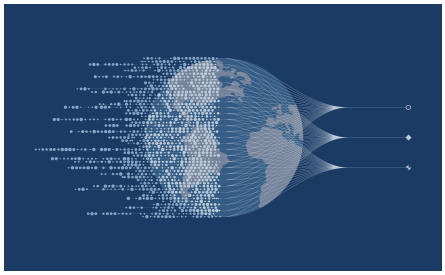

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Source-Type Analysis for Seismic Event Classification

Moment tensors encode seismic source mechanisms and magnitudes, providing a basis for classifying seismic events. The moment tensor is a 3×3 symmetric matrix representing three orthogonal dipoles, with their magnitudes and orientations defining the mechanism. Decomposing the tensor into eigenvalues and a rotation matrix enables analysis and classification of source mechanisms on the lune source-type diagram, where positive isotropic sources (+ISO, explosions), negative isotropic sources (-ISO, collapses) and double-couple sources (DC, earthquakes) map to distinct regions. Traditional single-point classifications do not account for uncertainties spanning source types. To address this, we describe a probabilistic framework using probability density functions (PDFs) on the lune. We propose two approaches: (1) sampling posterior PDFs to compute conditional probabilities for source types (e.g., P(+ISO), P(-ISO), P(DC)) and (2) modeling the PDF as a mixture of elementary probabilistic source models. We demonstrate the framework by applying it to seismic events with diverse mechanisms, including earthquakes, collapses and the North Korean nuclear tests.

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