# ADVANCED DIGITAL SIGNAL PROCESSING FOR EFFECTIVE BEAM POSITION MONITORING

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Abstract

The latest experiences in digital signal processing of BPM data obtained at the synchrotrons of ITEP and GSI are discussed. The data from the ITEP was collected by a BPM processor prototype while the SIS18 BPM DAQ (GSI) uses an already renovated digital system. Due to the different concept of BPM architectures on those facilities it is possible to compare algorithms oriented to certain hardware. Several algorithms of position detection are compared to each other.

HARDWARE
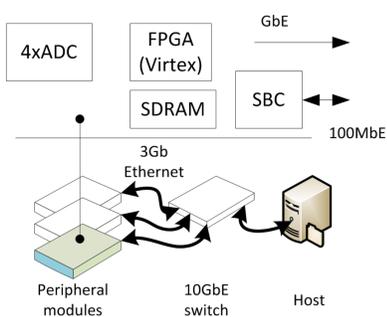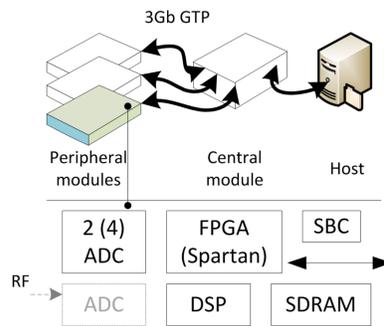
GSI (in operating)   ITEP (prototyping stage)

- The digital part of BPMs is almost unified
- DSP is not mandatory, but shorts a development time
- 3Gb GTP has less overheads than Gb Ethernet

ERROR SOURCES

- Natural noise is not a main contributor to BPM errors
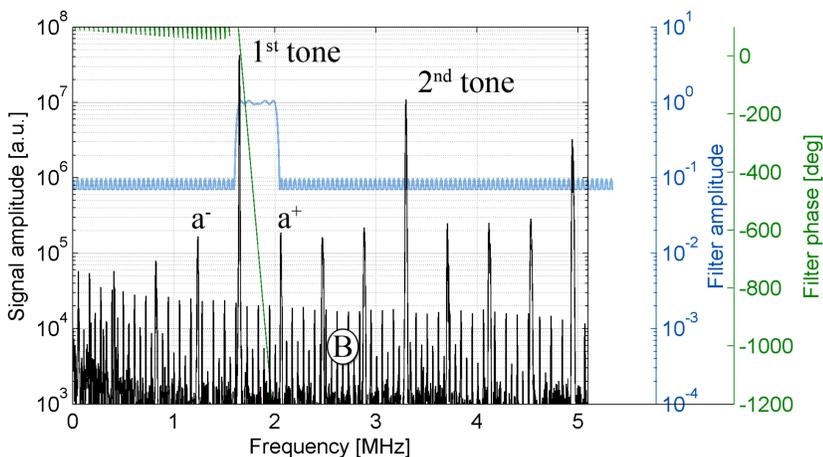
A signal spectrum on the input of the SIS18 BPM module, Bode diagram of the carrier reconstruction filter.
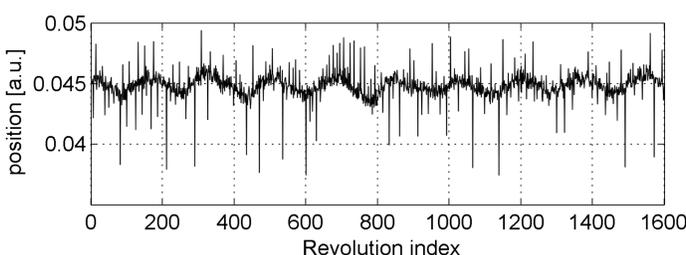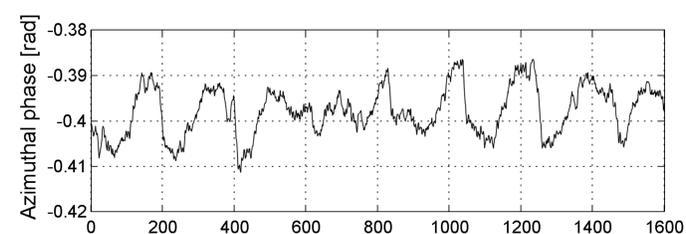

Azimutal oscillations are interfering with transversal position measurements.

