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Low Latency, Online Processing of the High-Bandwidth Bunch-by-Bunch Observation Data from the Transverse Damper Systems of the LHC

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The transverse feedback system in LHC provides turn-by-turn, bunch-by-bunch measurements of the beam transverse position with a submicrometer resolution from 16 pickups. This results in a 16 high-bandwidth data-streams (1Gbit/s each), which are sent through a digital signal processing chain to calculate the correction kicks which are then applied to the beam. These data-streams contain valuable information about beam parameters and stability. A system that can extract and analyze these parameters and make them available for the users is extremely valuable for the accelerators physicists, machine operators, or engineers working with LHC. This paper introduces the next generation transverse observation system, which was designed specifically to allow demanding low-latency (few turns) beam parameter analysis such as passive tune extraction or transverse instability detection, while at the same time provide users around CERN with the raw data-streams in form of buffers. A new acquisition card and driver was developed that achieves a latency less than $100\mu\text{s}$ from the position being measured by the pickup to data being available for processing on the host. This data is then processed by a multitude of applications that are executed in a real-time environment that was fine-tuned for the driver and the applications. To handle the high throughput required by the analysis applications without saturating the computing resources, a combination of parallel programming techniques are used in combination with GPGPU computing.

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No

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