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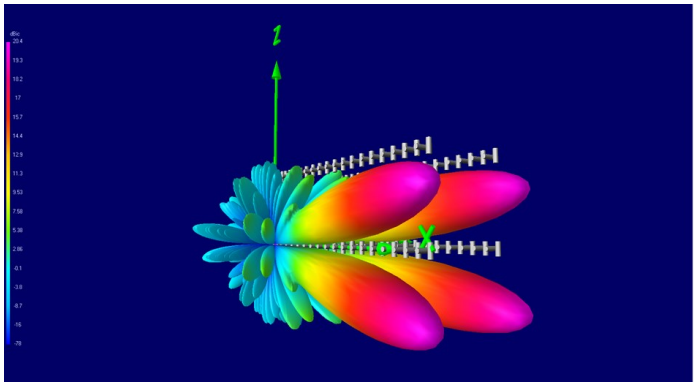
Bachelor-Diplomarbeit Elektrotechnik

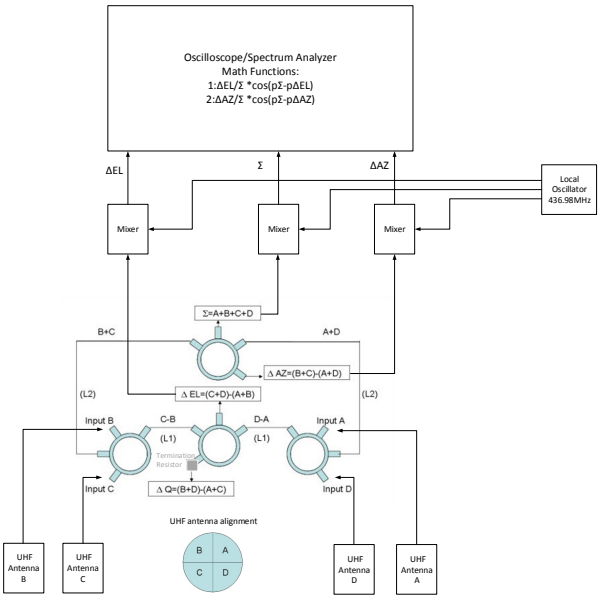
CubETH Ground Station — Setup and Satellite Tracking

Simulation of Beam Splitting with 4nec2

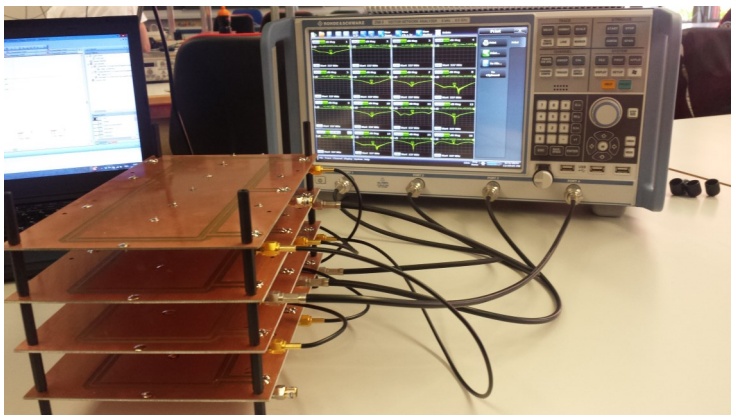


CubETH Ground Station Antenna System

Test Arrangement for the Proof of Concept



Test of the Microwave Combining Network



Mission
The aim of project CubETH is to realize a satellite according to the CubeSAT standard that is able to determine its exact position in space with an accuracy of one meter using commercial GNSS receivers.

Problem
With almost every satellite project, the downlink is of highest mission priority. This lies in the nature of not having sufficient power onboard the satellite to transmit information at high power levels and limited opportunities for high-gain antennas.
The same is the case with CubETH.

Task
In order to get as much out of the incoming signal strength at the ground station, the antenna system follows the satellite orbit using the so called Keplerian Elements.
Although quite accurate, these elements specify where the satellite can be seen at a specific time. Due to atmospheric phenomenon such as bending and reflection the radio wave line of sight differs from that. Therefore, three concepts for closed loop control of the antenna mover systems are suggested.
All concepts are thoroughly described and an implementation solution is provided for each concept. Finally, the concepts are compared and the best promising is further investigated.

Test
The most promising concept, beam splitting, uses radar monopulse technique and has the great benefit that the sum signal (all four UHF antennas combined) is available simultaneous with the error signal generated. Therefore, the antenna system can be adjusted at the same time while data is sent and received.

This concept is tested by means of a proof of concept. It involves a microwave combining network arranged out of four Rat-Race Hybrid couplers that generate the error signal.

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