World Academy of Science, Engineering and Technology
International Journal of Computer and Systems Engineering
Vol:17, No:09, 2023

Embedded System of Signal Processing on FPGA: Underwater Application Architecture

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Abstract : The purpose of this paper is to study the phenomenon of acoustic scattering by using a new method. The signal processing (Fast Fourier Transform FFT Inverse Fast Fourier Transform iFFT and BESSEL functions) is widely applied to obtain information with high precision accuracy. Signal processing has a wider implementation in general-purpose pro-cessors. Our interest was focused on the use of FPGAs (Field-Programmable Gate Ar-rays) in order to minimize the computational complexity in single processor architecture, then be accelerated on FPGA and meet real-time and energy efficiency requirements. Gen-eral-purpose processors are not efficient for signal processing. We implemented the acous-tic backscattered signal processing model on the Altera DE-SOC board and compared it to Odroid xu4. By comparison, the computing latency of Odroid xu4 and FPGA is 60 sec-onds and 3 seconds, respectively. The detailed SoC FPGA-based system has shown that acoustic spectra are performed up to 20 times faster than the Odroid xu4 implementation. FPGA-based system of processing algorithms is realized with an absolute error of about 10^{-3}. This study underlines the increasing importance of embedded systems in underwater acoustics, especially in non-destructive testing. It is possible to obtain information related to the detection and characterization of submerged cells. So we have achieved good exper-imental results in real-time and energy efficiency.

Keywords : DE1 FPGA, acoustic scattering, form function, signal processing, non-destructive testing
Conference Title : ICED 2023 : International Conference on Embedded Devices
Conference Location : Toronto, Canada
Conference Dates : September 18-19, 2023

Open Science Index, Computer and Systems Engineering Vol:17, No:09, 2023 publications.waset.org/abstracts/162313.pdf