**Ilya Tsvankin**

**Seismic Anisotropy: Basic Theory and Applications in Exploration and Reservoir Characterization**

**Course description*:**

Elastic anisotropy, widely recognized as a typical feature of sedimentary formations, has a strong influence on seismic velocities and amplitudes. For example, the difference between the stacking and vertical velocity in anisotropic media is the most common reason for misties in time-to-depth conversion. This course provides the necessary background information about anisotropic wave propagation and discusses modeling, inversion and processing of seismic reflection data in the presence of anisotropy.

The most critical step in extending seismic processing to anisotropic media is to identify and obtain from the data the medium parameters responsible for measured reflection signatures. Therefore, the course emphasizes parameter estimation for transversely isotropic and orthorhombic subsurface models using both conventional narrow-azimuth data and wide-azimuth surveys. A description of P-wave time and depth processing for VTI (transversely isotropic with a vertical symmetry axis) media is followed by analysis of the joint inversion of P-waves and converted PS-modes which can yield the true vertical velocity needed for depth imaging. Field-data examples illustrate the improvements achieved by anisotropic migration algorithms and the possibilities of applying anisotropy parameters in lithology discrimination. The part devoted to anisotropic AVO analysis includes simple analytic approximations for reflection coefficients as well as for amplitude distortions (geometrical spreading) in the overburden. The course also introduces fracture-detection methods based on the azimuthal variation of reflection moveout and prestack amplitudes of P- and PS-waves.

The course should be useful for both graduate students and geophysicists working in exploration or reservoir monitoring. Mathematical details are kept to a minimum, but familiarity with the basics of elastic wave propagation and seismic data processing would be helpful.

**Course outline:**

-- Basic description of anisotropic wave propagation
-- Anisotropic ray tracing
-- Notation and seismic signatures for vertical transverse isotropy
-- Normal-moveout velocity for 2D anisotropic models
-- 3D description of NMO velocity and NMO ellipse
-- Nonhyperbolic reflection moveout
-- P-wave time-domain signatures in VTI media
-- Inversion of dip and nonhyperbolic moveout
-- Time and depth processing of P-wave data for VTI models
-- P-wave stacking-velocity tomography
-- Moveout of PS-waves and the PP+PS=SS method
-- Joint inversion of PP and PS data and multicomponent tomography for TI media
-- Case studies of multicomponent (PP+PS) processing
-- Thomsen-style parameters for orthorhombic and HTI media
-- Anisotropic AVO analysis
-- Effective medium theory and fracture characterization
-- Anisotropic inversion of VSP data

*For more information on this course and other SEG Continuing Education Courses, see https://seg.org/education/courses/