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Multiscale full-waveform inversion: From the whole earth to the human breast

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Abstract

Seismic tomography using earthquake or explosion data is among the most powerful tools to explore the internal structure of the Earth. The images that it produces are used to study the evolution of our planet, locate and monitor natural resources, constrain the mechanisms of large earthquakes, issue earthquake and tsunami early warnings, and to monitor the Nuclear Test Ban Treaty. In recent years, seismic tomography has been experiencing a shift from classical ray-based methods to full-waveform inversion, built on the combination of numerical wavefield simulations and adjoint techniques. As a result, more of the available waveform data can be exploited, and the resolution of Earth models is increased. The simultaneous emergence of full-waveform inversion in different fields - ranging from whole-Earth tomography to medical imaging - offers new opportunities for interdisciplinary collabora-tion. In this spirit, I will review recent developments and applications in seismic full-waveform inversion, emphasizing similarities and differences with respect to medical imaging problems. This is intended to serve as the starting point for further discussions that may help to bridge the (language) gap between the medical and seismological communities.

Author: FICHTNER, Andreas (Swiss Federal Institute of Technology (ETH) Zürich)

Presenter: FICHTNER, Andreas (Swiss Federal Institute of Technology (ETH) Zürich)

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