TFS for SIS 18/SIS100

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This short report gives an overview of the work on the project Transverse Feedback System (TFS) for the SIS 18, which will be commissioned later on at the SIS 100 of FAIR project, upon its completion.

The TFS is planned mainly for the SIS 100. However, experiments will be done this year 2013 after commissioning it at the SIS 18 for testing its functionality on stabilizing a real beam.

A new concept for using multiple pickups for estimating the feedback correction signal (beam angle at the kicker position) in order to minimize noise power. Furthermore, a system design for the existing SIS 18 facility has been developed.

Noise Minimization Using Multiple Pickups

A new concept for using multiple pickups for estimating beam angle at the kicker position has been addressed. The estimated signal should be the driving feedback signal of the kicker.

The signals from the different pickups are delayed, such that they correspond to the same bunch. Consequently a weighted sum of the delayed signals is suggested as an estimator of the beam angle at the kicker. The weighting coefficients are calculated such that the estimator is unbiased, i. e. the output corresponds to the actual beam angle at the kicker for non-noisy pickup signals. Furthermore, the estimator must give the minimal noise power at the output among all linear unbiased estimators. This is the so called Minimum-variance unbiased estimator (MVUE).

Simulation Results

The results are depicted in Figure 1 for horizontal direction of doublet mode. As a reference we take the noise power for using the closest two PUs to the kicker, which are the currently used PUs for the TFS in the SIS 18. Two curves are depicted, i.e. the noise power reduction by using increasing number of closest PUs to the kicker and the noise power reduction by using the best combinations of increasing number of PUs.

System Design

An overview of the main TFS design is depiction in Figure 2. The System is to be implemented on a Virtex 6 FPGA kit from the company Xilinx. The position data from the PUs are sampled and preprocessed at the Libera kits from the company intrumentation technology. The data are then sent from the Liberas to the TFS board via Aurora multi-Gigabit communication cores each.

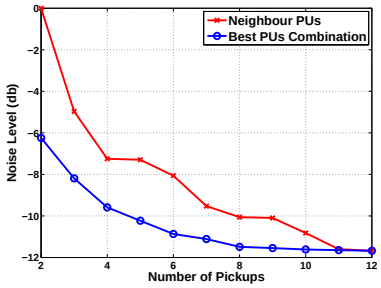

Figure 1: Noise power reduction.

In order to feedback head-tail oscillations, which become dangerous for high beam intensities, three positions are measured for every bunch, i.e., two for the ends and one for the middle.

In the case of coasting beam, three bunch positions per rf period are enough. Therefore, a generic data packet containing postion data and time stamps can be sent from each Libera to the TFS.

Providing feedback parameters, e.g., revolution frequency and linear combination factors, and system configuration are done by an external computer via ethernet connection. Implementation is planned to be finalized by October, where commissioning phase on the SIS18 will start.

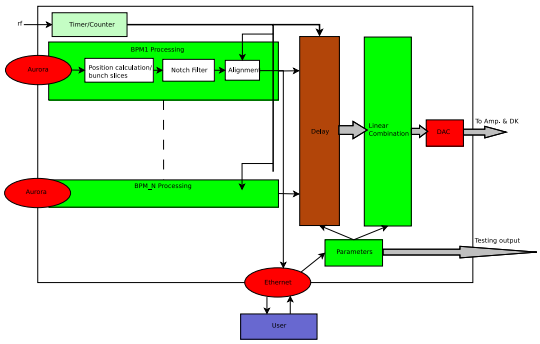

Figure 2: TFS design.

References

[1] M. Alhumaidi and A.M. Zoubir, “A TRANSVERSE FEEDBACK SYSTEM USING MULTIPLE PICKUPS FOR NOISE MINIMIZATION”, IPAC’11, September 2011, San Sebastin, Spain.

[2] M. Alhumaidi and A.M. Zoubir, “A ROBUST TRANSVERSE FEEDBACK SYSTEM”, IPAC’12, May 2012, New Orleans, USA.