



Contribution ID: 81 Contribution code: TUP10

Type: Poster Presentation

A high-precision low-latency DBPM processor for HALF

Tuesday 10 September 2024 16:00 (1h 30m)

Hefei Advanced Light Facility (HALF) is a fourth-generation vacuum ultraviolet and X-ray diffraction limit synchrotron radiation (DLSR) light source under construction. It is expected to have an ultra-low emittance and an extremely small beam size, which requires high-precision orbit detection and fast feedback control. The processor is the key component of the digital beam position monitor (DBPM) and control system, which is required to provide a submicrometer resolution in beam position measurement with a processing latency of lower than 90 μs . This paper presents the design and testing of a high-precision low-latency DBPM processor. In order to reduce the latency and ensure the high position resolution, a specific higher sampling frequency is chosen to reduce the quantization noise platform of the analog to digital convertor and an optimized low-order filter is adopted. Specialized efforts are devoted to the low jitter sampling clock generation and low noise analog circuit design. Furthermore, a dual-pilot tone structure was employed to compensate the gain variations across the four channels of the beam monitor sensor. The laboratory test results show that the DBPM has a position resolution of better than 400 nm for turn-by-turn acquisition, better than 90 nm for fast acquisition at 20 kHz rate, and better than 20 nm for slow acquisition at 10 Hz rate, with a total latency of less than 80 μs .

Footnotes

Funding Agency

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Yes

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Session Classification: TUP: Tuesday Poster Session

Track Classification: MC3: Beam Position Monitors