Introduction to Scalar Wave Processing In Sonic Systems

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In this lecture basic elements and methods of the diffraction and scattering theories will be presented. These theories enable modeling the phenomenon and systems that process scalar waves as a carrier of information on the lossy and heterogeneous media. The methodological approach as well as advices for numerical modeling will be given. Examples of solutions for the problems of the scalar waves propagation and the scalar waves processed system will be presented.

Main topics:

WAVE EQUATION(S) **WITH THE D'ALAMBERT OPERATOR**

I. HOMOGENOUS MEDIUM (los less, absorbing)

1. Unbounded homogenous medium
2. Bounded homogenous medium

(**Key words:** coordinate systems, Fourier transforms, typical boundary conditions, solution methods propagators, spectral representations of the solutions, numerical realizations)

II. HETEROGENEOUS MEDIUM

1. The models of the scattering medium
2. Foundation of the theory of the scattering of scalar waves
   a) Point and like point scatterer
   b) Final dimension scatterer
3. Scattering
   a) multi-scattering
   b) the RBN approximation (Rubinowicz-Born-Neumann)

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

III. MODELING OF THE SCALAR WAVE PROCESSING SYSTEMS
SYNTHETIC APERTURE (SA)

1. Elements of the system
2. The analysis and synthesis of the system
   - Characteristics of the system
   a) transmit characteristic - transmit pulse response,
   b) received characteristic - received pulse response,
   c) transmittance function and resulting pulse response.
3. Synthetic Aperture (SA)

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

The total number of lecture hours: 28, self-teaching: 30, direct tutoring and consultations: 5 hours.

ECTS Points: 2