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Approximations Using Radon Projection Data in the Unit Disc

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Abstract

Noninvasive methods using line integrals for 2D object reconstruction have their theoretical foundation in the work of Johann Radon in the early twentieth century and have important practical applications in medicine, geology, radiology, astronomy, etc.

In our survey we present recent results on various approximation problems where the basic information consists of line integrals in the unit disc. For instance, in 2D computing tomography, the data on which the reconstruction is based, comes as Radon projections along fixed directions. More generally, sometimes our data includes function values on the unit circle, in addition to line integrals. Our methods stay nondestructive in such a case and analytical as well.

For Radon projection data we have studied:

- interpolation and fitting by bivariate polynomials;
- interpolation by quadratic bivariate splines;
- interpolation and fitting by harmonic polynomials;
- interpolation problem for the Poisson equation;
- cubatures for harmonic functions.

Questions under consideration were to determine sets of chords on the unit disc for which the relevant problem has a unique solution, developing numerical algorithms, error estimation, etc.

Key words: Interpolation, fitting, cubature, bivariate polynomial, harmonic function, Poisson equation, Radon transform.