Popular science summary of the PhD thesis

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Title of the PhD thesis	Millimeter-wave near-field antenna measurements
PhD school/Department	DTU Electrical Engineering

Science summary

* Please give a short popular summary in Danish or English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology:

Millimeter-wave (mm-wave) frequency spectrum (30-300 GHz) has a number of benefits, which it brings to wireless communication systems among these being: wide available bandwidth and transmission of large capacity of information. Millimeter-wave antennas include applications such as: 5G, radio astronomy, imaging and medical applications. The antennas in general and in particular antennas for space applications require to be thoroughly tested. Accurate mm-wave near-field measurements is essential for testing antennas within industry and academia for mm-wave applications. Advanced antenna testing is a field research at the DTU. The Electromagnetic Systems Group (EMS) at the Department of Electrical Engineering at DTU operates, in cooperation with the European Space Agency (ESA), the DTU-ESA Spherical Near-Field (SNF) Antenna Test Facility. Here accurate antenna measurements are conducted, within 0.4-40 GHz.

The research concerns the investigation of conducting 60 GHz accurate antenna measurements, as not so much experience exists on this topic. Several challenges are encountered when carrying out antenna measurements at mm-waves such as: the increase effect of thermal drift and noise, the large path loss and an acccurate mechanical calibration of the measurement setup is more difficult to achieve at 60 GHz. To overcome some of the challenges, a 60 GHz dual-polarized probe was developed to characterize antennas for all kind of applications.

Dual-polarized probes have several advantages over other types of probes, as for example, the measurement time is reduced by half of the one when using other type of probe. Literature studies show, that such a dual-polarized probe has not been developed yet at mm-waves. The dual-polarized probe was tested for the measurement of two widely different antennas. The results showed a high performance of the dual-polarized probe and that accurate measurements can be conducted, but they are challenged by the components technology at 60 GHz.

The work also includes 60 GHz antenna diagnostics investigation, where the radiated field by antenna is analyzed by using quantities not exploited previously. The results demonstrated that these quantities contain additional and useful information of the tested antenna radiated field.

The project outcomes support the advance and development of the expertise within mm-wave antenna measurements for industry applications, such as 5G and science applications, such as antennas for space applications.