Millimeter-Wave Antennas for Next Generation Telecommunications Networks

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In this talk, I will describe my research efforts in millimeter-wave antennas for next generation telecommunications networks for high data-rate communication links. Millimeter-wave antennas are key to deploying next generation 5G networks and satellite systems that promise broad bandwidths and smart data links for mobile users. In collaboration with major industrial and academic partners, I recently proposed quasi-optical planar systems as efficient beam formers for multi-beam, wide scanning antennas. Such an approach overcomes the loss and prohibitive cost associated with phased arrays in the millimeter wave range, while preserving the agility of the radiating unit. Low-cost implementations of the proposed system in substrate integrated waveguide (SIW), pure metallic implementations and low temperature co-fired ceramic (LTCC) technologies will be presented in V and E bands for 5G networks. For satellite links in Ka-band, I will show that these quasi-optical planar systems can be used to drive the focal array of a multi-reflector system. Such a configuration reduces the phase aberrations of multi-reflector configurations for high-data rates and wide coverage. For terminal users, I will present some recent activities on wideband wide-angle continuous stub arrays. I will introduce the unique scanning and bandwidth capabilities of such arrays.

Disposable RF devices based on Printable Non-Volatile RF-Switch

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The need for information identification and capture is a matter of prime importance in modern societies. Every sectors of society rely on the identification of data exchanged, the updating of the data recorded on a tag and the measurement of physical parameters. Key issues such as the way to reduce power consumption, to improve the communication quality-of-service and to enhance connectivity have recently come up for lots of industries. One important direction for researchers to consider is to develop low-power, low cost tags for wireless identification and sensing. Lots of improvements have been done in the past few years on communication systems, based on printed electronic devices. However, it is still difficult to print with low cost techniques a basic component like a RF switch that could be used for many applications where the device need to be reconfigure while it is in use. For instance, the possibility of designing reconfigurable and low cost, printable chipless tags, antennas, or even filters… involves the development of original approaches at the forefront of progress, like the use of structures from the CBRAM microelectronics technology, allowing to achieve reconfigurable elements based on Nano-switches.

Broadband RF switch for telecommunications where the power consumption of the switch is reduced is clearly awaited. Today's technological solutions [solid state and radiofrequency microelectromechanical (RF MEMS) based systems] need some improvements to meet the challenges of the future. The CBRAM technology has shown the potential to operate at lower energies and voltage, making it particularly interesting for embedded applications. I will present our last results in the use of CBRAM cells to realized printable and disposable non-volatile RF-switch for specific RF applications.

Calibration, de-embedding and measurement techniques for mm-wave device characterization

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The increase in technology performance and maximum operation frequency carries various challenges in the characterization chain of these devices. The simple frequency upscaling of traditional RF band calibration and de-embedding techniques does not provide the required accuracy and consistency to accurately model ultra-scaled CMOS nodes. Similarly, the different mode of operation and the limitations, when compared with coaxial RF setups, of mm-wave characterization test-benches imposes extra efforts from the operators to achieve accurate small and large signal DUT measurement.

In this talk the approach developed at TU Delft in the last decade to improve the calibration and de-embedding of advanced CMOS nodes in the upper mm-wave frequency bands will be presented. Moreover, the various dedicated test benches developed for the small and large-signal device characterization of (sub)mm-wave devices will be reviewed.