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Deep analysis of millimeter-wave imaging diagnostics data

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Millimeter-wave imaging and visualization diagnostics have demonstrated outstanding performance and have contributed to numerous physics studies, including magnetic reconnection, energetic particle instabilities, ELM crash and suppression, and EHO instabilities. The conventional 2D imaging data analysis approach has been developed over 20 years. Huge amounts of data have been generated and stored and may have undiscovered results in deeper layers. For example, lower level fluctuations are difficult to observe on single chord 1-D ECE spectra. In contrast, ECE-imaging places measurements at many more minor radii by forming a 2D array of measurements that are finely spaced radially and vertically about flux surfaces in the plasma. Reduced dimension computation leads to higher spatial resolution between different flux surfaces and enhanced fluctuation amplitude resolution using coherence methods. It provides obvious improvements in spectral contrast, which are suitable for short life-time, weak amplitude fluctuation detection. Furthermore, millimeter-wave imaging diagnostics generate ~3 TB per week. The machine assisted learning provides the possibility of comparing physics images between thousands of shots on different fusion experimental facilities. To this end, an intelligent mode recognition module has been developed to separate meaningful signals from meaningless background noise.

References

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