Passive Microwave Components and Antennas - DTU Orbit (28/03/2019)

Passive Microwave Components and Antennas
State-of-the-art microwave systems always require higher performance and lower cost microwave components. Constantly growing demands and performance requirements of industrial and scientific applications often make employing traditionally designed components impractical. For that reason, the design and development process remains a great challenge today. This problem motivated intensive research efforts in microwave design and technology, which is responsible for a great number of recently appeared alternative approaches to analysis and design of microwave components and antennas. This book highlights these new trends focusing on passive components such as novel resonators, filters, diplexers, power dividers, directional couplers, impedance transformers, waveguides, transmission lines and transitions as well as antennas, metamaterial-based structures, and various electromagnetic analysis and design techniques. Modelling and computations in electromagnetics is a quite fast-growing research area. The recent interest in this field is caused by the increased demand for designing complex microwave components, modeling electromagnetic materials, and rapid increase in computational power for calculation of complex electromagnetic problems. The first part of this book is devoted to the advances in the analysis techniques such as method of moments, finite-difference time-domain method, boundary perturbation theory, Fourier analysis, mode-matching method, and analysis based on circuit theory. These techniques are considered with regard to several challenging technological applications such as those related to electrically large devices, scattering in layered structures, photonic crystals, and artificial materials. The second part of the book deals with waveguides, transmission lines and transitions. This includes microstrip lines (MSL), slot waveguides, substrate integrated waveguides (SIW), vertical transmission lines in multilayer media as well as MSL to SIW and MSL to slot line transitions. Impedance matching is an important aspect in the design of microwave circuitry since impedance mismatches may severely deteriorate performance of the overall system. Different techniques for wideband matching are presented in the third part of this book. The design of compact microwave resonators and filters is also covered in this part. Compact, high-performance microwave filters are essential for high-efficiency miniaturized microwave systems. The filter circuit size is large in traditionally designed planar bandpass filters due to a high number of large area resonators. The rejection level in the upper stopband of the filters is usually degraded by the spurious response at twice the passband frequency. Several types of resonators have been designed to overcome these problems, such as miniaturized hairpin resonators, stepped-impedance hairpin resonators, and slow-wave open-loop resonators. Miniaturized resonators lead to a reduced filter size, but not always improve the spurious response. Another method relies on various resonator combinations within one filter structure to reduce the circuit size, such as the loop resonator or hairpin resonator incorporated with one or several open stubs. Recently, microwave filters based on electromagnetic bandgap structures and artificial materials have attracted a great deal of interest because of improved characteristics in comparison to traditional filter design. Such artificial materials can be realized using periodic inclusion of variously shaped metals into a host medium. The most prominent candidate for such structures has been the split-ring resonator. In addition to the split-ring resonator there are several alternative realizations based on lumped elements, quasi-lumped LC resonators and other planar microwave resonators which are in details discussed in the fourth part of this book. Antennas are key components in most microwave devices and systems. They are used everywhere where a transformation between a guided wave and a free-space wave (or vice versa) is required. The final part of the book is dedicated mainly to the design and applications of planar antennas and arrays including metamaterial-based antennas, monopoles, slot antennas, reflector antennas and arrays. The book concludes with a chapter considering accuracy aspects of antenna gain measurements.

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