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Institute of Robust Power Semiconductor Systems

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10.04.2021

Research Work*
Bachelor's Thesis*
Master's Thesis*
HiWi*

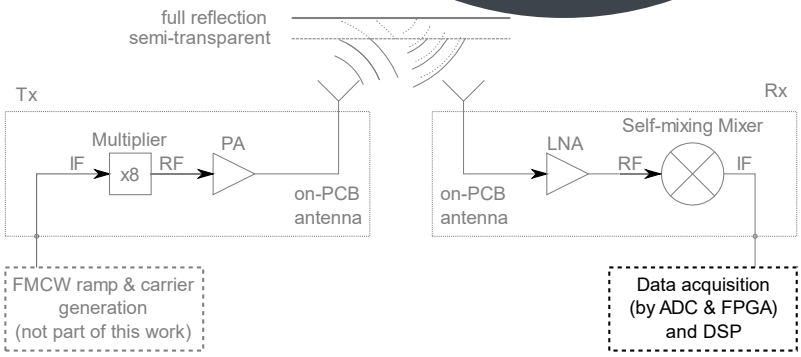
to be assigned

ILH RF-group

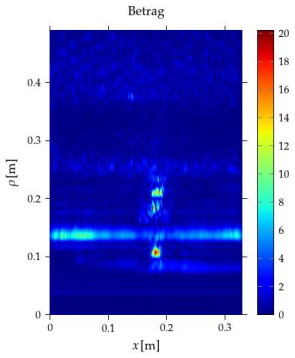
Radar Signal Processing for a novel, self-mixing Radar Principle

Motivation:

A novel FMCW radar principle operates without an explicit local oscillator signal in the receiver, but relies on self-mixing of the receiver. Thus, the receiver is electrically, as well as locally completely independent from the transmitter. In contrast to common radars, the information gained is not the absolute distance to the target object, but the relative distance between multiple surfaces. This allows numerous potential applications, particularly in the fields of production engineering, medicine, materials analysis and safety.



Scheme of self-mixing radar with DSP interface



Exemplary measurement of two targets (metal balls) with a stepped frequency continuous wave radar of a preceding work. The balls get visible as the red dots in the radar picture.

Goals:

Covered by the project MIRADOR (Self-mixing **mi**llimeter-wave **rad**ar based on multiple surface reflections) and in possible collaboration with *Balluff GmbH,* a digital signal processing (DSP) for a self-mixing radar based on FPGA or microcontroller should be developed.

- ADC and FPGA-based signal acquisition
- Implementation of DSP algorithms for processing relative distance information from a self-mixing mono or bistatic radar
- Real-time or quasi-real-time DSP
- miniaturization towards handheld radar demonstrator solution (not part of this work)

Your possible Tasks (*):

- Investigate State-Of-The-Art Radar Signal Processing and understand the theory
- Programming of FPGA or microcontroller and implement DSP
- Debugging and characterization with generic and real-life radar data
- Design of an interface / data display for demonstration purposes
- Examine possibilities to embed the FPGA-based DSP in a handheld radar demonstrator platform

Your Qualifications:

- Hands-on experience in developing FPGA or microcontroller algorithms
- Familiar with software development: VHDL and/or Verilog, Xilinx Vivado, C, Visual Studio
- Passion for producing high quality DPS algorithms for challenging requirements with eventually limited space and power constraints
- Knowledge of Radar Signal Processing fundamentals is advantageous

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Language: German/English

**Parts of the work can and will be split into suitable amounts for research-work/BA/MA topics*