UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft

FAKULTÄT FÜR
ELEKTROTECHNIK,
INFORMATIK UND
MATHEMATIK

Abstract of thesis

Procedures for the modeling of board level optical interconnections towards time efficient simulations

of Mr. Oliver Stübbe

The progressive development of new hard- and software applications leads to an increase in the amount of data to be processed and to a constantly rising need in bandwidth. To be able to efficiently process these data more powerful systems of information and communication technologies are needed. The performance of these systems is determined by its individual components and by the bus systems connecting the components. One can foresee that in the future the performance of the systems will be limited by these bus systems. To get rid of this bottleneck board level optical interconnections are introduced in exchange for the electrical bus systems. A standard printed circuit board is enhanced by an additional layer with embedded optical wave guides.

Currently there are no methods allowing an analysis of the transmission behavior within a short period of time of these additional layers. This is where this work starts. The aim is to develop models for the time efficient simulation of the embedded optical wave guides. For this, a method is introduced based on a modular concept. A complex system is divided into subsystems. For these subsystems efficient models concerning the demands of time efficient simulation must be developed.

The embedded waveguides are highly multimodal; therefore the development of models based on ray optical methods is feasible. Based on these methods, two strategies for generating the models are introduced. The first strategy uses symmetries of the core cross section of the embedded waveguides. The path of the rays within these waveguides is being substituted by two ray paths on orthogonal planes. With this method, at least one of the two ray paths is calculated within a short period of time by few directly solvable analytical equations. The second strategy emphasizes redundancies in calculating ray parameters. By using this strategy a multiport model determining transmission behavior by applying algebraic methods is developed.

The calculation time of these models is not dependent on geometrical and material parameters. To verify these models different waveguides are modeled and the deviation as well as the efficiency corresponding to a ray optical reference algorithm is discussed.

This thesis has shown that the transmission behavior of embedded optical waveguides can be calculate time efficiently. Due to the modular approach a simulation of a complete system is possible.