1-Design of Wide-band Phase Shifter for Beam Switching Networks

Mm-wave components development is growing exponentially to satisfy the expected needs of the future communication systems. One of the most critical diversities in the upcoming communication systems is the space diversity, which will depend on the beam forming as an essential building block. The hybrid beam forming system is promoted as an essential component for future communication, where it is an integration between digital beam forming and analogue beam switching. In particular, phase shifter is considered as an important building block for beam switching network. Different phase shifter configurations can be realized to satisfy a wide phase imbalance with low loss.

In this project, we aim to design and implement various phase shifters based on Ridge gap waveguide technology. In addition, we aim to develop an accurate modeling for the phase shifter based on different guiding structures in mm-wave frequency range. The anticipated activities through this project can be listed as follows:

Technical Activities

- Analysis of different guiding structures via numerical simulation tools such as microwave studio CST and ANSIS HFSS
- Analysis and modeling for vertical and horizontal ferrite slabs inside traditional guiding structures such as rectangular waveguide
- Analysis and modeling for vertical and horizontal ferrite slabs inside modern guiding structures such as Substrate Integrated waveguide (SIW) and Ridge Gap waveguide (RGW)
- Fabricate a prototype for a ferrite based phase shifter
- Experimental validation for the proposed model through testing the fabricated prototype

Presentation & communication Activities

- Present the research outcomes in the research group periodic meeting on weekly or biweekly basis
- Attend the research group meeting to share ideas and build a technical experience
- Engage in meetings with the supervisors to guide the research directions

Documentation & reporting activities

- Continue Writing the Bachelor thesis
- Prepare reports to list the research outcomes

2-Design and Analysis of Beamforming MW Components

Beamforming or spatial filtering is a signal processing technique used in sensor arrays for directional signal transmission or reception. This is achieved by combining elements in an antenna array in such a way that signals at particular angles experience constructive interference while others experience destructive interference. Beamforming can be used at both the transmitting and receiving ends in order to achieve spatial selectivity. It can be used for radio or sound waves. It has found numerous applications in radar, sonar, seismology, wireless communications, radio astronomy, acoustics and biomedicine.

In this project the design and analysis of MW coupler using ridge gap technology is intended.

CST microwave studio is used for simulation.

Network analyzer is used for measurements

3- Design and Analysis of Dual Band MIMO Antenna System

Data transmitting rate of wireless communication systems has been remarkably increased in recent years owing to the transferring requirements of the enormous data belonging to the multimedia services. MIMO systems have been one of the most significant breakthrough in modern wireless communication due to overcoming the limited channel capacity because it is capable of simultaneously transmitting multiple signals through spatially parallel channels between isolated multiple antennas.

The MIMO technology has been recently adapted to latest mobile communication standards such as long term evolution (LTE), worldwide interoperability for microwave access (WiMAX) and wireless local area network (WLAN). It is, therefore, necessary to incorporate compact, wideband MIMO antennas with high isolation between antenna elements to mobile terminals.

In recent years, MIMO antenna designs vary in geometry, size, bandwidth and isolation are available in the literature.

In this project, MIMO antenna designs proposed for different applications like GSM, LTE, WiMAX and WLAN wireless standards.

CST microwave studio is used for simulation.

Network analyzer and anechoic chambers used for measurements.

4-Design and Analysis of Magneto Electric Dipole Antenna for 5 G Applications

With the tremendous development of mobile communication systems, there has been increased interest in wideband, multiband, high gain, and high-isolation antenna designs in different communication system constellations. Wideband antennas are needed to satisfy the increasing number of service bands, especially the WLAN, WiMAX, LTE, and 5G operating frequency bands.

Over the last few years, dual-polarized antennas have become popular in base stations, which contributes to their good performance in reducing multipath fading and increasing channel capacity. Meanwhile, wideband dual-band, high isolation, low cross-polarization, and compact size are huge challenges for a wideband dual-band dual-polarized antenna. In recent years, several dual-polarized antennas with good performances have been designed based on patch antenna and magneto-electric (ME) antenna. Patch antennas became popular with advantages of low profile, low cost, and ease of mass fabrication. However, it is extremely difficult to achieve wide impedance bandwidth with patch antennas. Several types of magneto-electric dipole antennas have been reported in literature.

In this project it is intended to design and analyze a magnetic dipole antenna suitable for 5G applications using state of the art technology.

CST microwave studio is used for simulation.

Network analyzer and anechoic chambers used for measurements