

University of Stuttgart

Institute of Robust Power
Semiconductor Systems

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(Research Work*)
Master's Thesis

to be assigned

ILH
RF-group

Large bandwidth
frequency ramp
generation for a
novel, self-mixing
FMCW 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.

Goals:

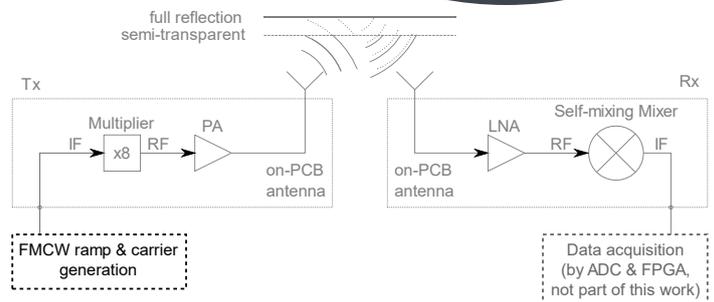
Covered by the project MIRADOR (Self-mixing millimeter-wave radar based on multiple surface reflections) and in possible collaboration with *Balluff GmbH*, a solution for digitally controllable generation of large bandwidth (BW) frequency ramps should be developed, for the use with a handheld radar demonstrator platform (not part of this work).

- Total BW must be large enough ($> 10\text{GHz}$) to achieve a radar-resolution in *cm* range.
- Fast chirp rate (in the order of $\text{GHz}/\mu\text{s}$) is aimed at, to accomplish well processable distance term.

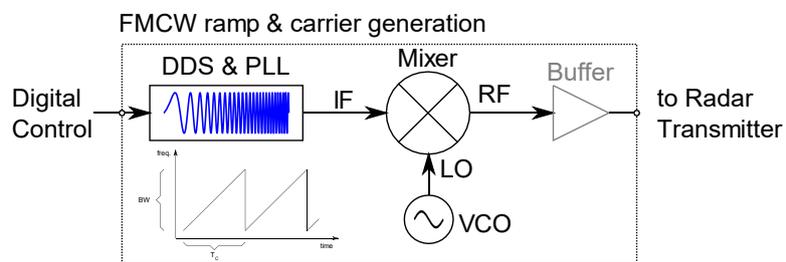
Your Tasks (*)

- Investigate State-Of-The-Art Frequency ramp generation and understand the theoretical background
- Profound choice of frequency ramp generator (DDS, PLL, FPGA,...) and upconverter components according to given specifications
- Design, simulation, layout and assembly of an RF-PCB
- Programming and debugging of generator
- Setup, measurement and characterization
- Design of an interface for digital control

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Scheme of self-mixing radar with external frequency ramp generation



Scheme of FMCW generation with typical radar frequency chirp sequence

Your Qualifications:

- Hands-on experience in PCB-design
- Familiar with software development
- Passion for challenging RF-circuit and analog circuit design
- Knowledge of RF-circuit design is advantageous

Language: German/English

*the workload can be split into two research works, e.g. by separating into digital part and RF-PCB design part

