Maestría en Ingeniería en Sistemas y Computo Inteligente

Title

Simulink-Matlab computing tool for fast and low-cost prototyping of analog-to digital ΣΔ converter in reconfigurable hardware

Author

Yazmín Gaytán Luis

Contributor

Luis A. Sánchez Gaspariano

Carlos Muñiz Montero

Víctor R. González Díaz

Jesús M. Muñoz Pacheco

May-August 2016

Simulink-Matlab computing tool for fast and low-cost prototyping of analog-to-digital ΣΔ converter in reconfigurable hardware

Yazmin Gaytán Luis, Luis A. Sánchez Gaspariano, Carlos Muñiz Montero, Victor R. González Díaz, Jesús M. Muñoz Pacheco
Master in Systems and Intelligent Computing
Yazmin.Gaytan@uppuebla.edu.mx, luis.sanchezgas@correo.buap.mx

1. Introduction

Today, analog-to-digital sigma-delta converters (ΣΔ-DAC) have become one of the most common options used in the electronics industry aiming for better resolution as well as low power consumption [1]. On the other hand, engineers and electronics designers need a methodology for creating a low-cost system for the fast prototyping of these types of data converters [2]. This would be beneficial for both the integrated circuit design and the research communities. Since experimental results can be attained in a very short amount of time, non-ideal effects considered in the design process can be modified without expending too much money and effort.

2. Objectives

2.1. General objective

- To implement a tool in SIMULINK / MATLAB that allows for low-cost prototyping of analog-to-digital ΣΔ converter in a short amount of time.

2.2. Specific objectives

- To carry out behavioral models in SIMULINK / MATLAB of the building blocks that constitute the architecture of the ΣΔ converter.
- To verify the correct performance of each of the proposed building blocks by simulations in MATLAB.
- To transfer the complete ΣΔ design from SIMULINK / MATLAB to a reconfigurable hardware (FPAAs, FPGAs, μ-controller) in order to validate the performance of the proposed design.

3. Method

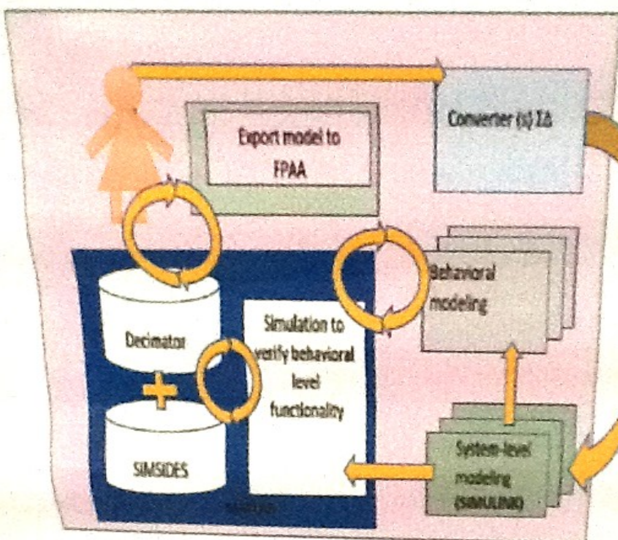

Figure1. Methodology employed in this Project.

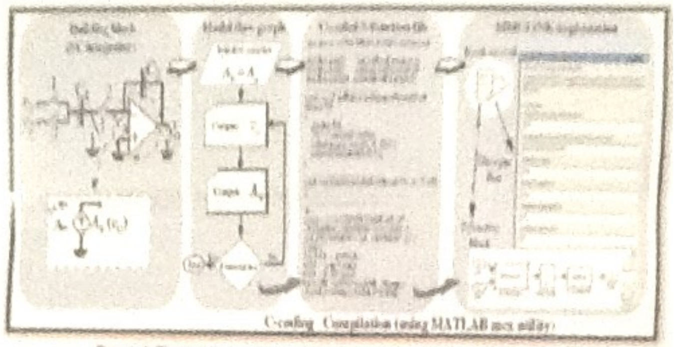

Figure 2 The implementation of the S-function of Figure 5 in SIMULINK.

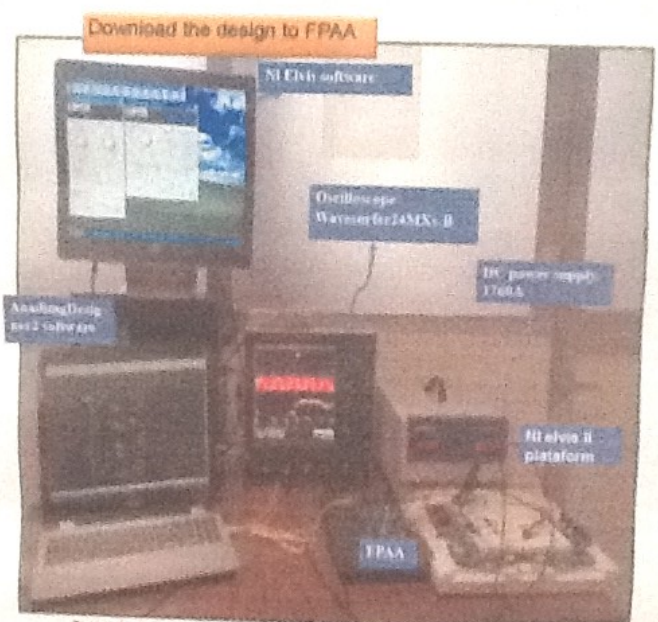

Figure 3. Experimental diagram for downloading the ΣΔ modulator to the FPAAs.

