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bathymetry near a source; 1.7.3 Acoustic Engineering Test; 1.7.4 Alternate Source Test; 1.7.5 Acoustic Thermometry of Ocean Climate; 1.8 Summary; 2. Ray Chaos; 2.1 Hamiltonian Chaos; 2.1.1 Dynamics of Hamiltonian systems; 2.1.2 Statistical description of Hamiltonian chaos; 2.2 Lyapunov Instability; 2.3 Ray-Medium Resonance; 2.4 Overlapping of Resonances; 2.5 Vertical Resonance; 2.5.1 Adiabatic approximation; 2.5.2 Passage through a resonance; 2.5.2.1 Scattering on a resonance; 2.5.2.2 Capturing into a resonance; 2.5.3 Vertical resonance versus ray-medium resonance; 2.5.4 Resonance-induced chaotic layer; 2.5.5 Influence of vertical resonance on a timefront of a received pulse; 2.6 Manifestation of Regular and Chaotic Ray Motion in Distributions of Ray Travel Times; 2.6.1 Perturbed waveguide; 2.6.2 Timefront; 2.6.3 Amplitude of a pulse signal in plane "travel time-depth"; 2.6.4 Gap between travel times of chaotic and regular rays; 2.6.5 "Focusing" of ray travel times; 2.6.6 Role of stickiness and chaotic jets in "focusing" of ray travel times; 2.6.7 Smoothed intensity of pulse signal; 2.7 Summary; 3. Wave Chaos; 3.1 The Problem of Wave Chaos; 3.1.1 Ehrenfest time; 3.1.2 Semiclassical propagator; 3.1.3 Fidelity or overlap of wave fields; 3.1.4 Dynamical localization; 3.2 Normal Modes; 3.2.1 Range-independent waveguide; 3.2.1.1 Eigenfunctions and eigenvalues in the WKB approximation; 3.2.1.2 Mode amplitudes; 3.2.1.3 Brillouin waves; 3.2.1.4 Matrix elements; 3.2.1.5 Ray-mode relations; 3.2.2 Range-dependent waveguide; 3.2.2.1 Coupled mode equations: slow and strong range dependence; 3.2.2.2 Coupled mode equations: weak range dependence; 3.2.3 Normal modes corresponding to the Helmholtz equation

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Sommario/riassunto

A systematic study of chaotic ray dynamics in underwater acoustics began in the mid-1990s when it was realized that this factor plays a crucial role in long-range sound propagation in the ocean. The phenomenon of ray chaos and its manifestation at a finite wavelength -- wave chaos -- have been investigated by combining methods from the theory of wave propagation and the theory of dynamical and quantum chaos. This is the first monograph summarizing results obtained in this field. Emphasis is made on the exploration of ray and modal structures of the wave field in an idealized environmental model with periodic range dependence and in a more realistic model with sound speed fluctuations induced by random internal waves. The book is intended for acousticians investigating the long-range sound transmission through the fluctuating ocean and also for researchers studying waveguide propagation in other media. It will be of major interest to scientists working in the field of dynamical and quantum chaos.

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