

Travel Time Tomography and Boundary Rigidity

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ABSTRACT

We survey recent results on the inverse kinematic problem arising in geophysics. The question is whether one can determine the sound speed (index of refraction) of a medium by measuring the travel times of the corresponding ray paths.

This inverse problem arose in geophysics in an attempt to determine the substructure of the Earth by measuring at the surface of the Earth the travel times of seismic waves. An early success of this inverse method was the estimate by Herglotz and Wiechert and Zoeppritz of the structure of the Earth in the case of a spherically symmetric index of refraction.

This problem can be reformulated in more general geometric terms as to whether given a compact Riemannian manifold with boundary one can determine the Riemannian metric in the interior knowing the lengths of geodesics joining points on the boundary. This is a problem that also appears naturally in rigidity questions in Riemannian geometry. It is known as the boundary rigidity problem.

In this talk we will discuss what is known about the boundary rigidity problem and formulate several open problems.