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Soft X-ray tomography for monitoring fusion plasma dynamics

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In fusion devices, the local soft X-ray (SXR) plasma emissivity is rich in information about electron temperature and density, magnetohydrodynamic (MHD) activity and concentration of impurities that can be inferred with the help of dedicated tomographic inversion and synthetic diagnostic tools [1, 2]. Nevertheless, estimating the local plasma emissivity from a sparse set of noisy line-integrated measurements is a mathematically ill-posed reconstruction problem, that requires an adequate regularization procedure [1]. In this contribution, we introduce some tools aiming at validating and speeding up the X-ray tomographic inversions. The traditional approach based on Tikhonov regularization, including magnetic equilibrium constraint and parameter optimization, is presented. The advantages and drawbacks of substituting it with neural networks for fast inversions are investigated. Finally, the perspectives for plasma profiles reconstruction and validation are discussed.

[1] A. Jardin et al, *Validating and speeding up x-ray tomographic inversions in tokamak plasmas*, *Plasma Phys. Control. Fusion* 66 (2024) 085010.

[2] A. Jardin et al, *Synthetic X-ray Tomography Diagnostics for Tokamak Plasmas*, *Journal of Fusion Energy* (2020) 39:240–250.

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