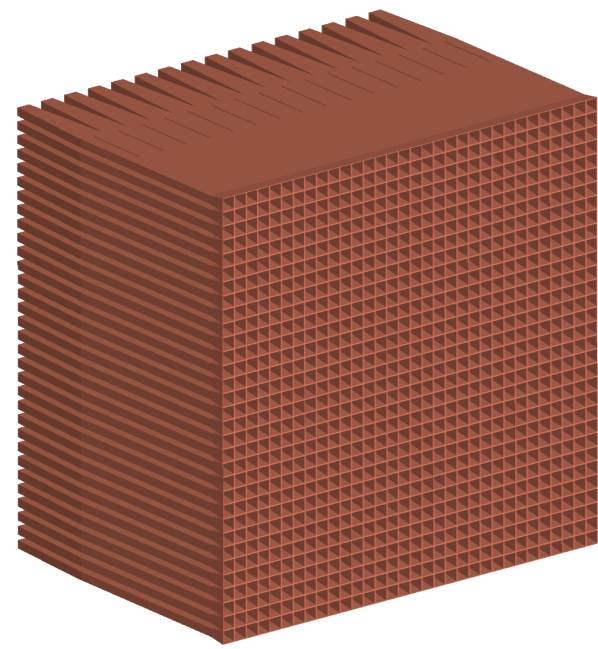
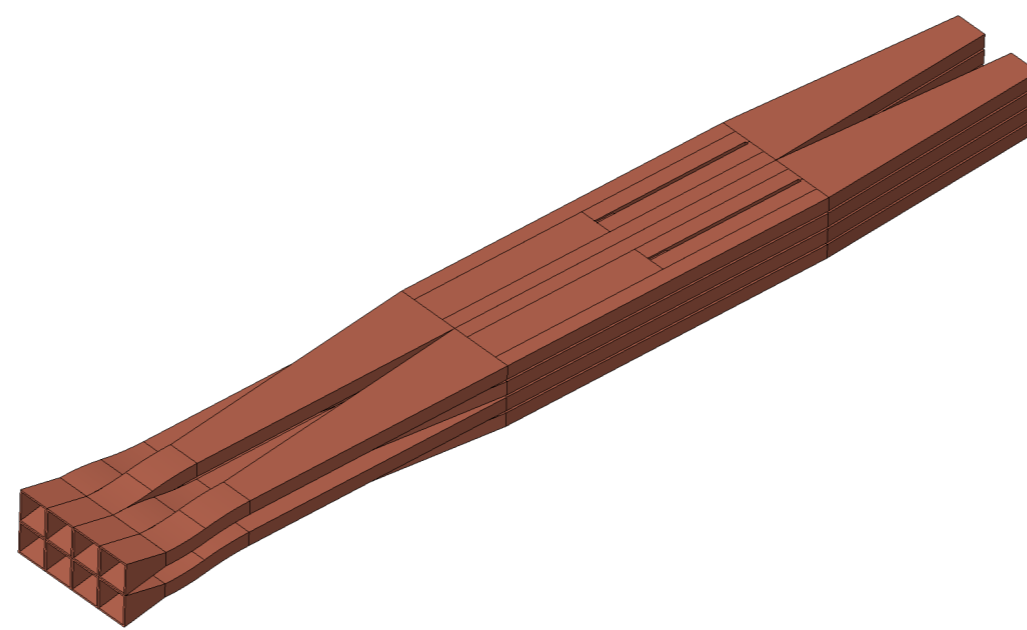


