The Role of the Reflection Coefficient Phase in the Design of Acoustic Wave Filters

Patricia Silveira*(1), Jordi Verdú (1), and Pedro de Paco (1)
(1) Department of Telecommunications and Systems Engineering, Autonomous University of Barcelona, Campus of Bellaterra, Barcelona, 08193, Spain
*patricia.silveira@uab.cat

The telecommunication industry has grown appreciably because of the development of new mobile standards. The optimization of the size of the filters is critical due to the quantity of them in the existing handsets. In stand-alone filters, the management of the reflection coefficient phase (ϕ_{11}) is normally used to prevent the presence of external reactive elements at the input/output stage. In duplexers and multiplexers, the input phase is used to avoid loading effect in the common port. However, it has been observed that the phase can also be used to improve the performance of the designed filter significantly reducing the total area without affecting the amplitude response of the filter.

The analysis has shown that the phase value will affect the static capacitance of all resonators of the filter (C_0), but also the capacitance ratio (*r*-factor) of the first and last resonator, defined as the ratio between the static (C_0) and the acoustic capacitance (C_a). In order to obtain filtering networks that better accommodate the technology, reducing the total area of the filter expressed as the total static capacitance of the filter C_{0_tot}, but also in terms of uniform r-factor among all resonator to reduce the number of reactive elements, has been improved a synthesis methodology which considers the influence of the phase of the input reflection coefficient in the design process.

The value of the elements of the synthesized filter with defined transmission zeros, return loss and order varies in dependence of the input phase. An analysis shows how the input phase affects the static capacitance of all the resonators of the filter, therefore, the total area, in a fully canonical asymmetrical stand-alone filter. Also, a variation on the input phase affects the *r*-factor. As expected, *r*-factor remains constant for inner resonators while it varies for outer resonators. Also, there is a range of phases where r-factor and C_0 get positive/negative extreme values. This behavior involves a filter size increase. The network construction in both cases is not feasible in acoustic filters.

The phase plays an important role to find the best solution for specific goals as it can be seen in this work, providing the filter designer with more flexibility and a new guideline for the design.