Bayesian soft X-ray Tomography on Tore Supra and WEST

Tianbo Wang¹,²,³, Didier Mazon², Jakob Svensson⁴, Dong Li¹ and Geert Verdoolaege³,⁵

1. Southwestern Institute for Physics, CNNC, C-610200 Chengdu, China
2. Institute for Magnetic Fusion Research, CEA, F-13115 Saint-Paul-lez-Durance, France
3. Department of Applied Physics, Ghent University, B-9000 Ghent, Belgium
4. Max-Planck-Institut für Plasmaphysik, D-17491 Greifswald, Germany
5. Laboratory for Plasma Physics, Royal Military Academy (LPP-ERM/KMS), B-1000 Brussels, Belgium

Gaussian Process Tomography (GPT) [1] is a recently developed tomography method based on Bayesian probability theory. This method has been applied to many nuclear fusion diagnostics, for example soft X-ray diagnostics in [2]. By modeling the SXR emissivity field in a poloidal cross-section as a Gaussian process, Bayesian SXR tomography can be carried out in a robust and extremely fast way. Owing to the short execution time of the algorithm, it is an important candidate for providing real-time information on impurity transport and for fast MHD control. In addition, the Bayesian formalism allows quantifying the uncertainty on various profile parameters.

In this paper, Gaussian process tomography is validated using a synthetic data set and results are shown of its application to the reconstruction of SXR emissivity profiles on the Tore Supra and WEST tokamak. The method is compared with the classical algorithm based on minimization of the Fisher information, in terms of accuracy, robustness and computational load.

Keywords:
Soft X-ray diagnostic, tomography, Bayesian probability theory, Gaussian processes

Reference: