When designing a real-time control system, a fast data transfer between the different pieces of hardware must be guaranteed since synchronization and determinism have to be respected. One efficient solution regarding these constraints is to embed the data collection, the signal-processing and the driving of the acting devices in an FPGA even if this solution does not come without difficulties. To overcome one of these difficulties, it is possible to open the development of the signal processing to non HDL (Hardware Description Language) specialists; here, System Generator [1] has been chosen for development purposes, in Simulink / Matlab from Xilinx and The MathWorks. Another challenge with such a system design is the ability to integrate real-time models on already pre-configured hardware platforms. Although the hardware can be ready for communication, standard PCI or PCI express bus and dedicated fast data links like Gigabit Ethernet, the corresponding interfaces must be carefully defined and designed to communicate with HDL System Generator control systems blocks. Therefore, the work in this paper describes with two examples how to take advantage of hardware delivered ready for use from a communication point of view and how to get it ready to integrate a design under System Generator.

1) BOOSTER TUNES ESTIMATION FROM THE CURRENTS IN THE MAGNETS
The booster is a circular machine designed to accelerate the electron beam from 200 MeV to 6 GeV energy. During the ramping, since the currents in the 3 main magnet families involved are not perfectly proportional all along the accelerating cycle and can slightly vary in an unpredictable way from one cycle to the next, the tunes are varying accordingly. As we need to know the value of the tunes to excite the beam for a cleaning process [3], a measurement and calculation in real-time will be performed to drive an amplifier with the correct frequency to perform a blow-up of the unwanted bunches of the beam.

REQUIRED INTERFACES IN THE FPGA
1) Driver for ADCs readout from serial to 24 bits word
2) Misc I/Os for the trigger and cleaning device
3) PCIe interface with ComExpress board

CONCLUSION
Progress in FPGA technology along with availability of high level tools for modeling, simulation and synthesis have made FPGA a key platform. Today, it is a good choice for the hardware development and implementation of high-performance applications requiring rigorous calculations in real-time. Many developments at ESRF have proven that FPGAs can outperform DSPs and embedded processors in signal processing, while minimizing the hardware burden of multiple data paths. The right tools and techniques coupled with innovative features in silicon architecture can produce complex DSP functions in a single FPGA. Xilinx System Generator is a System level modeling tool that facilitates Simulink / Matlab in numerous ways to provide a powerful modeling environment. It opened the field of FPGA design to non-specialists through its design environment. In addition, the possibilities for testing and verification both at simulation level and combined simulation / hardware in the loop are an essential point to successfully implement a design.

References

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