Regularization extraction for real-time plasma tomography at JET

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Plasma tomography [1] consists in reconstructing the 2D radiation profile on a poloidal cross section of the fusion device. Such reconstruction is based on measurements of the line-integrated radiation along multiple lines of sight. However, since these lines are sparse, the problem is under-determined, and a solution must be found by employing regularization methods [2]. Typically, such regularization is implemented by enforcing smoothness along the magnetic flux surfaces [3] or by using prior knowledge from other diagnostics [4]. In addition, an iterative procedure is needed to find the optimal regularization parameters [5]. As a result, tomographic reconstructions are computationally expensive and have extensive knowledge embedded.

In this work, we describe an approach to extract the regularization from existing reconstructions. Based on a set of about 500 reconstructions that have been carefully curated at JET, we use a machine learning framework to extract a regularization matrix that can be used to generate new reconstructions directly from measurement data. Figure 1 shows one of the regularization patterns that can be found in such matrix, where a measurement taken along a line of sight contributes to pixels along a curvature that resembles a magnetic flux surface. Once the regularization matrix has been found, new reconstructions can be computed in a single matrix multiplication step, thus enabling the use of plasma tomography as a real-time diagnostic.

References


*See the author list of X. Litaudon et al., Nuclear Fusion 57, 10 (2017)

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