# Summary

## Printed Periodic Waveguide Structures: Full-wave Characterization, Guided-wave Characteristics and Applications

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Printed periodic waveguide structures are investigated for applications in waveguide-based band pass filters, electromagnetic band gap (EBG) structures and double negative (DNG) metamaterials. Such waveguide structures are characterized using the proposed hybrid Mom-Immittance approach in which Immittance approach is employed for calculation of spectral dyadic Green's functions for the multilayered waveguide structures. Method-of-moments (MoM) is utilized for solving the unknown current densities on the printed strip/slots and mode-matching method has been used for obtaining the reflection and transmission coefficients for various waveguide discontinuity elements. The impedance-type hybrid MoM-Immittance approach is formulated here for the transversely printed strip obstacle whereas the admittance-type hybrid MoM-Immittance approach is formulated for the transversely printed slot obstacle. From full-wave characterization of a single unit/cell of the printed periodic waveguide structure, the guided-wave per-unit length transmission parameter which consists of complex propagation constant ($\gamma=\alpha+j\beta$) and complex wave impedance ($Z=Re\{Z\}+j\ Im\{Z\}$) are numerically obtained and studied for various possible applications. Such printed periodic waveguide structures are investigated further in depth for specific applications. Firstly, we have innovated a new type of waveguide band pass filter in which the printed stepped impedance slot (SIS) resonators are linked by $\lambda/4$ waveguide sections or impedance transformers. This novel waveguide filter shows a considerable improvement in the stop band filter performance: an increased and steeper out-of-band rejection. Secondly, printed periodic waveguide structures with various frequency selective surface (FSS) elements have been investigated for the design of EBG transmission media. A printed FSS element with the widest bandstop in the Brillouin diagram has been used for constructing wideband waveguide based EBG circuits. Finally, a novel and simple architecture for waveguide based DNG metamaterials is proposed. It has been observed that periodic waveguide structures loaded with double strips printed on the two sides of dielectric substrate exhibits the fundamental properties of DNG metamaterials viz., negative permeability, negative permittivity, negative refractive index and backward wave propagation.