Two-Dimensional Tomography with Unknown View Angles

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Abstract

In the standard mathematical formulation of the parallel beam tomography the projection directions are assumed to be known. In some practical applications, however, these directions might be known only approximately or they might be completely unknown. The former occurs for example in magnetic resonance imaging due to involuntary motion of the patient, whereas the latter occurs in cryo-electron microscopy of viral particles.

In the talk the author presents some new results about two-dimensional parallel beam tomography with unknown view angles, i.e. tomography in which the projection directions are unknown. The first result is that infinitely many projections at unknown view angles of a sufficiently asymmetric object determine the object uniquely. An explicit expression for the required asymmetry is given in terms of the object's geometric moments. The second result is about the uniqueness of determination of the unknown view angles by finitely many projections. The analysis is based on some algebraic geometric properties of a system of polynomials determined by the Helgason-Ludwig consistency conditions.

This work has been done in collaboration with Lars Lamberg, Department of Mathematics and Statistics, University of Helsinki, Finland.