

Surface Acoustic Waves (SAW) Experience

Dr. Alexander Rukhlenko, SAW/BAW Consultant

SAW experience, as developed and accumulated by Dr. Alexander Rukhlenko, includes advanced design, modeling, and programming work in the field of SAW filter computer-aided design (SAWCAD). In particular, this work covers SAW modeling, optimization, synthesis, [MATLAB®](#) and [Fortran](#) software development, reflective transducer analysis, mixed scattering matrix techniques, and practical IF/RF SAW filter design.

1. SAW Experience in CAD Software and MATLAB Integration

His MATLAB, C/C++, and Fortran programming SAW experience includes:

- Integration of MATLAB SAW models into [Keysight® PathWave Advanced Design System \(ADS\)](#)
Development of ADS Process Design Kits (PDKs) with basic SAW components such as SAW transducers, multistrip couplers (MSCs), and reflector gratings
Development of diverse SAW Filter Computer-Aided Design (SAWCAD) software using Fortran and MATLAB®
Development of the MATLAB SAW Filter Analysis Toolbox (SAWFAT) for bidirectional SAW filter design
Practical design of IF SAW filters using proprietary SAWCAD software (MATLAB, C/C++, Fortran)

2. SAW Experience in Optimization and Synthesis

Dr. Alexander Rukhlenko contributed extensively to the theory and practice of optimum and suboptimum SAW filter design. As a result, he developed effective techniques and algorithms implemented in his comprehensive proprietary SAWCAD software. In particular, these include:

- Optimum and suboptimum SAW filter synthesis techniques including:

- Remez exchange algorithm (Fortran)
- Proprietary iterative Weighted Least-Squares (WLS) technique (MATLAB)
- Linear programming (MATLAB, Fortran)
- Nonlinear programming (MATLAB, Fortran)
- Mixed-integer linear programming (Fortran)
- MATLAB Genetic Algorithm
- Chebyshev approximation techniques for optimization of complex-valued SAW filter responses
- Design of SAW filters with arbitrary magnitude, phase, and group delay specifications
- Factorizational (Z-transform zero-separation) synthesis of minimum-length bidirectional SAW filters
- Mixed-integer programming techniques for optimization of wideband polarity-weighted SAW transducers
- Iterative algorithms for compensation of second-order effects including SAW diffraction, circuit effects (electrical loading and matching), and SAW attenuation

3. SAW Transducer Modeling

Dr. Alexander Rukhlenko has extensive expertise in modeling and simulation of SAW devices. In particular, he contributed significantly to the theory of interdigital transducers (IDTs). Initially, he focused on electrostatic analysis of generalized periodic IDTs and developed efficient algorithms for analysis of unapodized (uniform) IDTs with arbitrary polarity sequences as well as floating (isolated) electrodes. Later, he generalized the electrostatic theory to apodized IDTs. Moreover, he developed fast and accurate algorithms for calculation of IDT admittance, including SAW radiation conductance, susceptance, and static capacitance. Additionally, his developments serve as a basis for efficient modeling of complex SAW transducer configurations.

In summary, his SAW transducer modeling experience includes:

- Withdrawal-weighted (polarity-weighted) SAW transducer analysis and design

- Analysis of non-equidistant IDTs using periodic discretization
- Mixed scattering matrix (P-matrix) theory and practical implementation for periodic IDTs
- Electrostatic analysis of generalized periodic SAW transducers
- Closed-form calculation of admittance and static capacitance for unapodized and apodized IDTs
- Synthesis and analysis of classical single-phase unidirectional transducers (SPUDTs)
- Reflective SPUDT (RSPUDT) optimization using nonlinear programming
- Design of broadband SAW filters based on slanted-finger bidirectional interdigital transducers (SFIDTs) and slanted-finger SPUDTs (SFSPUDTs)
- Reflective Array Model for reflective IDTs on SAW, LSAW, and Natural SPUDT (NSPUDT) substrates
- Semi-heuristic closed-form modeling of reflective unapodized and apodized IDTs with arbitrary polarity sequences
- Coupling-of-Modes (COM) analysis for SAW transducers and reflectors

4. SAW Experience in Filter Design and Practical Applications

In the past, Dr. Alexander Rukhlenko served as a SAW designer for international industrial companies. He designed a number of SAW filters with challenging specifications manufactured in mass-production. He also developed software for designing RF SAW filters. In particular, his practical experience comprises:

- Practical design of IF SAW filters for industrial companies
- Analysis, algorithms, and software development for generalized multiport and multitransducer SAW devices
- One- and two-port SAW/LSAW resonator modeling
- Modeling and design of Double Mode SAW (DMS), ladder-type SAW filters, and duplexers
- One- and two-component SAW filter matching using interactive and optimization techniques

- Automated SAW filter photomask design in AutoCAD DXF format

Dr. Alexander Rukhlenko also provides a series of advanced SAW lectures covering many aspects of SAW device theory, modeling, and computer-aided design. Therefore, his extensive theoretical and practical SAW experience can be effectively applied to consulting in the field of computer-aided design of SAW devices, as well as to professional learning, engineering education, and advanced research and development in this area.

Web version: [SAW Experience of Dr. Alexander Rukhlenko](#)