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DCIS2020 - Track1

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PhD Forum. DCIS 2020. November 18 – 20. Segovia, Spain.

# The design of a Continuous-Time Delta Sigma (CT ∑Δ) ADC For particle identification

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## BACKGROUND & MOTIVATION OF THE THESIS

- *Introducing the benefits of CT delta-sigma ADC the field of designing electronics for particle detection.*
- *Digitizing the signal as soon as possible as demonstrated in figure 1 (b) in order to replace the analog shaper bloc shown in figure (1) a.*

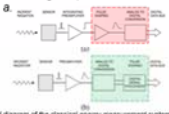
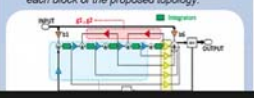


Fig. 1. (a) Simplified diagram of the classical energy measurement systems 1. (b) Simplified diagram of the novel energy measurement systems

## INNOVATION

- *The design of a custom ADC with a resolution of 10 bits and a bandwidth of 40 MHz based on CT Cascaded Resonators Feedforward architecture (CRFF) for particle identification.*
- *Building a simulation tool using Monte-Carlo like simulation to study in an early stage of the design flow, the impact of non-idealities of each block of the proposed topology.*



## OBJECTIVES AND WORK PLAN

***Main tasks:***

- *WP1 : Study of different topologies and the synthesis of a custom one using graphical models in MATLAB Simulink, and Schreier's Toolbox.*
- *WP2 : Building the non-idealities simulation tool illustrated in figure 3*
- *WP3: Designing analog blocks using $^{g_m}/_{I_d}$ methodology.*
- *WP4: Test and validation*

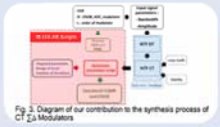
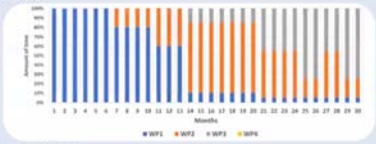


Fig. 3. Diagram of our contribution to the synthesis process of CT ∑Δ Modulators

***Organization:***

*Diagram of the distribution of time for each main task during the last 30 months*



***Limitations :***

- ***Tradeoff between complexity and speed** : for delta-sigma ADC, Simplifying the architecture of the modulator (order and internal ADC) leads to the use of high speed clocks ( jitter issues)*

## METHODOLOGY

- *For the design, we are applying a top-down approach in order to extract enough information about the behavior of the proposed architecture using graphical models in MATLAB Simulink and the developed simulation tool. This allows us to gain time and effort in the circuit level phase and to use fast design methodologies ($^{g_m}/_{I_d}$).*
- *The thesis project aim to design a part of the readout circuit for diamond detectors for hadrontherapy applications. The final circuit is composed of two systems: a high-accuracy time measurement system and an energy measurement system used for particle identification.*
- *This thesis is a part of DIAMASIC project, a part of CLaRyS collaboration done by the CNRS/IN2P3/LPSC lab.*

## RESULTS AND IMPACT

- *the synthesis of a fifth order CT ∑Δ modulator for 10-bit ENOB ADC based on a CRFF architecture using graphical models.*
- *the study of the effect of the dispersion (due to fabrication process) of the loop coefficients using the developed simulation tool as shown in figure 4. First investigations are shown in order to reduce the impact of these dispersions.*

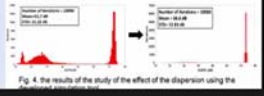


Fig. 4. the results of the study of the effect of the dispersion using the

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Anup saha

Grabac

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# Contributions to the efficient implementation of high-computational demanding video algorithms over heterogeneous platforms

Anup Saha, Miguel Chavarrías, Fernando Pescador, Matías Garrido González, Universidad Politécnica de Madrid

POLITÉCNICA

## BACKGROUND & MOTIVATION OF THE THESIS

**The capacity of storing appliances & communication channels is not increasing at the same rate as increasing demand for Ultra/high definition video for medicine, entertainment, surveillance, and industry.**

- *Handling highly computationally complex load is the challenge while keeping real-time*
- *Standard video and image processing algorithms are not generalized for different heterogeneous embedded systems*

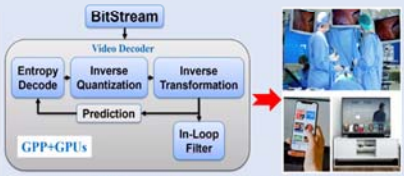

## INNOVATION

- *Target better use of heterogeneous embedded systems due to the increasing complexity of the processing algorithms*
- *Generalize standard video coding algorithm for different embedded architectures*

