very good grade in the lecture Mixed Signal Integrated Circuit (INT), Verstärkertechnik (INT), Grundlagen Integrierter Schaltungen (INT) or in a similar lecture.
- ANN-modeling: Very good grade in lecture the Deep Learning (ISS) or in similar lecture.

We Offer:
- Individual supervision and support
- Freedom to contribute and implement your own ideas
- State-of-the-Art process design kits for IC design

Background:

Artificial intelligence has found its way into more and more areas of life in recent years. This also applies to mobile applications with limited available energy. The energy efficiency of AI accelerators therefore plays a decisive role. Analog implementations are moving into focus, as they have considerable energy-saving potential**s**. By considering electrical voltages**,** currents and charges as continuous analog quantities to perform arithmetic operations, the energy required for inference can be significantly reduced compared to conventional digital calculation. At INT, we are working on an all-analog system, where the multiply-accumulate (MAC) operation and ReLU-activation operation is performed in analog.

Your Task:

We are looking for very good students who want to help us to develop energy-efficient circuits or program hardware-aware models needed to train neural networks.
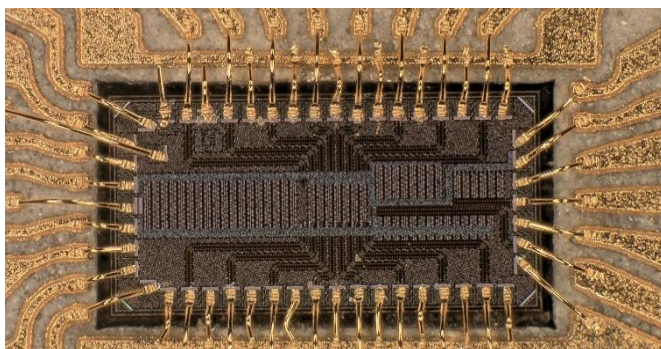

Figure 1: Photo of the first AI inference chip developed at INT.

Exemplary Topics:
- Modeling of analog circuit components in Python/Tensorflow/PyTorch.
- Design of highly energy- and area-efficient A/D and D/A converters
- Development of strategies to reduce or compensate mismatch at system level, circuit level or software level.

Contact:

Jakob Finkbeiner, jakob.finkbeiner@int.uni-stuttgart.de
Raphael Nägele, raphael.naegele@int.uni-stuttgart.de

Institute of Electrical and Optical Communications
Prof. Dr.-Ing. Georg Rademacher
Pfaffenwaldring 47, 70569 Stuttgart