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6.17 Extracting the turbulent flow-field using velocimetry analysis

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Velocimetry analysis of density turbulence images obtained with beam emission spectroscopy (BES) on DIII-D is used to infer the 2D turbulent flow-field. The BES system on DIII-D obtains low-wavenumber density fluctuation images using an 8x8 grid of channels in the radial-poloidal plane with ≈1 cm spatial resolution and 1 μs sampling rate. The time-resolved 2D turbulent flow-field is obtained by spatiotemporally interpolating the limited resolution images and then applying an orthogonal dynamic programming (ODP) algorithm [1]. The algorithm is a frame-to-frame matching technique that works by using a global minimization method to determine which velocity vector maps one frame to another. In this work, the accuracy and uncertainty of the ODP algorithm applied to BES data is assessed using density and electrostatic potential fluctuation data from higher spatial resolution nonlinear gyrokinetic GENE simulations by comparing the velocimetry-estimated flow-field to the true ExB flow-field. Algorithm parameters, including search domain and spatiotemporal interpolation, are scanned to determine optimal values for most accurately estimating flow velocities.Supported by US DOE under Award No. 3DE-SC0001288, DE-FG02-08ER54999, and DE-FC02-04ER54698. [1] G. McKee et al, RSI 75 3490 (2004)

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