FOFB System Upgrade to ZynqMP FPGA with Fast ORM Measurement

THPAB264

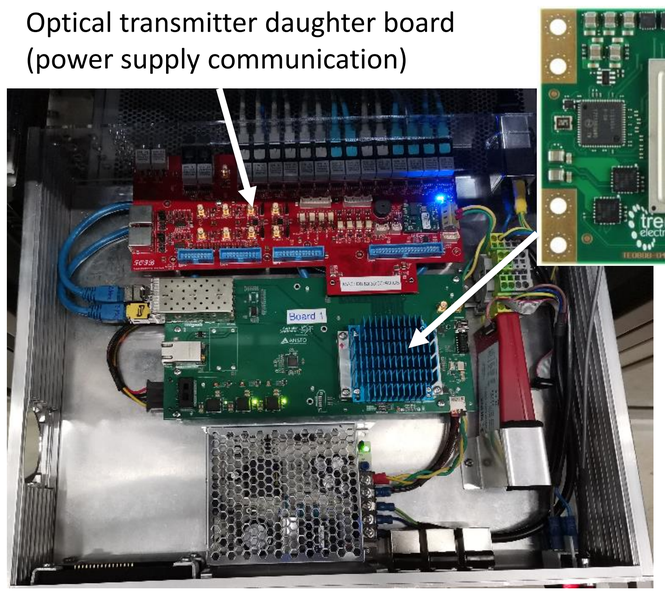
Simin Chen, Y.-R. Eugene Tan Australian Synchrotron – ANSTO, Clayton, Australia

The FOFB processor has been ported from a Vertex 6 FPGA to a ZynqMP SoC (System on Chip) to provide additional resources to include a system, called the enhanced orbit diagnostics (EOD) system, to inject sinusoidal and pink noise through the feedback loop. The amplitude, duration, phase and frequency of sinusoidal, amplitude and duration of pink noise is user programmable.

Platform

- Trenz Electronics TE0808 system-on-module is selected to replace the legacy Xilinx Virtex 6 FPGA.
- This module is equipped with a Xilinx Zynq UltraScale+ XCZU9EG-1FFVC900E and 4 GByte on-module DDR4 RAM for the embedded 4 cores ARM Cortex-A53 CPUs. The FPGA portion of this chip is ~7 times larger than the replaced one.

Optical transmitter daughter board (power supply communication)



Trenz TE0808 FPGA module

FOFB+EOD processor unit

Enhanced Orbit Diagnostics (EOD)

- EOD runs parallel to the FOFB system. Driving fast correctors with a sinusoidal signal or pink noise.
- Real-time data stream of the fast corrector output values from the FOFB + EOD system is sent to two virtual PCs for spectral analysis and data archiving.
- Using M. Abbot's FA Archiver (DLS) to archive the position and corrector data at 10058 Hz.

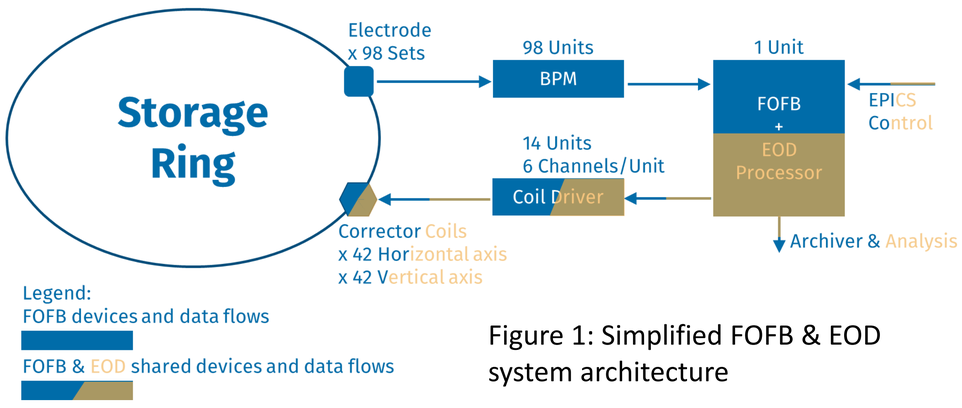
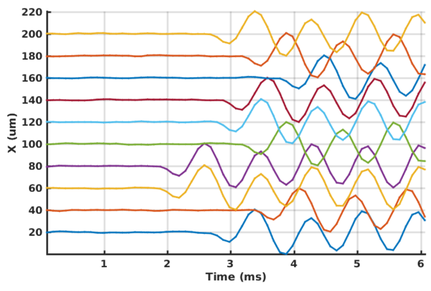


