UNIVERSITÄT DUISBURG ESSEN

Fachgebiet Hochfrequenztechnik

H F T

Fachbereich Ingenieurwissenschaften
Abteilung Elektrotechnik und Informationstechnik

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Aufgabe der Abschlussarbeit im

ISE Masterstudiengang

für: Frau Yan Shen

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Thema: An automatic antenna matching method for mono-static FMCW radars.

Description:
A low crosstalk between transmitted (Tx) and received signals (Rx) is important for a high performance mono-static radar system. The decoupling of the Tx and Rx signals can be done by different types of diplexers. The Rat-Race coupler is a good choose in micro strip technology although a loss of 3 dB is introduced in Rx and Tx. The Rx and Tx signals are well decoupled, if the image impedance of the Rat-Race coupler is similar to the antenna impedance. Unfortunately the impedance of the antenna, apart from frequency dependence, is not constant over all temperatures and radiation environments.

In this master thesis the task is to develop a dynamic method, which will match the Rat-Race image impedance to the total antenna impedance by using the DC offset at the Rx mixer output as an input parameter of a controller, which varies the tunable impedance network in such a way, that the mixer DC offset will be minimised. A demonstrator will be built on a RF grade circuit board (PCB) working at an RF of some GHz and consisting of a voltage controlled oscillator (VCO), a Rat- Race coupler, a tunable impedance network, a Gilbert cell mixer and an antenna. The VCO and the RF mixer will be provided by Bosch as much as the necessary RF-equipment (hardware and software).

Work packages:

1) System definition (selection of the carrier frequency).
2) Design of a patch antenna (single patch and a small array: 2-4 patches).
3) Antenna impedance measurement for different antenna setups (including different cable length).
4) Development of a bipolar, FET or diode based network, which can be adjusted to match the measured antenna impedances (impedance tuner) by electrical control.
5) Circuit design of the coupler and the tunable impedance network.
6) Assembly of the demonstrator (open loop)
7) Interconnection between the circuit print board and computer (PC)
   (PC-Interface card includes A/D and D/A converters)
8) Implementation of the MATLAB code (starting with a standard minimisation procedure) for the automatic impedance matching (close the loop).
9) Discussion of alternative controller concepts (e.g. compare effort, cost and functionality of analog and digital controller)
10) As a final solution, selection, assembly and evaluation of a closed loop demonstrator with either digital optimized controller or with analog controller integrated on the same PCB.

After completion of thesis work a public presentation of results is to be given at the department.