Local and global boundary rigidity

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Abstract: The boundary rigidity problem consist of recovering a Riemannian metric in a domain, up to an isometry, from the distance between boundary points. We show that in dimensions three and higher, knowing the distance near a fixed strictly convex boundary point allows us to reconstruct the metric inside the domain near that point, and that this reconstruction is stable. We also prove semi-global and global results under certain an assumption of the existence of a strictly convex foliation. The problem can be reformulated as a recovery of the metric from the arrival times of waves between boundary points; which is known as travel-time tomography. The interest in this problem is motivated by imaging problems in seismology: to recover the sub-surface structure of the Earth given travel-times from the propagation of seismic waves. In oil exploration, the seismic signals are man-made and the problem is local in nature. In particular, we can recover locally the compressional and the shear wave speeds for the elastic Earth model, given local information. The talk is based on joint work with G.Uhlmann (UW) and A.Vasy (Stanford). We will also present results for a recovery of a Lorentzian metric from red shifts motivated by the problem of observing cosmic strings.