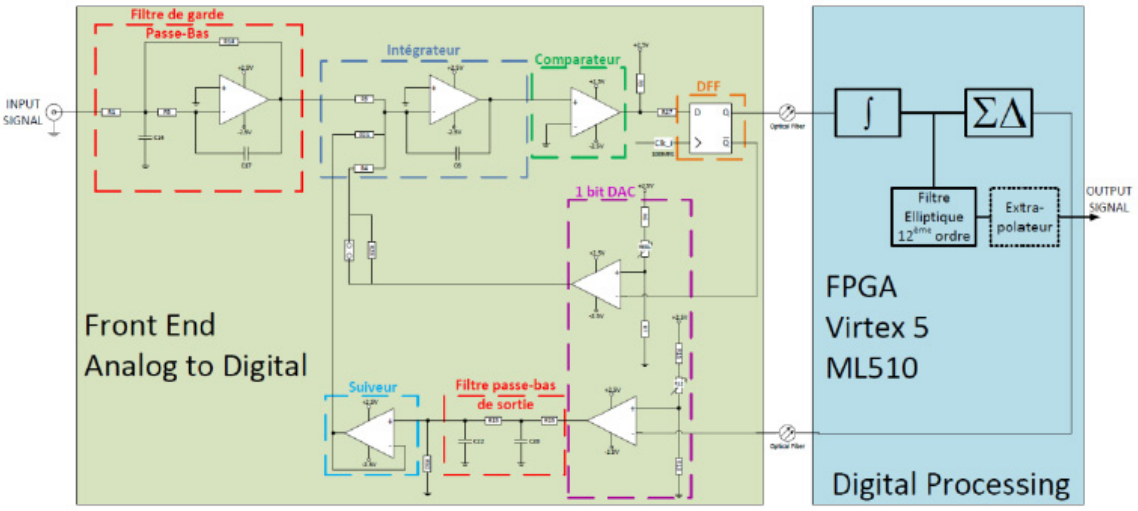

SMIS2

Designing a system for measuring phase's currents of a three-phase synchronous machine.

Project Abstract

To control the movement of a three-phase synchronous machine, the quality measurement of the phase currents is essential to achieve the desired accuracy. Previous work has shown that the main noise comes from power bridge switching that disrupts supplies and measured analog signals. This project focuses on improving the quality measurement phase currents done by shunt and/or magneto-resistive sensor directly on the engine (i.e. not on the side of the three-phase bridge power). Proposed solution implements a control loop. In order to decouple the maximum of noise power, galvanic isolation through plastic optic fiber is performed. The target SNR is 60 up to 100dB for a bandwidth of 20 kHz to 50 kHz. As part of this project, three PCB operating at sampling frequency of 100MHz and three others at 20MHz are designed, developed, assembled and submitted to several tests, to validate their good working. The desired accuracy, about 12 to 14 bits, is not reached. Indeed, the A/D conversion has a precision of 8 bits for an input signal of ±1.25V. This loss of accuracy is not related to the concept but rather linearity defect of the components used and the difficulty of making an accurate discrete analog circuit in the frequency range from 20MHz to 100MHz. Optical communication is functional but opto-electrical converters bandwidth is 25MHz, requiring a reduction of the bit-stream by a factor 2 (sigmadelta working at 100MHz can provide a bit-stream of 50MHz). Furthermore, an automatic generation of VHDL code for digital sigmadeltas of order greater than 2 with their decimation filters is performed. Control loop of the system is delayed for about 10us, significant for the useful signal bandwidth of 1 kHz to 5 kHz. In order to compensate this delay, an extrapolator is modeled and characterized on Matlab/Simulink. VHDL realization of this extrapolator will be made by a student of Polytech of Nantes during a 3 month project in the summer 2014.

Valorisation

Acquisition system developed should interest many engine suppliers. Motors are not equipped with an interface for the current measurement. This demonstrator shows that with a simple electronics design on the engine, a higher quality measure of phase currents is possible. Project results will be presented at least two manufacturers to find funding (Mandate or CTI project) to develop a integrated circuit capable of accurate average (if possible 14 bits) of a bit-stream coming from a sigmadelta converter. The value added is a measure without any delay, delocalized with galvanic separation and digital sigmadelta modulators of order greater than 2 with their recovery filter on FPGA.

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