The integration of high-Q 3-D filters with highly efficient antennas is addressed in this dissertation. Integration of filters and antennas into inseparable units eliminates the transitions between the otherwise separate structures resulting in more compact and efficient systems. The compact, highly efficient integrated 3-D filter/antenna systems, enabled by the techniques developed herein, allow for the realization of integrated RF front ends with significantly-reduced form factors.

We first demonstrate the integration of cavity filters with slot antennas in a single planar substrate. Due to the high Q factor of cavity resonators, the efficiency of the integrated filter/antenna system is found to be the same as that of a reference filter with the same filtering characteristics. This means a near 100% efficient slot antenna is achieved within this integrated filter/antenna system. To further reduce the footprint of the integrated systems, vertically integrated filter/antenna systems are developed. We then demonstrate the integration of cavity filters with aperture antenna structures which enable larger bandwidths compared with slot antennas. The enhanced bandwidths are made possible through the excitation and radiation of surface waves. To obtain omnidirectional radiation patterns, we integrate cavity filters with monopole antennas. Finally, the integration of filters with patch antennas is addressed.

The presented techniques in this dissertation can be applied for filter/antenna integration in all microwave, and millimeter-wave frequency regions.

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The public is welcome to attend.