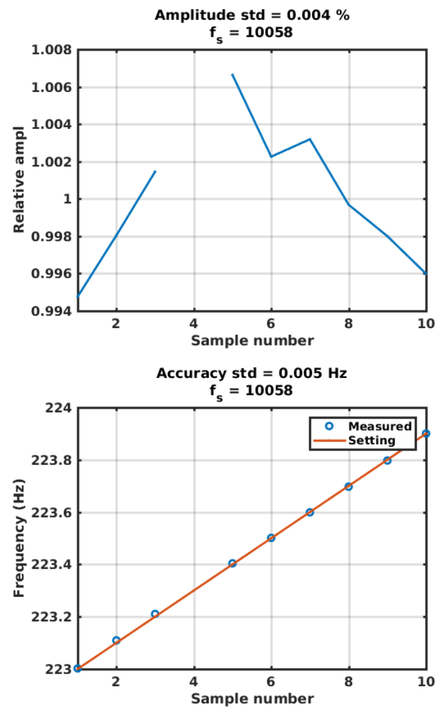
Figure 1: Simplified FOFB & EOD system architecture

Synchronisation For Data Collection

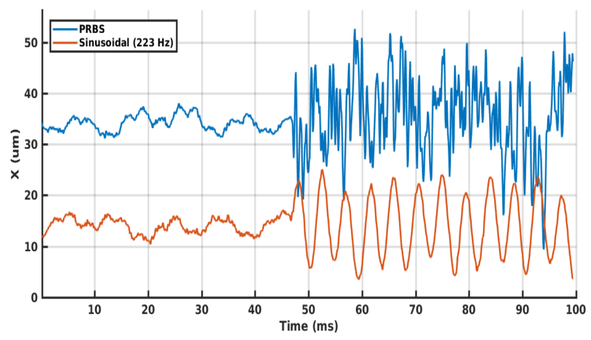
- No synchronization scheme built into the system to collect Fast Acquisition (FA) data.
- Using local PC time to log start times then requesting data from FA Archiver.
- Accuracy measured to be approx. ±1 ms.

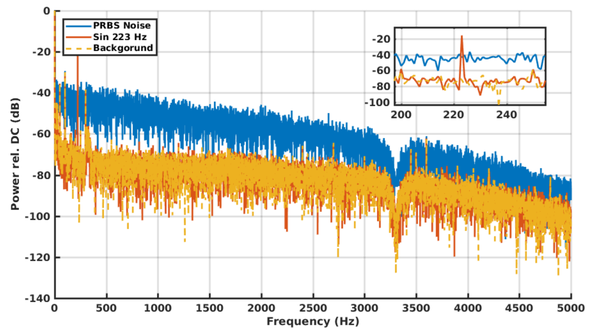


Parameter	Value
Amplitude resolution	0.5 mA (PSU resolution)
PRBS Duration Min / Max / Resolution	0.1 s / 10 s / 0.001 s
PRBS Amplitude Max	1.0 A
Sinusoidal Duration Min / Max / Resolution	0.1 s / 10 s / 0.001 s
Sinusoidal Amplitude Max	1.0 A
Sinusoidal Amplitude Accuracy (std)	0.5%
Sinusoidal Frequency Min / Max / Resolution	1.0 Hz / 10 kHz / 0.001 Hz
Sinusoidal Frequency Accuracy (std)	0.005 Hz
Sinusoidal Phase Min / Max / Resolution	0 deg / 360 deg / 1 deg
Sinusoidal Delay Min / Max / Resolution	0 s / 10 s / 0.001 s



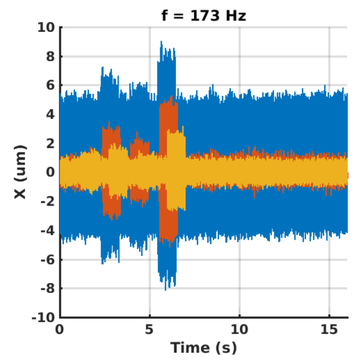
Pink Noise (PRBS generator) and Sinusoidal Driver

