Coupled-Resonator-Based Design of Thin-Film Bulk Acoustic Resonator (FBAR)-Based Bandpass Filters

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Recent advances in wireless communications are demanding the development of reconfigurable RF front-ends able to support multiple bands and standards. Whereas acoustic-wave-resonator-based filters such as those based on SAW or BAW resonators have been the key RF filtering technology of these systems, their transfer function can't be tuned. Furthermore, they can't be scaled to frequencies higher than a few GHz. Thin-film bulk acoustic resonator (FBAR)-based filters have been recently being explored as a solution to the aforementioned limitations due to their intrinsically-switched response that can be obtained by applying DC biasing. Important demonstrations of these technology include switchable bandpass filter (BPF) banks. Despite their significance, their design requires full-wave simulation analysis which requires large-scale computational resources and exhaustive optimization cycles.

Using as a reference the operational characteristics of the FBAR technology, we developed mathematically-synthesized models that can be supported by standard programming tools for the design of FBAR-based BPFs with short turn-around design cycles. As opposed to conventional circuit-based FBAR design approaches, the proposed models use as a basis coupled-resonator-based synthesis through coupling routing diagrams (CRDs) that are shaped by resonant and non-resonant nodes The proposed BPF design methodology is based on CRDs for in-parallel and in-series connected FBARs that can be readily employed for the realization of switchable multi-stage ladder-type architectures as well as for advanced filter architectures. The proposed method has been verified through the synthesis of various transfer function examples using CRDs and conventional circuit schematic simulations, as for example the one shown in Fig. 1 for the case of a 6-stage ladder-type BPF. Further examples of ladder-type BPFs as well as a detailed description of the proposed method will be discussed at the conference.

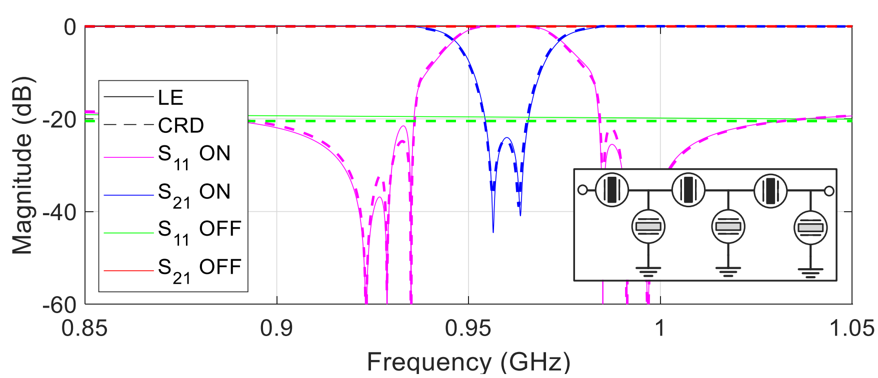

Fig. 1. Power transmission and reflection response of a 6-stage ladder-type BPF using circuit lumped-element (LE) simulations and the CRD-based method.