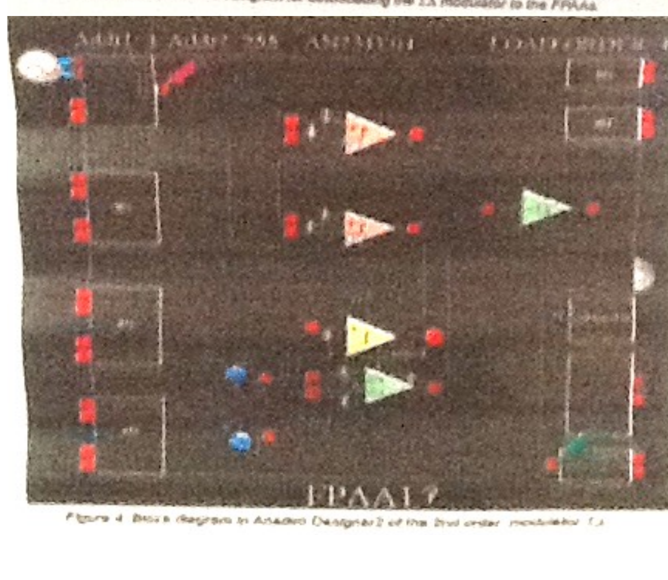

Figure 4. Block diagram in Anadigm Designer2 of the 2nd order modulator ΣΔ

4. Results

The ΣΔ modulator was analyzed with a sinusoidal input with a frequency of 5kHz and $1V_{peak}$ and over-sampling ratio (OSR) of 128. The experimental results of this work are presented below:

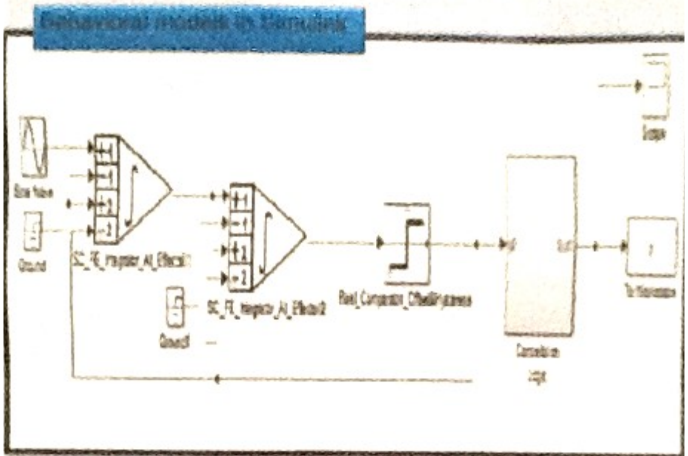

Figure 5 Block diagram in SIMSIDE of the 2nd-order cascade ΣΔ modulator.

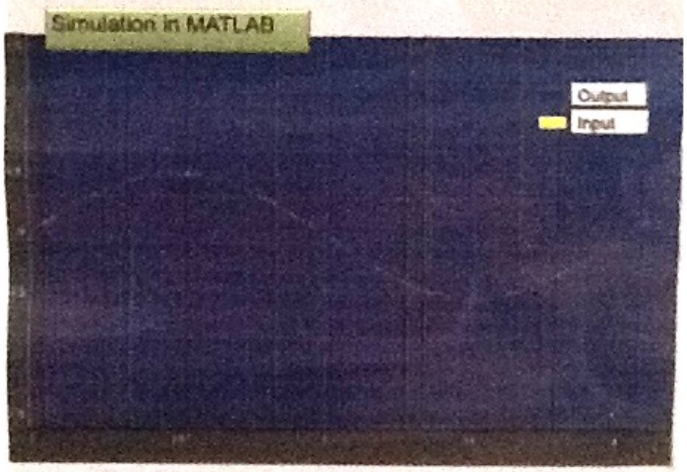

Figure 6. Spectrum (magnitude) of output of the modulator of Fig. 5

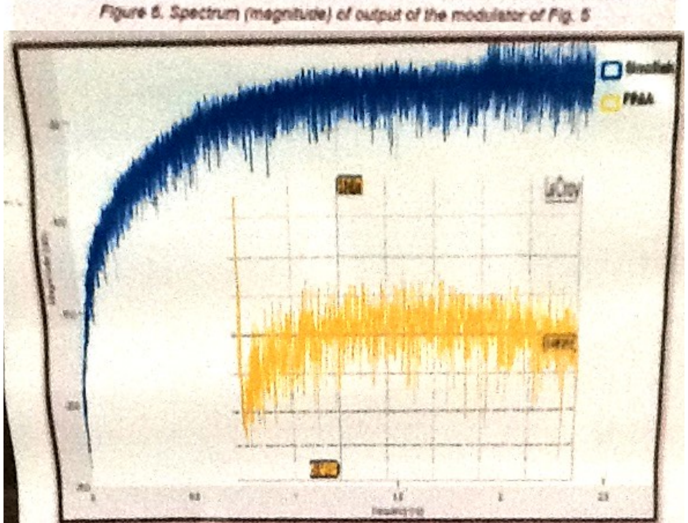

Figure 7. Second order modulator ΣΔ output

5. Conclusion

It is possible to build behavioral models from electronic circuits in SIMULINK. Such is the case of ΣΔ modulators. Once the system has been simulated and the results are satisfactory, we proceeded to transfer it to a FPAA circuit. For this purpose, we used the Anadigm AN231E04 solution. Experimental results match simulation results which confirms the effectiveness of the proposed methodology for achieving an electronic circuit from mathematical models built in software.

Acknowledgements

Yazmin Gaytán Luis thanks to CONACYT-Mexico for the funds through the scholarship 701955.

References

[1] J. M. de la Rosa, and, R. del Rio, Cmos sigma-delta converters, John Wiley & Sons, 2013, pp. 1-5.
[2] R. C. Neves and A. Girardi, "Fast prototyping of ΣΔ modulators using reconfigurable analog arrays", 2011

2016