Contribution ID: **3053** Type: **not specified**

P1.1007 Tomographic reconstruction of COMPASS tokamak edge turbulence from single visible camera data and automatic turbulence structure tracking

Monday, 8 July 2019 14:00 (2 hours)

See the full abstract here:
http://ocs.ciemat.es/EPS2019ABS/pdf/P1.1007.pdf

The growing capabilities (speed, sensitivity, dynamic range) of fast visible cameras make this tool more and more interesting for diagnosing turbulence in plasma devices, and in particular,
in fusion ones. Especially, cameras' speed is approaching probe acquisition frequencies while they usually reach higher spatial resolution. On the other hand, light emission from a plasma
is usually not local and makes the data interpretation difficult. To overcome this 3D problem, imaging of a poloidal gas-puff jet has become a common method. However, this method is
known to locally perturb the plasma and to have effect on the probed turbulence [1].
In this contribution, we present tomographic inversion of edge turbulence recorded by a single visible camera observing the interaction between the edge plasma and the neutral gas naturally present in the vacuum vessel (i.e. no extra gas-puff) [2] - therefore a fully passive observation. Since the observed turbulent structures (filaments) are 3D and their images on the camera chip 2D, an assumption has to be taken to avoid ill-posed problems. As velocities of charged particles along field lines are very high, it is possible to assume that light emissivity is constant along that direction and then to reconstruct any poloidal plane in the field of view of the camera. Within this assumption, the method has been carefully checked using synthetic data from the TOKAM3X code [3] and then further validated by comparing experimental camera and Langmuir probe data. Using a recently developed detection and tracking software [4], it is then possible to study the position, size and velocity of the turbulent structures in the reconstructed poloidal plane and to obtain reliable statistics. Examples illustrating the benefits of the method for the characterization of edge plasma turbulence will be presented.

References:
[1] S. Zweben et al., Plasma Physics and Controlled Fusion, 49 (S1-S23), 2007.
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[3] P. Tamain et al. Journal of Computational Physics, 321 (606-623), 2016.
[4] R. Baude and M. Desecures. Track software. http://www.aprex-solutions.com/, 2018.

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Session Classification: Poster P1

Track Classification: MCF