Universität Stuttgart

Institut für Robuste Leistungshalbleitersysteme

Prof. Dr.-Ing. Ingmar Kallfass

30.08.2022

Research / Master Thesis Topic
FA / MA

HF

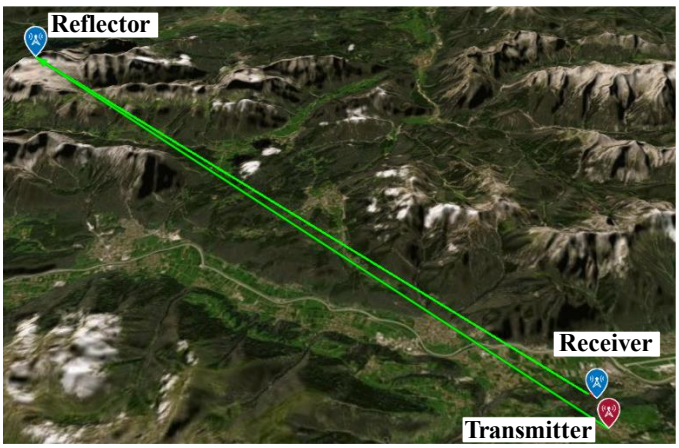
Automatic Antenna Positioning Algorithms for Millimeter Wave Communication Systems

Description & Motivation:

- Measurement, modeling and characterization of the atmospheric and weather effects on an E/W band communication link (71-76 GHz & 81-86 GHz) with different elevation angles;
- Demonstration of wireless radio broadband Internet in remote areas (>40 Gbps in frequency and polarization multiplex scenarios).

Goals:

- Automatic remote antenna calibration;
- Identify and quantify optimal search algorithms to align 3 antennas.
- Modelling, simulation and control of the optimal antenna positions, allowed deviations and alignement precision;
- Development of an automatic algorithm to align 3 highly directive (HPBW= 0.3°) antennas
- Continious automatic antenna alignment and position adjustment (Antenna Gain: 59 dBi and half power beamwidth: 0.3°) based on the received signal power;
- Automatic quantification and graphical representation of signal quality, antenna alignement and weather conditions.



System characteristics:

- Alignement of 3 antennas
- Each antenna is situated on an automatic controllable positioner
- Positioner step in azimuth and elevation: 0.01°
- Antenna HPBW: 0.3°
- Transmission distance: ~ 40 km
- Remote control of all 3 stations.

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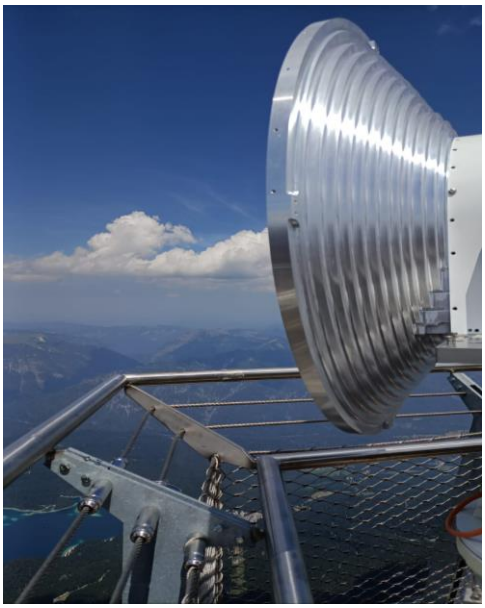
Cross-polarization Effects in Broadband Wireless Communication Systems

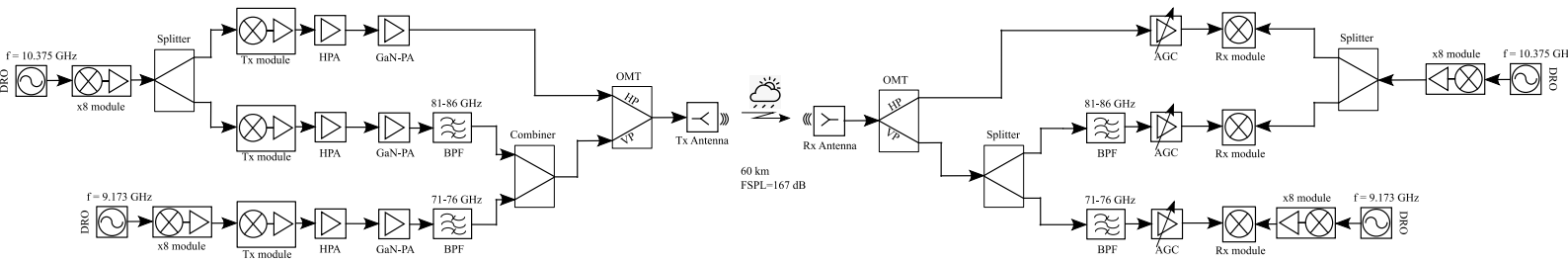
Description & Motivation:

- Measurement, modeling and characterization of the atmospheric and weather effects on an E/W band communication link (71-76 GHz & 81-86 GHz) with different elevation angles;
- Demonstration of wireless radio broadband Internet in remote areas (>40 Gbps in frequency and polarization multiplex scenarios).

