Scalar wave processing in sonic systems

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Basic elements and methods of the scattering and diffraction theory which permit on the modeling of the phenomena and the systems processing the scalar waves (pulse response) as the carrier of information on the heterogeneous and lossy media will be presented; methodological approach and advices for numerical modeling and examples of the solutions for the problems of the scalar waves propagation and the scalar waves processed system will be shown.

Main topics:

I. Scatering of the scalar waves

1. Foundation of the theory of scattering of the scalar waves
   - From the inhomogeneous partial differential equation to the integral equation
   - Diffraction theory (recalling)
2. The models of the scattering medium
   - Heterogeneous medium and scattering potential
   - Point and point like scatterer
   - Finite dimension scatterer
3. Scattering
   - Multi-scattering
   - The RBN approximation (Rubinowicz-Born-Neumann)

   (Key words: Scattering potential, integral equations of scattering, near-far fields, spectral representations, numerical realizations)

II. The modeling of the scalar wave processing systems synthetic aperture (SA).

1. Elements of the system
2. The Analysis and Synthesis of the system
   - Characteristics o the System
     a) transmit characteristic - transmit pulse response
     b) received characteristic - received pulse response
     c) Transmittance function and resulting pulse response
3. Noise in imaging system
   - Sources of the noise
   - Noise inherent part of the transmittance function (pulse response)
4. Synthetic Aperture (SA)

   (Key words: spectral representation, spectral analysis, numerical examples)

The total number of lecture hours: 32 h, laboratory exercises: 0 h, self-teaching: 30 h, direct tutoring and consultations: 5 h.

ECTS Points: 2