

§26. Tomographic Imaging of the LHD Plasma

Iwama, N. (Dept. Applied Electronics, Daido Institute of Technology),
 Hosoda, Y. (Dept. Information Science, Fukui Univ.),
 Ohdachi, S., Sudo, S.

Numerical studies of computed tomography have been made for the purpose of LHD plasma imaging: a theoretical study on methods for eliminating the finite beam-width effects in bolometer tomography, and the following studies with use of soft X-ray camera data in LHD and others.

The Fourier-Bessel series expansion method, which is expected useful for imaging the MHD instabilities, has a problem of the basis function system definition in the unit circle. In application to the LHD plasma, the method should be modified to meet the non-circularity of magnetic surface, which is increased in high beta operations. An approach is to make the image reconstruction in the circular domain of magnetic surface coordination, where the lines of sight are curved. Study was made on a one-directional soft X-ray camera mounted in a poloidal plane and its detector signals. The curved lines of sight were obtained by pursuing the intersections with the theoretically calculated magnetic surfaces. For image reconstruction, the Fourier-Bessel series expansion method with Tikhonov regularization [1] was employed for its advantages of high reliability and fast computation, and was applied to signal values.

A result is exhibited in Figs. 1~3. With assumption of the constant emission intensity on each magnetic surface, the azimuthal Fourier mode was set to $M=0$, and the

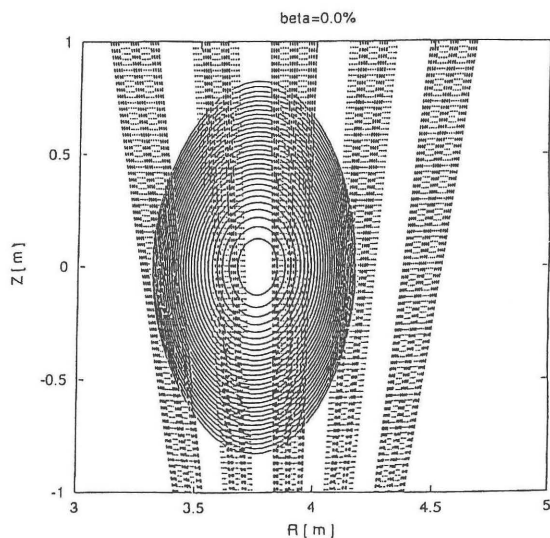


Fig. 1. Lines of sight of a soft X-ray camera, and the magnetic surfaces plotted with equal interval.

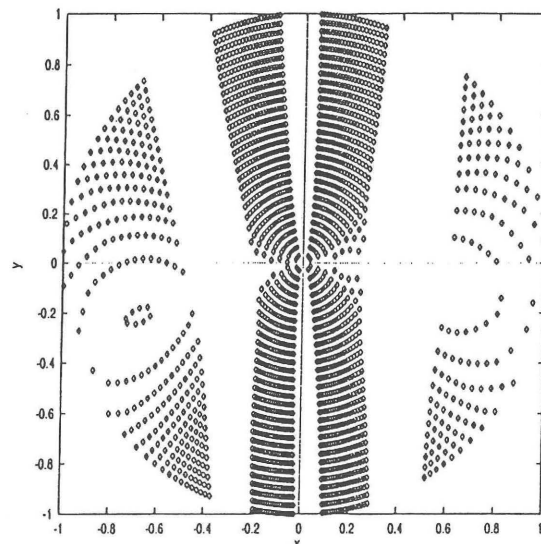


Fig. 2. Intersecting points of the lines of sight in the magnetic-surface coordinate space.

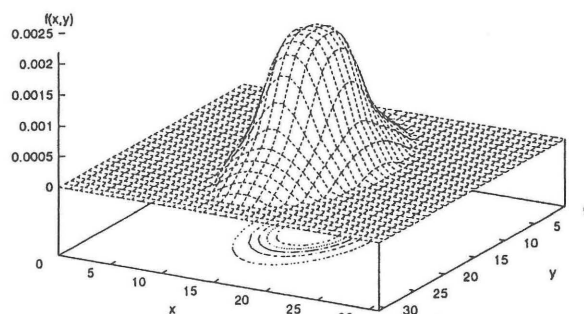


Fig. 3 An obtained plasma image in real space ($M=0$, $L=3$; $\gamma=0.2$).

highest mode L of Bessel function and the regularization parameter γ were chosen by reference to the generalized cross validation. The reconstructed plasma image was displayed in the actual coordinate space after taking a simple procedure of coordinate transformation. A software for obtaining the plasma image from signal values was made up.

Additional studies were made on the singular value decomposition of multichannel detector signal for the purpose of higher reliability in plasma image animation, and also on the usage of the neural net for image reconstruction; the obtained images were investigated with interest to the behaviors in the regions of the missing lines of sight.

Reference

- [1] N. Iwama: ITER Progress Meeting on Diagnostics, JAERI Naka-site, Japan, April 19-20, 1999.