## OBJECTIVES AND WORK PLAN

***Objectives***

- *To address key part of heavy video-based algorithm for parallelizing the process*
- *To establish a methodology to accelerate the applications of video and image processing in GPUs and other heterogeneous platforms existing in the market*
- *To optimize methodologies and design tools that facilitate the development of video solutions on heterogeneous architectures. Thus, reducing also time to market*






***Publications***

## METHODOLOGY

- *Study of the state of the art in the implementation of processing algorithms in heterogeneous platforms*
- *Implementation of a video decoder on a heterogeneous platform which is compatible with standard algorithm*
- *To generalize the obtained solution for other problems*
- *Synthesis of the methodology and application to other algorithms*

## RESULTS AND IMPACT

- *Acceleration of State of the Art VVC over OpenHEVC using GPUs*
- *3 different embedded architectures was tested which includes ARM+GPUs or multiple ARMs*

**NANOPC-T3** **NVIDIA JETSON AGX XAVIER DEVELOPER KIT**

***Impact***

- *The performance of standard algorithm was increased by 11 times, when migrated to a GPU based heterogeneous platform*

***Tentative conference/ journal***

- *IEEE Access, Embedded Systems Week 2020*

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Jaime Sancho Ar...

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PhD Forum. DCIS 2020. November 18 – 20. Segovia, Spain.

# Automatically Accelerated Hyperspectral 3D Point Cloud Generation

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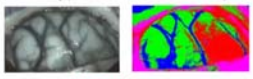
POLITÉCNICA

## BACKGROUND & MOTIVATION OF THE THESIS

***Classification Maps generated from Hyperspectral Images (HSI) are normally 2D***

- *They can not be introduced in immersive systems, which worsens the user interaction*
- *They can not be fused properly with other data sources unless they are acquired from the same position*
- *Multimodal data fusion can improve severely precision on classification maps*



## INNOVATION

***Generate in real-time 3D Point Clouds (PC) with spectral information from HSI***

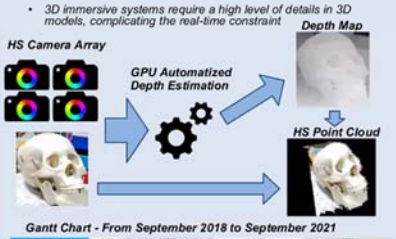
- *Extract effectively the information contained in multiview Hyper Spectral (HS) camera arrays to generate depth estimations*
- *Target acceleration in GPUs to achieve continuous rendering in immersive systems*
- *Develop tools to simplify automatic code generation and application autotuning*

***Objectives***

- *To generate a design methodology to produce 3D point clouds from a HS camera array in medical applications*
- *To propose a methodology to accelerate in GPUs immersive depth-based applications*
- *To develop an automatic code generation tool for GPUs which leverages on the previous methodology*

***Limitations***

- *3D immersive systems require a high level of details in 3D models, complicating the real-time constraint*




***Gantt Chart - From September 2018 to September 2021***

***Publications***

- *2 Journals*
- *2 conferences*
- *8 MPEG contributions*

**Current Technology Readiness Level (TRL ) – TRL3:** point cloud generation in RGB images is already tested and validated, however, HS point clouds need to be tested in lab conditions.

## METHODOLOGY

- *Start from the State of the Art (SoA) tool: MPEG Depth Estimation Reference Software (DERS)*
- *Propose changes and test them with SoA RGB multiview sequences*
- *Propose new HS multiview sequences for medical applications*
- *Research on the code generation SoA to find and extend an GPU automation tool*
- *Incorporate the automatic code generation in the application developed*

***Collaborations***

- ***MPEG-I Group:*** *depth estimation tools and RGB material*
- ***Hospital 12O:*** *brain tumour medical HSI*

## RESULTS AND IMPACT

***Achieved***

DERS using GPUs with RGB sequences

- ***25×*** *average* ***speed-up:*** *from ~10min/frame to ~30 s/frame*
- ***PSNR 1.6 dB*** *average* ***quality loss:*** *from 31.6 dB to 30 dB*

***Expected***

- *Novel HSI multiview open dataset*
- *Accurate depth estimations on HSI using the automated application*

***Impact***

- *Allow multimodal registration with HSI to improve classification results*
- *Immersive experience during medical operations*

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