Industrial Technologies

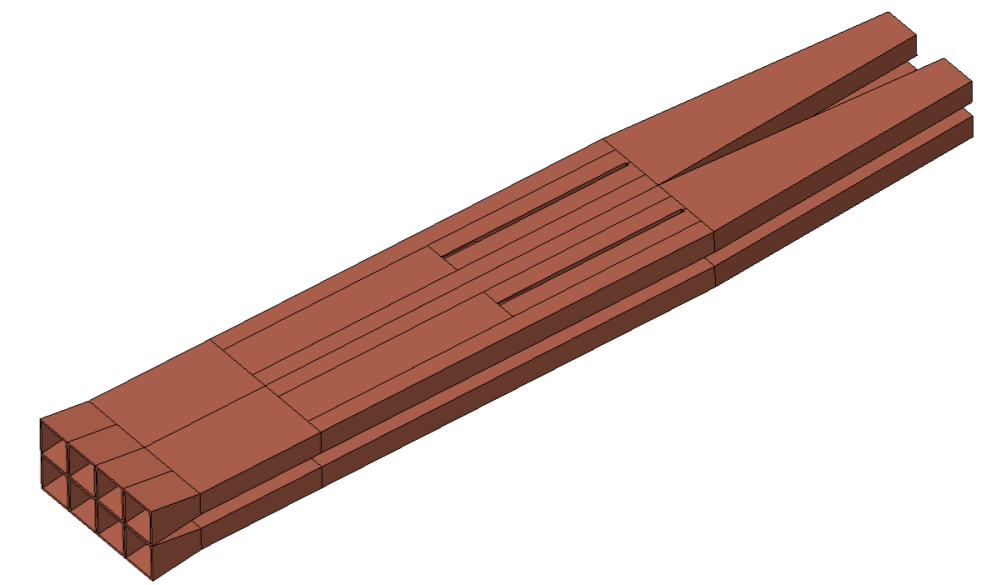
A High-Precision Phase Shifter Design for a Wireless Power Transfer System in the 35 GHz Band



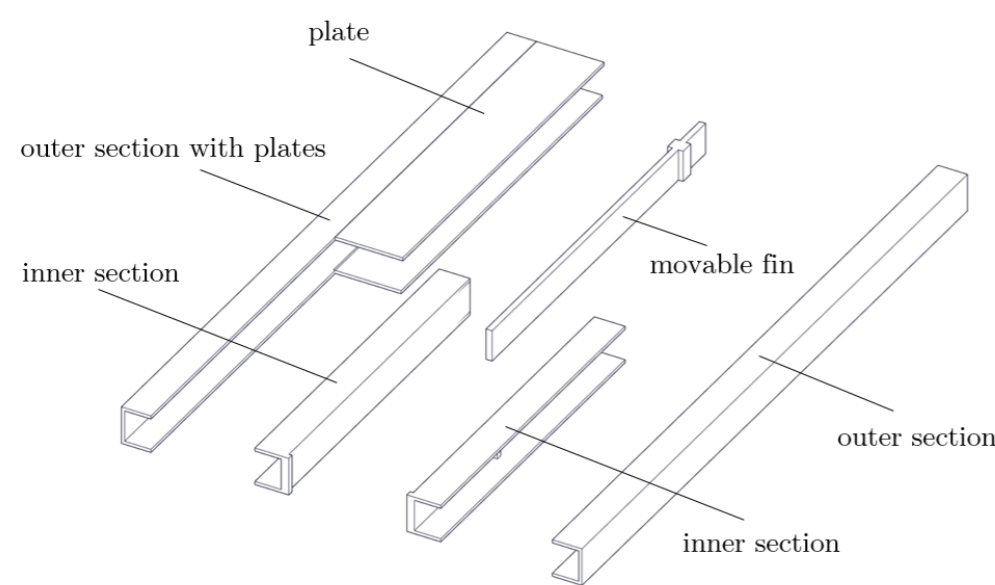
A 32 x 32 Section of a Horn Antenna Transmitter Array



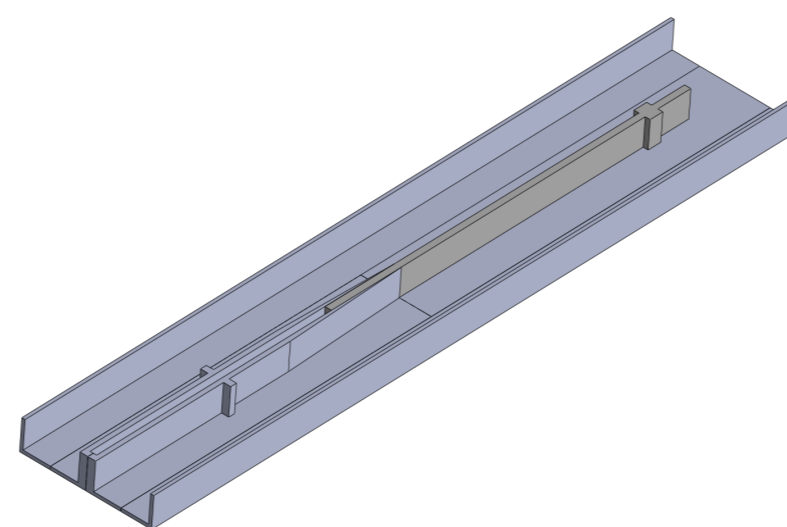
Antenna and Phase Shifter Arrangement for Single Element Control



