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ADVANCED TOMOGRAPHY BASED ON THE MAXIMUM LIKELIHOOD PRINCIPLE FOR INTERSHOT ASSESSMENT OF THE RADIATION LOSSES

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On the Joint European Torus (JET) first and more recently on ASDEX-Upgrade (AUG), an Expectation Maximization algorithm has been implemented to derive the Maximum Likelihood (ML) between the line integrated measurements of the bolometers, and the reconstructed tomograms representing specific poloidal emissive distributions. On both devices, the Line of Sights (LOSs) coverage of the foil bolometers have been used to evaluate bolometric tomographies. The main and most distinctive feature of the method is the possibility to estimate the variance related to the reconstructed tomogram and, consequently, to evaluate the uncertainties on the derived quantities. Since the first implementation on JET, dedicated studies have been performed to improve the outputs of the ML tomographies and consequently, to increase the reliability, quality and accuracy of the derived quantities. The algorithm developed can handle missing or unreliable LOSs due to faults that might occur during an experimental campaign, as well as systematic errors and outliers in the measurements. More recently two upgrades have been developed and implemented to: a) minimize the risk of producing artefacts, an unavoidable and an unwanted feature that can strongly influence heat transport and turbulence studies; b) to handle the asymmetric brightness on LOSs, due strong gas puffings close to one of the bolometer arrays. The developed algorithm is therefore probably one of the most complete and advanced available nowadays in the fusion community. Having proved the portability between devices, efforts have been spent, and are also currently on going, to develop a real-time version compatible with the ITER fast controller platform. Such efforts succeeded at reducing by a factor ten the time interval required for estimating a reconstruction, paving the way at least for an intershot application of the ML code in future versions.

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