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: Herrn Anom Ebenezer

gestellt von: Prof. Dr.-Ing. K. Solbach
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Thema: **Compensated Crossing of Transmission Lines in Stripline Technology for Butler Matrix Networks in 7-Tesla MRT**

Thesis Task:

A Butler matrix network can be used to create phase-modes in a 7 Tesla Magnetic Resonance Tomograph (MTR) system. Such a network consists of a number of power dividers with a phase difference of 90° between the output ports (90°-hybrid) connected in a several stages.

Between the stages some connecting lines have to cross from one side to the other. When the matrix network is realized as a planar structure using stripline technology, the crossing of lines cannot be realized as a planar crossing, in order to avoid the galvanic coupling of the lines. One solution is the use of two transitions from the stripline to a coaxial transmission line which bridges the two sides of the gap in one of the striplines, while the other stripline goes through. For low-power applications it also is possible to use a zero-resistance SMD-resistor mounted over the gap to connect both ends. For high transmit power (as in the MRT) strip width is too large for that and we require a long bridge-shaped crossing high enough to handle the high voltages (air-bridge).

The thesis task is to design and optimize an air-bridge crossing for a Butler matrix in microstrip technology on a dielectric laminate. The optimization aims at keeping the characteristic impedance of the crossing transmission lines (modification of strip width) constant and at the compensation of the residual coupling capacitance between the two crossing lines by a shunt inductor.

In particular the task is to

- design and model an air-bridge crossing and simulate the transmission characteristics using an electro-magnetics (EM) simulator tool
- optimize the strip dimensions of both strip lines for lowest reflection coefficients
- extracting the coupling capacitance between the lines and calculating a suitable inductance for shunt resonance compensation
- create a test circuit and measure the reflection coefficients, insertion loss and coupling of lines
- optimize the circuit for improved performance

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