

**Assignment of the Master's Project Work in the Program Electrical and Information
Technology (EIT)**

Topic: Design of High-Performance Differential THz Oscillators in SiGe BiCMOS Technology

Task:

In the terahertz (THz) range from 300 GHz to 4 THz, many novel applications are currently being developed: for example, contactless material detection and characterization, ultrafast wireless data transmission of several Tbit/s, or detection of concealed objects in robotics and security applications. For these application areas, compact and powerful signal sources with high efficiency are needed. In the realm of transistor-based signal sources, InP-DHBT-based circuits achieve some of the highest efficiencies and output powers at frequencies above 300 GHz. However, these are contrasted by high manufacturing costs and low availability of commercially usable foundry services.

Alternatively, SiGe-based HBTs can also achieve cutoff frequencies over 700 GHz, which in principle allows for high oscillation frequencies. However, high power levels and efficiencies are difficult to achieve due to the low breakdown voltage of less than 2V.

The aim of this work is to investigate the feasibility of high-performance differential oscillator circuits with an output frequency above 400 GHz in state-of-the-art SiGe BiCMOS technology. The focus will particularly be on the "cross-coupled" and "reflection-type" topologies. The circuits will initially be designed at the schematic level, and a qualitative understanding of the influence of various design parameters on the performance of the oscillators will be developed. The achieved output power and efficiency will subsequently be compared with published values for InP-based oscillator circuits with a similar topology and critically discussed. Finally, at least one of the developed circuits will have a physical layout designed, which will be verified through EM simulations and will also pass the design rule check of the used SiGe foundry.