Vector tomography in cone beam and inhomogeneous geometries

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Vector tomography is the inverse problem of computing a 2D or 3D vector field given integrals of the searched field over geodesic curves. The most common setting is the Doppler transform which are line integrals of the vector field and thus is the analogon to the X-ray transform for standard computerized tomography. Vector tomography has a wide variety of applications in such different fields as medicine, industry, oceanography, plasmaphysics, polarization tomography or electron microscopy. In the talk we introduce to this challenging research field and focus on the cone beam geometry for 3D vector fields as well the case of an inhomogeneous medium with a variable refractive index. We present an inversion formula for the cone beam case which has been recently developed in a joint work with Alexander Katsevich and a numerical solution approach to the very demanding and nonlinear problem of reconstructing the refractive index from time-of-flight measurements. Our results are illustrated by some numerical experiments.