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Development of Automated Postprocessing System for ECEI data

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The electron cyclotron emission imaging (ECEI) technique has become a powerful tool for the visualization of local electron temperature fluctuations in tokamak plasmas.[1,2] In addition to radial electron temperature profiles provided by conventional ECE radiometry, the ECEI diagnostics enables detailed 2D measurements of various MHD instabilities and turbulence.

ECEI data typically contains internal system noise, white noise, and external noise from tokamak operation, which are a nuisance for visualization of MHD modes of interest. In order to eliminate the noise while keeping the spectral components of MHD modes, proper filtering methods are desired.[3] The bandpass filtering provides an easy way to remove unwanted spectral components. However, the selection of filtering parameters is a manual and time-consuming process since the frequency of periodic MHD signal varies, making it difficult to predict the spectral region of importance in advance.

Offering postprocessed ECEI images to a researcher during experiment has not been possible, resulting in the limitations not only on on-demand analysis but also in timely feedback on the operation of ECEI or auxiliary systems. To alleviate these problems, we have developed an automatic postprocessing system that can provide visualized images of postprocessed data.

We adapt a threshold filtering method[3] with adjustable parameters for the removal of white noise and system noise. Figure 1 illustrates the visualization of a tearing mode via the automatic postprocessing system (right), compared with the ECE images of the unprocessed raw data (left). With performance tests, we demonstrate the aptness of the system for real-time analysis of ECEI data. This work is supported by NRF of Korea under grant no. NRF-2019MIA7A1A03088456.

References

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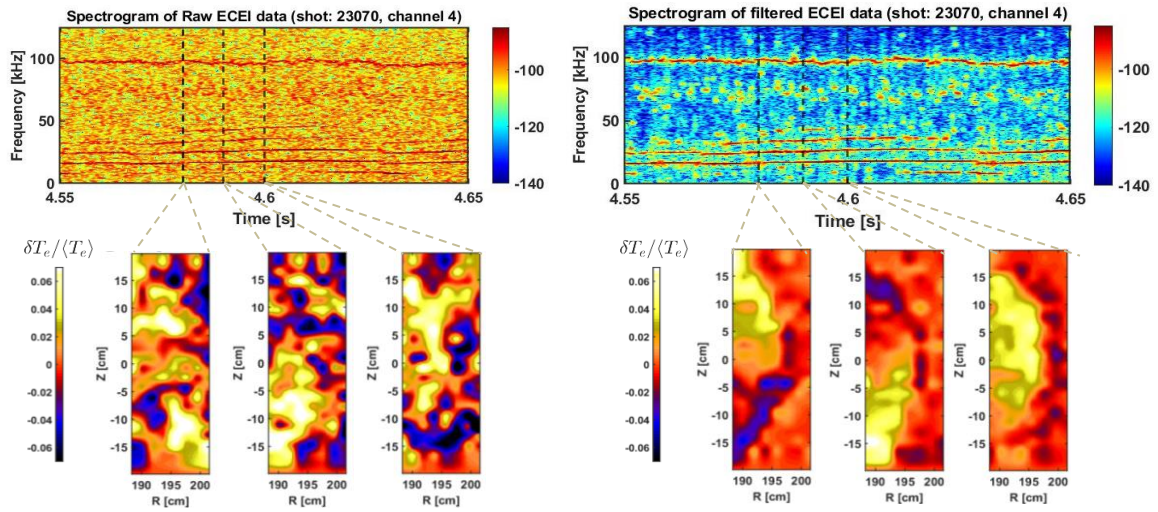

Figure 1. ECE spectrogram and image produced with raw data (left) and those produced with postprocessed data (right). As a result of threshold filtering, the background white noise has been reduced up to ~35 dB. Tearing mode structure visualized by postprocessed images demonstrate the performance of automatic postprocessing system.