CARRIER RESTORATION, FREQUENCY TRACKING
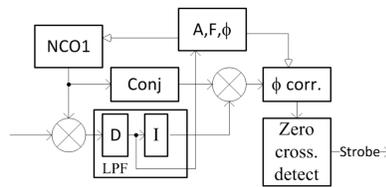
Logic module for bunch frame reconstruction. With certain class of regulator this module operates in PLL mode.
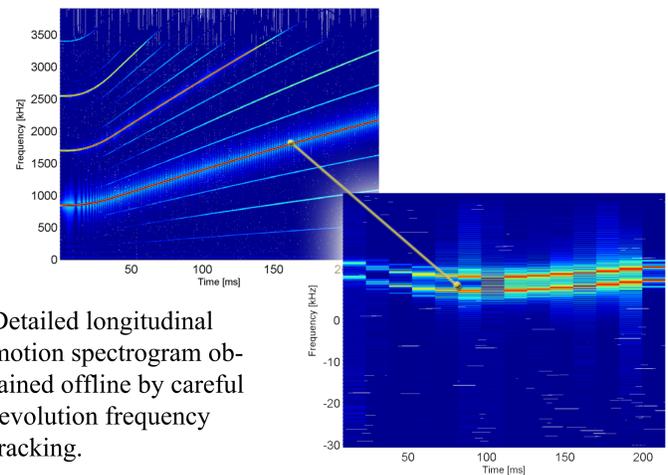

Detailed longitudinal motion spectrogram obtained offline by careful revolution frequency tracking.

MULTIPLE SIGNALS AND OVERDETERMINED SISTEMS

- Digital processors allow non trivial data operations even for overdetermined systems
- The overdetermination comes from the signal frequency spectrum, data oversampling or BPM construction
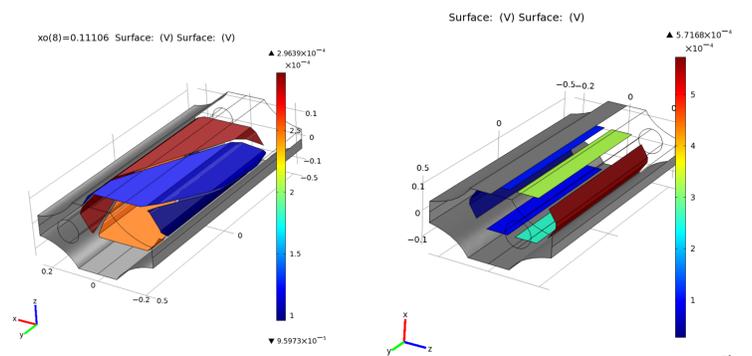
A linear-cut with linear position responce and six-pole BPM for low current operation in the collector ring of FAIR
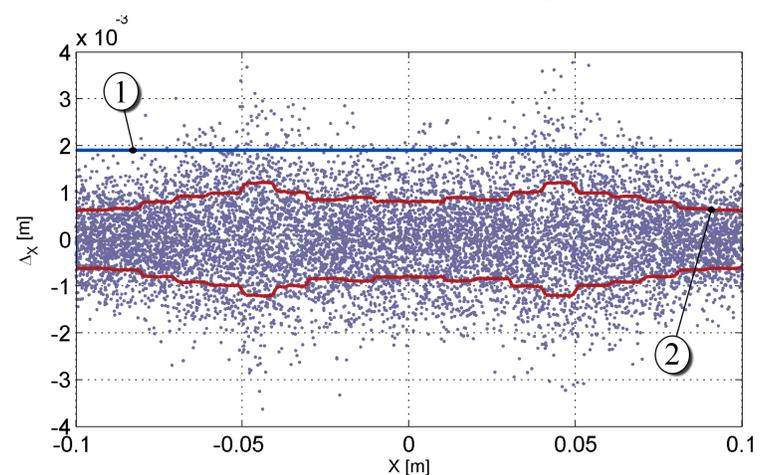
Standard deviation from actual position for linear-cut(1) and six-pole(2) BPMs.

REFERENCES

1. K.Lang et al., Performance test of digital signal processing for GSI synchrotron BPMS. Proc. Of PCaPAC08, Ljubljana, Slovenia.
2. A.Galatis et al.,Digital beam position measurement at GSI-SIS and CERN-PS. Proc. Of DIPAC 2005, Lyon, France.
3. S.Stergiopoulos(editor) Advanced signal processing handbook, CRC Press LLC,2001.