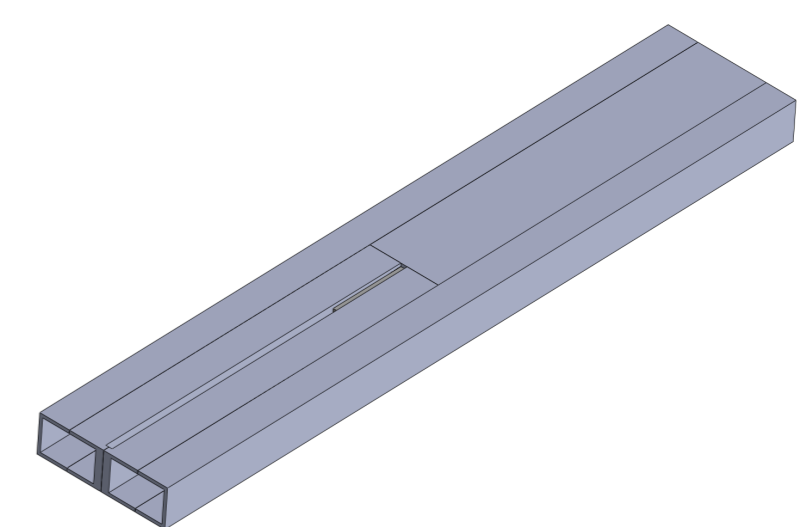
Antenna and Phase Shifter Arrangement for a combined Dual-Element Control



