High performance ADCs for industrial imaging applications

Members: M. Barragán, M. Diallo, D. Dzahini, H. Malloug, S. Manakli, S. Mir, F. Pancher, E. Simeu

Cooperation: XDIGIT

Contract: PYXCAD — XDIGIT/TIMA Common Research Laboratory

1. Introduction

XDIGIT and TIMA Laboratory have set up a common research laboratory named PYXCAD in January 2018, currently for a 3-year period (2018-2020). The goal of the laboratory is the joint development of very high performance analog/mixed-signal measurement interfaces and software solutions for the treatment of the generated data. The work in 2018 has focused on the layout optimization of ADC blocks and the setting up of an advanced ADC characterization test bench. Work is also recently underway for the design of analog single-photon counters.

2. ADC layout optimization

In switched-capacitor ADCs for image sensors, one has to deal with the very small value of capacitors to reduce the pitch and the area, while at the same time parasitic capacitance could create distortion. The goal of this research is to find a balanced and optimal layout structure using customized capacitances rather than the usual pcells that are made available with the technological design kits. As an example, Figure 1 illustrates the layout for a 10-bit DAC using customized MOM capacitors. The linearity is good according to layout extracted simulations for a pitch of 24µm that is required in some specific imager applications. Work is currently underway in order to study the incorporation of this type of solutions in advanced ADCs commercialized by XDIGIT of the MASSAR type [1].
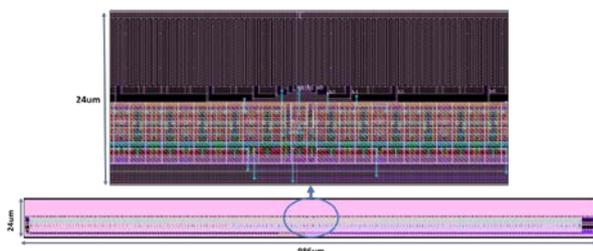
Figure 1. Layout of a 10-bit DAC with MOM capacitors.

3. ADC characterization test set up

Testing a high resolution converter is a difficult task usually involving a digital analyzer with a high resolution generator and a data acquisition system. In the PYXCAD common laboratory, we use an Applicos [2] test equipment that is very flexible for testing converters (see Figure 2).

Figure 2. Test bench for the characterization of advanced converters.

We are currently developing a testing method very close to the imager application context where the converter designed is supposed to be used, as opposed to using the classical sinus testing set-up which is more used for telecommunication applications. This test set up will be used during 2019 for the characterization of fabricated samples of advanced ADC converters.

Work is also underway for the development of specific testing algorithms that help to track and identify limiting features for even higher resolution of non-conventional architectures such as MASSAR. This knowledge will be exploited for the development of off-line or on-line calibration procedures for ADCs with the aim of reaching higher resolution features with limited power dissipation.

4. HgCdTe avalanche photodiode ROIC

Work has been started towards the design of specific readout IC (ROIC) for high frequency avalanche photodiode with embedded flash ADC architectures. The detection, dating and counting of single photons is a key requirement for LIDAR (Light Detection and Ranging) applications typically used in control and navigation for some autonomous cars and for space communications.

References

[1] MASSAR in the imagers. *XDIGIT*, Grenoble, France (https://www.xdigit.fr/).

[2] ATX7006 data converter test system. *Applicos Measurement & Control*, Heerde, The Netherlands (http://www.applicos.com/).