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DSSC - an X-ray Imager with Mega-Frame Readout Capability for the European XFEL

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The paper presents the concept and the status of the DSSC project, an ultra-high speed detector system for the European XFEL in Hamburg. The DSSC (DEPFET Sensor with Signal Compression) is a 1Mpix camera with a sensitive area of 200x200 mm² designed to record X-ray images at a maximum frame rate of 4.5MHz. The system is based on a DEPFET Active Pixel Sensor as the central amplifying structure providing a detection efficiency of close to 100% for X-rays from 0.5 keV up to 10keV. 256 readout ASICs are bump-bonded to the detector in order to provide full parallel readout. The signals coming from the sensor, after being processed by an analogue filter, are digitized by 8-bit ADCs and locally stored in a SRAM.

The expected high brilliance of the XFEL beam calls for an extremely high dynamic range of up to 1e4 photons of 1 keV per pixel and requires at the same time for other experiments a single 1keV photon resolution. To achieve that, a strongly non-linear characteristic is required. The proposed DEPFET provides the required dynamic range compression at the sensor level. The most challenging property is that the single 1keV photon resolution and the high dynamic range are accomplished within the 220 ns frame read-out time.

The paper will discuss the main building blocks of the system, including the sensor with signal compression, read-out ASICs, module design, and report the status of the developments.

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