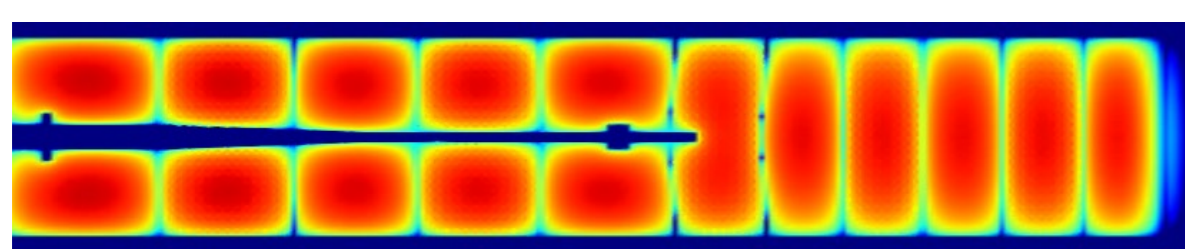
Exploded View of Subsections



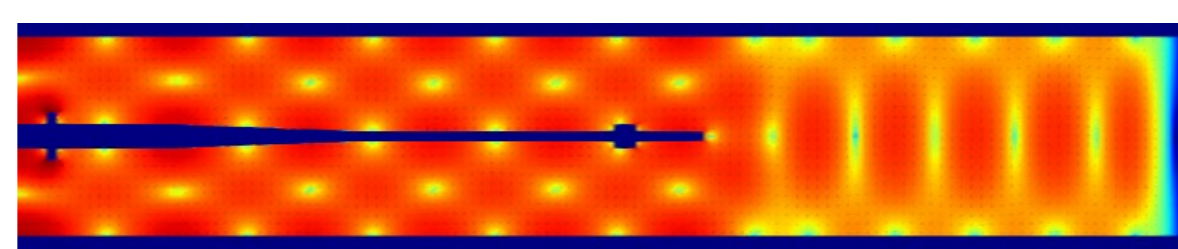
Section view with movable fin



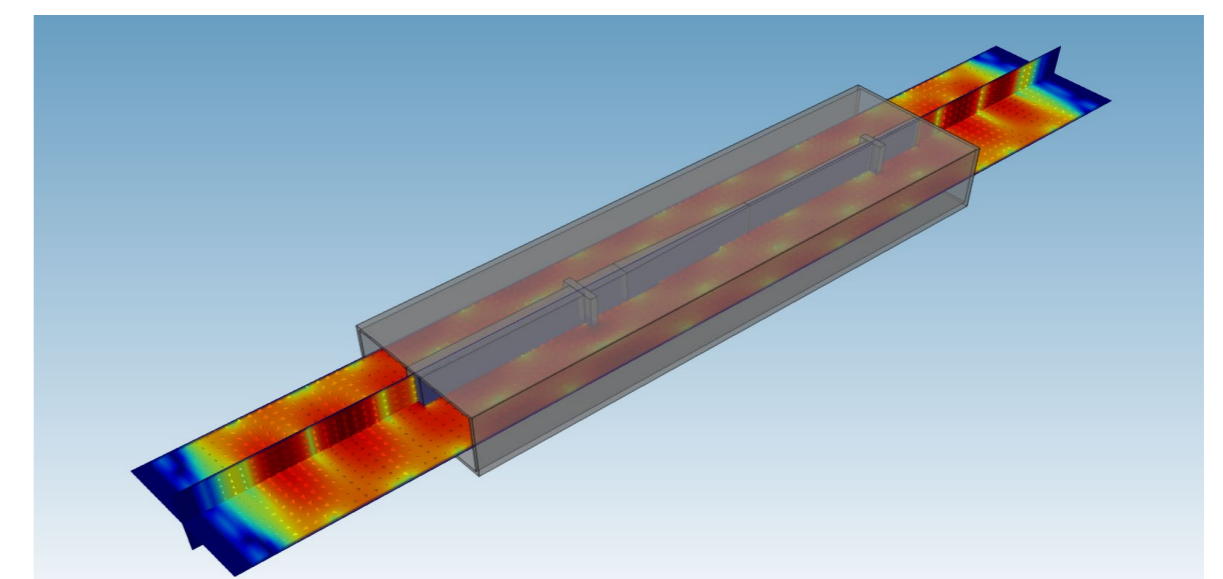
Single Phase Shifter Element



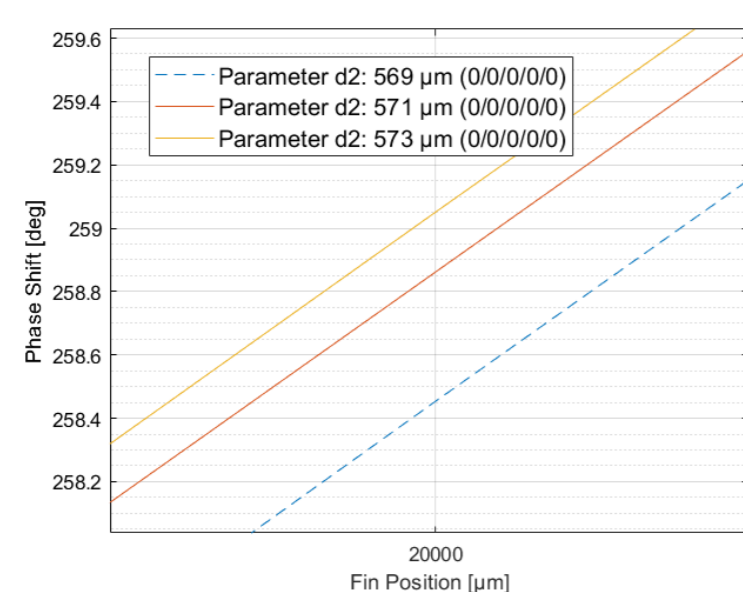
Electric Field Distribution in the Waveguide



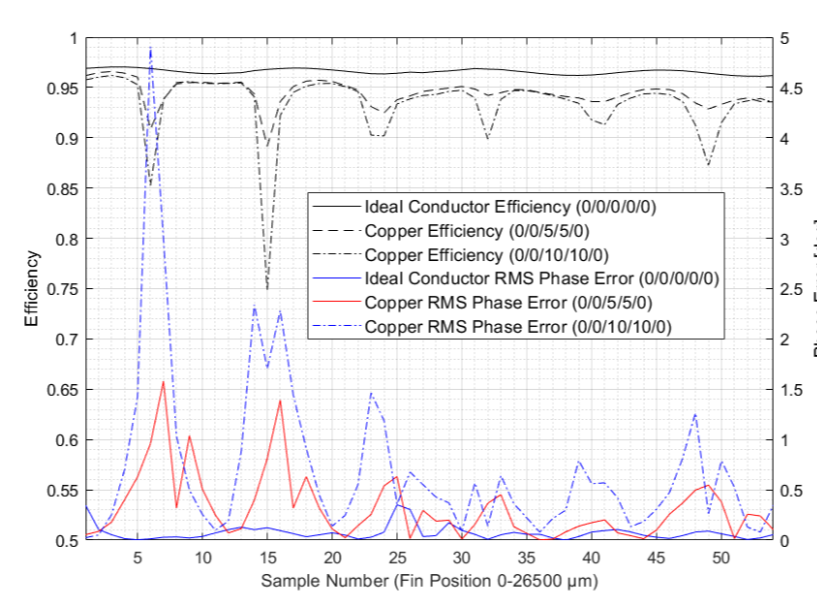
Magnetic Field Distribution in the Waveguide



