20 YEARS OF IMAGING IN VECTOR FIELD TOMOGRAPHY: A REVIEW

Thomas Schuster
Helmut Schmidt University Hamburg, Germany

Vector field tomography deals with the problem of completely reconstructing a vector field $\mathbf{f} : \Omega \subset \mathbb{R}^d \to \mathbb{R}^d$ from given integral data

$$\mathbf{Df}(x, \theta) = \int_0^\infty \langle \mathbf{f}(x + t\theta), \theta \rangle \, \mathrm{d}t \, .$$

Here x denotes a source point outside the support of $\mathbf{f}$ and $\theta \in S^{d-1}$ is a unit vector of direction. The research in the area of vector field tomography is concerned with finding inversion formulas, resolution results and reconstruction methods, where settings in 2D and 3D as well as different geometries are considered. The most popular ones are the *parallel geometry* where $x \in \{\theta^\perp\}$ or the *cone beam geometry* where x is located on a scanning curve Γ surrounding the object Ω.
The talk summarizes two decades of research in the exciting area of vector and tensor field tomography. In 1988 Norton published an article where he describes the possibility to reconstruct 2D flow fields. Four years later Juhlin suggests a geometry for a complete reconstruction of 3D velocity fields. This was the starting point for the application of mollifier methods leading to efficient and stable solvers. A current challenge is the development of inversion methods for arbitrary source curves. The talk subsumes the development of reconstruction methods and convergence results from the very beginning down to the present day.