Spherical Radon transforms in tomography

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We will analyze a spherical Radon transform, $\mathcal{R}$, which integrates a function over spheres in Euclidean space with arbitrary centers $\mathbf{y}$ and radii $r(\mathbf{y})$ that vary smoothly with $\mathbf{y}$.

We give an intuitive description of singularities of objects and provide examples. We give conditions under which the normal operator, $\mathcal{R}^*\mathcal{R}$, a standard imaging method, is an elliptic pseudodifferential operator. We explain in concrete terms why this is important. In particular, we show when reconstruction using the normal operator will detect all features of the object and when it will add artifacts–extra streaks that are not in the original object. We describe an application to Compton scattering tomography and show reconstructions from this data to illustrate our theoretical results.

This is joint work with James W. Webber (Cleveland Clinic).