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Title :
Single Mode Ring Resonator for Bandpass Filter Applications

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Technology advancements in microwave systems demand for high performance electronic devices. This leads to the creation and development of new microwave filter topologies to achieve better selection and control of response. Ring based filter topologies become immediately attractive options as they offer dual resonance in their response which will ensure high selectivity and physical compactness of the filter. However, in some cases, the ring filters do not come with complete mathematical synthesis, making them difficult to design and to be generalized at higher order. This thesis introduces a single mode ring resonator, fed via one of the resonator's quarter-wavelength coupled-line for simplification, with less control parameters. A global synthesis is developed to fix the transmission zeros and experiments are conducted to prove the validity of the synthesis and subsequently can be generalized for higher-order filters. To prove this concept, higher-order filters were realized by cascading the single mode ring to form multiple cells and additional coupled-lines were introduced in the structure to create additional poles. The global synthesis of the single mode ring was applied to demonstrate the flexibility of the single mode ring topology and its synthesis. Higher-order filters of up to 5th-order were implemented in the range of 1 GHz to 2 GHz to give a different range of fractional bandwidth between 10% - 26%. Further advancement on the application of single mode ring topology is presented in this thesis for reconfigurable filter application. By manipulating the electrical length of the ring lines using external tunable elements, the electrical length of the ring was varied, hence, shifting the frequency response to a desired position. The reconfigurable filter with its tunable scheme synthesis was developed to control the frequency response at arbitrary center frequency. Based on this reconfigurable concept and its synthesis, two reconfigurable designs were achieved using two different techniques. The first technique made use of lumped capacitors and was successfully reconfigured from 2 GHz to 984.4 MHz; while miniaturisation achieved up to 71% as compared to the conventional filter designed directly at 1 GHz. The second design made use of varactor-diodes and shifted the resonance frequency from 1.10 GHz to 1.38 GHz, spreading over 280 MHz frequency range to give 25% tuning range with fractional bandwidth below 9%. All the filters were realized using microstrip technology. The simulated and measured results are then presented and compared to demonstrate the excellent performance of the proposed filters.

*** (MS) = Main Supervisor (CS) = Co Supervisor**