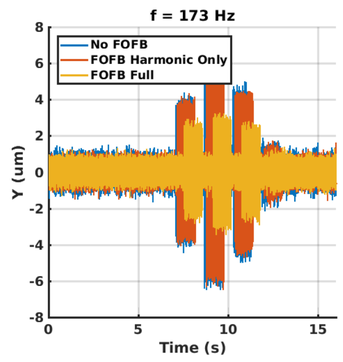




Excitation with and without FOFB

- Noise or sin signal can be applied with or without the FOFB system running in parallel.
- Harmonic suppressors: 50, 100 and 300 Hz.
- For system response analysis and research into



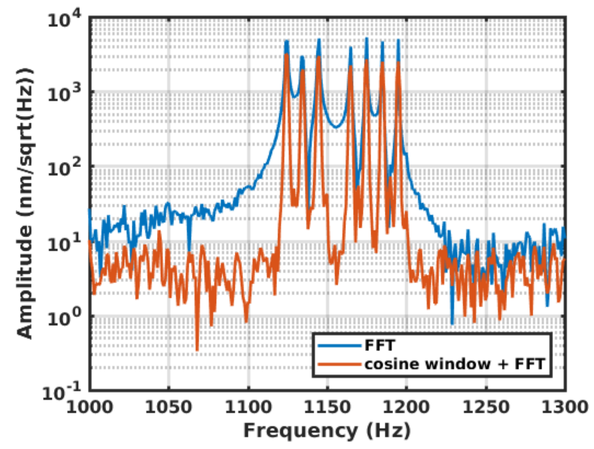


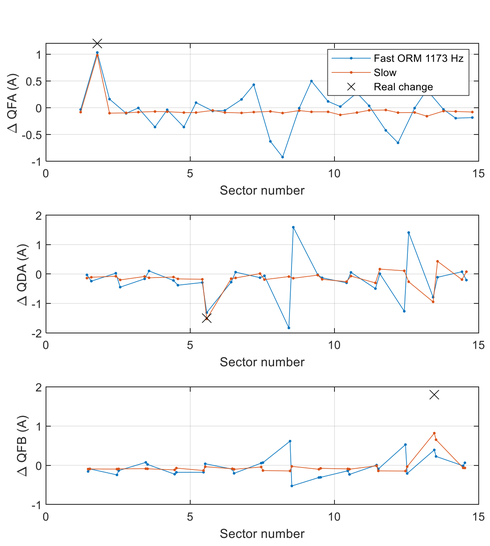
Fast ORM

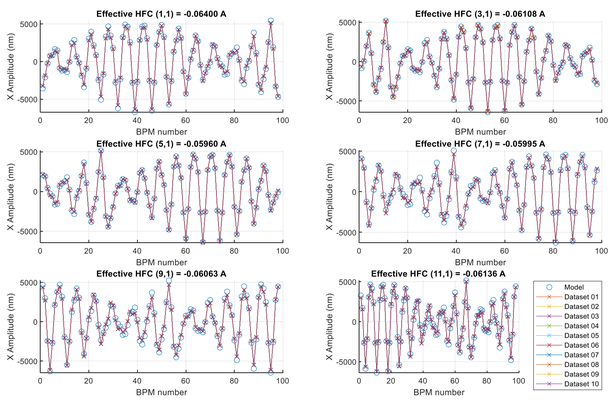
- Typical ORM measurements take 7 mins (420 s).
- In serial measurements with 1 s duration takes ~140 s.
- 7 parallel measurements, ~25 s.
- Analysis following method by Z. Marti.

Issues to resolve to date

- With no absolute synchronization between drive and acquisition there is a sign ambiguity in the data analysis.
- Parallel ORM measurements with a 10 Hz frequency separation may have appreciable crosstalk.
- Fast ORM response matrices are not as "clean". Current analysis methods needs refinement.







References

Abbott, M.G., Rehm, G. and Uzun, I.S., 2011. A new fast data logger and viewer at diamond: the FA archiver. Proceedings of ICALEPCS2011, Grenoble, France, pp.1244-1246.

Martí, Z., Benedetti, G., Carlà, M., Fraxanet, J., Iriso, U., Moldes, J., Olmos, A. and Petrocelli, R., 2017, May. Fast orbit response matrix measurements at ALBA. In 8th Int. Particle Accelerator Conf.(IPAC'17), Copenhagen, Denmark, 14â 19 May, 2017 (pp. 365-367). JACOW, Geneva, Switzerland.