Nowadays telecommunication systems have an increasing demand for high quality factor, small size and low power consumption components. Thin film bulk acoustic wave resonators (FBAR) technology replaced both the bulky off-chip surface acoustic wave (SAW) components and the low quality factor on-chip tank circuits in many commercial applications such as filters and duplexer.

This work extends the use of FBAR components to higher frequencies when the overtone resonances of the device are considered. First, a broadband measurement of the FBAR resonator shows that several high quality resonance modes are present at odd overtones. Existing modeling techniques are then extended towards their use in design at these overtone modes. To increase the quality of the models and validate the models against the real device behavior, a system identification based approach is proposed. It is shown that this new model empowers the design at overtone modes and increases the physical insight in the parasitic behavior of the devices.

A number of integrated CMOS and lumped demonstrators are designed based on this modeling approach to show both the feasibility of the overtone designs and their performance. Several configurations are investigated in detail through extensive simulations, and one design is realized and measured in detail.