Real Time IR Thermography at ASDEX Upgrade: Current Status and Future Prospects

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Power exhaust is a major challenge for the design and operation of future fusion devices such as ITER and DEMO. Infrared (IR) thermography is widely used in present fusion experiments to measure the heat flux onto the plasma facing components. Current IR systems are designed for pure data acquisition, with the data analysis taking place offline after the plasma discharge. With long pulse experiments in sight, such as Wendelstein 7-X, this procedure is questionable. An online data analysis of the target heat flux is desired. For this reason a new real time IR thermography system is designed, built and tested at ASDEX Upgrade.

For the system a new IR camera was developed using a commercially available IR detector measuring at a wavelength of 3.6 – 4.9 µm and using the Camera Link standard for communication. The camera housing is built out of soft iron to shield the detector and the electronics from the magnetic fields occurring during the operation of ASDEX Upgrade. Data acquisition is based on National Instruments hardware in the torus hall connecting to an industry computer on the outside via fiber optics.

Data acquisition and evaluation are implemented in C interfacing with LabVIEW for the setup of the acquisition. During the acquisition the data is directly streamed to a solid state disk in the industry computer allowing for long pulse operation. Correction and calibration of the acquired frames are performed in real time giving a continuous measurement of the surface temperature. For the calculation of the heat flux a real time version of THEODOR is implemented.

The integration time of the detector can be changed during the acquisition. Operation of the system with adaptive integration time based on the measured signal is possible. This opens the prospect of having automated IR measurements without the need of human intervention, which might be needed for long pulse operation.