COM-Analysis of SAW Devices

Abstract

The subject of this lecture is coupling-of-modes (COM) analysis of surface acoustic wave (SAW) devices. COM approximation is a closed-form technique for modeling systems with spatially varying properties. This is a convenient tool to model low-loss RF SAW filters taking into account interelectrode reflections due to mass-electrical load effect.

Modeling of SAW Reflective Arrays

First, COM-equations are deduced and applied to the analysis of SAW reflective arrays. Analytic solution of the system of homogeneous differential equations for passive reflective grating is considered. Reflection and transduction properties of the reflecting grating are discussed.

Analysis of SAW Transducers

Next, a general solution of the linear system of inhomogeneous differential equations describing an interdigital transducer (IDT) is considered, with one additional equation to account for a terminal current flowing into IDT. Both radiation and reception IDT modes are considered. As a result, the closed-form mixed scattering matrix (P-matrix) of an IDT is constructed.

COM Parameters: Definition and Determination

In COM modeling, the key role play COM parameters. COM equations are characterized by four independent COM model parameters to be determined a priori, namely: self- and cross-coupling coefficients, SAW excitation function, and static capacitance. Generally, COM parameters depend on frequency, substrate and electrode material, and transducer geometry (metallization ratio, pitch, and metal height).

Furthermore, physical meaning of COM parameters is explained. Derivation of COM-parameters values theoretically or experimentally is considered and illustrated with examples.

Simulation and Design Examples

Finally, practical COM applications are demonstrated by analysis of SAW reflectors, self-matched IDTs, long resonant IDTs with internal reflections, one- and two-port resonators, and Double Mode SAW (DMS) filters.

Good agreement between theory and experiment is observed.

Contents

Web version: *https://intrasaw.com/if-saw-filter-design*