UNIVERSITÄT DUISBURG ESSEN

Fachgebiet Hochfrequenztechnik

H F T

Fachbereich Ingenieurwissenschaften
Abteilung Elektrotechnik und Informationstechnik

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Aufgabe der Abschlussarbeit im ISE Bachelorstudiengang

für: Herr Abdullah **Demir**

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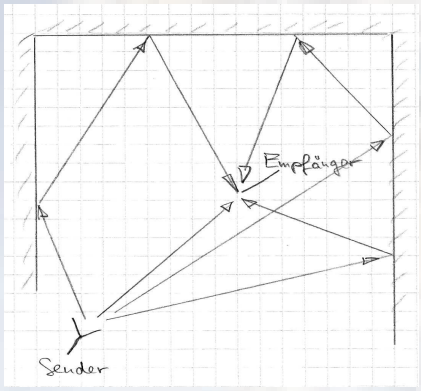
Thema: **Measurement of Microwave In-Room Transfer Function (Antenna-Antenna)**

Beschreibung:

In a new project, the communication using a large number of harmonically related microwave signals inside an office room is investigated. At the transmit side, modulated carriers are radiated out from an omni-directional antenna. The signals reach the omni-directional receive antenna after a multi-path propagation inside the room. This leads to different phase and amplitude for each received carrier and differs for different positions of the receive antenna. At the receiver, the complex sum (superposition) of all received carriers appears and is sampled down to base band. The combined channel for signals between transmit and receive antennas is therefore frequency dependent and position sensitive. The optimum combination for highest combined receive signal strength is achieved when all signals combine constructively (in-phase) which requires that the phase of each involved carrier be transmitted with an inverted phase w.r.t. the phase of its transfer function.



Thesis Task:
The thesis task is to make measurements of the complex transfer function between two antennas in a laboratory room and to analyze the variability of the channel transfer function as a function of frequency and antenna positions. The transfer function is to be measured as the complex transmission scattering coefficient s_{21} between two antennas using a microwave vector network analyzer. The frequency range to cover is 1 GHz to 3 GHz and 3 to 10 GHz using two sets of suitable omni-directional antennas (provided) which are connected to the test equipment by coaxial cable. From the measured transfer functions, statistical relations of phase and amplitude vs. position and phase and amplitude vs. frequency are to be investigated. In addition, a simulation of the receive signal strength is to be undertaken which shows the signal dynamic range in a conceptual communication system depending on the number of employed carriers and their frequency step.

The task entails the following steps:

1. Definition, preparation, and documentation of the In-Room scenario.
2. Characterization of the omni-directional antennas (impedance match and radiation pattern).
3. Calibration of the antenna-to-antenna transmission including loss and phase of the cables.
4. Measurement of sets of transfer functions for two frequency bands and with 20 to 30 different positions of antennas using a computer controlled vector network analyzer.
5. Analysis of the statistics of the measured transfer functions using, e.g., Matlab.
6. Definition of conceptual communication systems with 5 to 20 carriers and frequency steps of 100 MHz to 500 MHz. Assuming suitable phase inversion at the transmitter, calculation of expected signal strength from the superposition of received carrier signals as a function of position in the room.

At the end of the work, a public presentation of results is to be given.