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9.1 Tomographic Analysis of Complex Plasmas

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Many tokamaks now use visible light cameras to observe plasma-wall interactions and integrated line emission. The DIII-D Coherence Imaging Spectroscopy diagnostic cameras image interferograms that encode line integrated flow. By modeling the 2D camera image pixels as line-of-sight integrals through an axisymmetric discrete grid it is possible to do tomographic analysis to determine the local plasma line emissivity and parallel flow. We present methods to solve the inverse problem posed by these tangential viewing cameras. The inversion begins with calculation of the sparse response matrix that encompasses all the geometry and diagnostic information and reduces the process of image formation to a sparse matrix-vector multiply. This work includes techniques of determining the detailed geometry of the camera views and methods for handling physical quantities that vary spatially. Additionally, the size of the response matrix has driven the development of capability to distribute the coarse parallel calculation across a heterogeneous cluster of computers on the Energy Sciences Network. Iterative techniques are then used to solve the sparse matrix-vector linear system.Work performed by LLNL under auspices of US DOE, Contract No. DE- AC52-07NA27344 and DE-FC02-04ER54698.

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