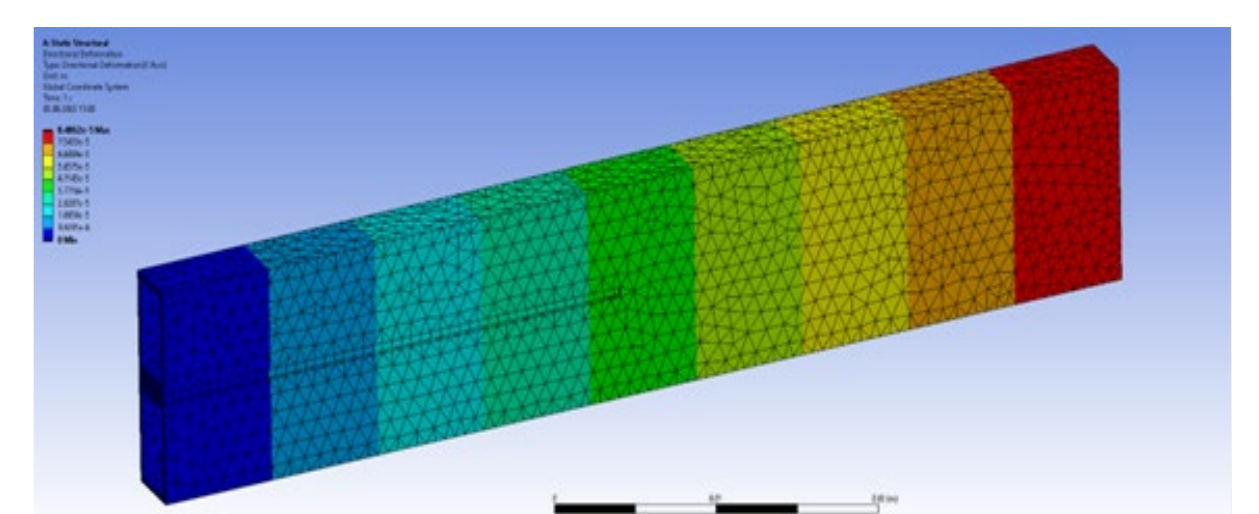
3D Model with Field Distributions



Required manufacturing Tolerance Analysis



Phase Linearity vs. Gap Dimensions



Thermal Expansion Analysis

Task and Requirements

Wireless Power Transfer (WPT) is a trending topic and has received attention recently. Japan is planning on sending energy collected from solar powered satellites with microwaves to earth very soon. This case study focuses on an application for a rover that is powered via a microwave beam over a distance of 100 m with up to 1 kW on the surface of the moon.

In this thesis, the state-of-the-art technology for a microwave feed, transmitting antenna and phase shifter design for a Wireless Power Transfer system in the 35 GHz band needs to be examined. A high-precision and very efficient phase shifter element needs to be designed to allow a precise beam steering to focus the transmitted energy to the receiving antenna. Furthermore, the phase shifter element needs to be integrated into the whole WPT system and matching feed and antenna designs need to be considered.

Solutions

A 3D simulation model of a precision mechanically tunable phase shifter has been designed and it is shown, that a very efficient and accurate phase shifter for the given application in space can be developed. Furthermore, the effects on the structure from temperature changes and from manufacturing inaccuracies are determined to create a realistic behavior prediction of the device.

In addition, conclusions from an extensive literature research are presented.

Frederik Imhof

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Prof. Dr. Anja Skrivervik

Kooperationspartner:
Sirin Orbital Systems AG