Goals:

- Measurement and quantification of the cross polarization effects introduced by the septum polarizer and the orthomode transducer (OMT).
- Analyze the cross-polarization effects on the received signal quality (signal power, error vector magnitude, bit-error rate).
- Analyze and implement methods for reduction of cross-polarization effects.
- Investigation of the atmospheric cross-polarization effects on a broadband millimeter-wave wireless communication system.
- Simulation, measurement and characterization of mutual coupling effects (if 2 antennas per site are used).
- Comparison between mutual coupling impairments and cross-polarization signal degradation.





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Master Thesis Topic
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Real-time signal evaluation and correction with Xilinx MPSoC

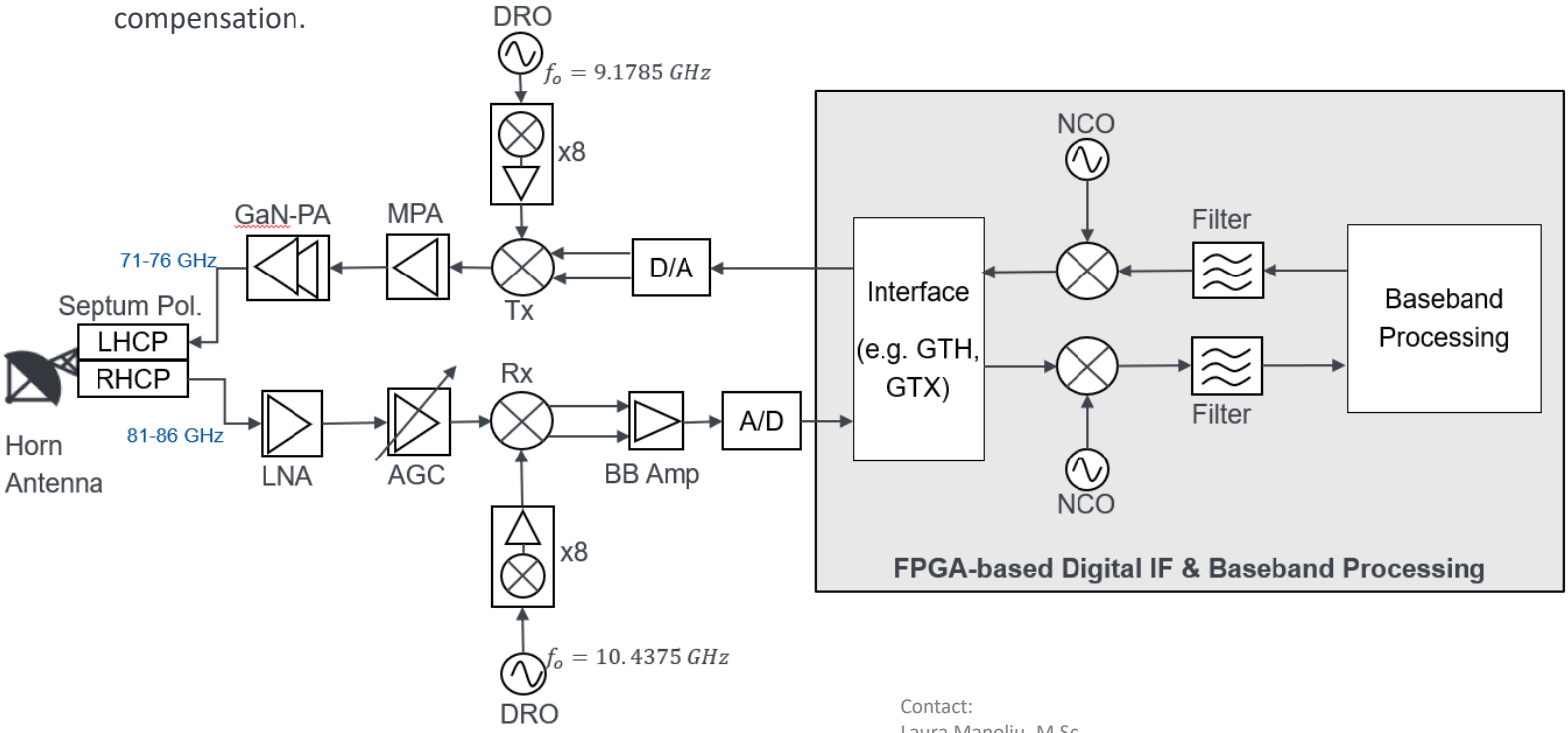
Description & Motivation:

- In Orbit Demonstration of a satellite payload for feeder link and Earth observation applications using E/W-Band Radio Frequency (RF) Analog Frontend and ultra high speed FPGA-based digital IF and Baseband processing
- The onboard signal processing will be based on an FPGA-platform, therefore allowing for a dynamic data throughput customization as well as live characterization of the modulated communication signal, combined with an MMIC-based RF transmit frontend and 2W GaN-based SSPA output stage and 2 dB NF GaAs LNA receiver.

[EIVE Digital Baseband (flight HW), in the function of Arbitrary Waveform Generator (AWG) based on multiMIND Platform]

Tasks:

- Generate bit sequences on the FPGA with different data rates (up to 20 Gbps), modulation formats, power levels.
- Transfer the bit sequences to an analod-to-digital (D/A) converter and transmit the data through a noisy channel.
- Receive the data and digitize it with an analog-to-digital converter (A/D) and dynamically compare it with the transmit data
- Improve the signal quality transmission in the digital domain to overcome impairments from the noisy channel.
- On-board Live signal proccessing, characterization and degradation compensation.



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