

FINAL REPORT

PROTOCOL BETWEEN APIET AND FCT

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Scientific Area: plasma diagnostics, electrical engineering,
Grant (internship) Period: 05/09/2022 to 02/12/2022
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Introduction

The Instituto superior Tecnico (IST) is a public school of engineering and part of University of Lisbon. The IST a prestigious and important university in Europe not only for training students, but also for research. I had the chance to work in the department Insituto de Plasmas e Fusao Nuclear (IPFN), which is one of the largest Portuguese research units in Physics. During my internship worked very closely with Bernardo Brotas Carvalho, a physics educator and researcher as well as João Antonio Silva Oliveira, which is a PhD. student currently working on his PhD. thesis.

Work Description

My Work at the IPFN was to support João Antonio Silva Oliveira with FPGA firmware. The goal of João's thesis is to create a multi channel analog interface for the ATCA control/acquisition board for the COMPASS upgrade Tokamak. To do so 48 ADC converters are being red in by an FPGA, which then can process the data and send it to a main controller board. Due to my electronic engineering background, I already had my hands on FPGAs. Nevertheless, on account of the new Brand and type of

FPGA (kv260) I had to work myself into the new environment and get used to the new software. The FPGA kit kv260, which is used for the project includes a powerful hard processor. Ubuntu, which is a Linux operating system was installed on the kv260. Ubuntu allows PYNQ to be installed, which is a python programming interface based on Jupyter. PYNQ allows to easily develop and test FPGA programs and firmware. During my internship I programmed, implemented and commissioned modules and IPs like DMA interface for the Hard processor, two versions of a special 18bit LVDS SPI Master and slave to send and receive data, AXI interfaces to transmit data from the SPI Master to the DMA or to store data in a FIFO. Several methods were tested to send and receive data from the FPGA to a controller computer. One way of exchanging data is by using a server and client which were programmed in python and run on the kv260 as well as on a computer in the same network. It was also tested how the transfer rate of different DMA types differ and whether the transfer size has an impact on the transfer speed. Several other tasks were concluded during my internship.

Conclusions

I had the chance to learn a lot in this Internship at the IPFN. Due to the close work with Bernardo Carvalho, I learned a lot regarding FPGA programming and debugging. Bernardo is an excellent FPGA developer which has a lot of experience and knowledge. I learned how to efficiently write Verilog code and how to simulate the written modules to check for errors or faulty behaviour. I also learned how to commission the already existing IP and how to correctly wire and program them. Furthermore, I learned how to change and adapt Verilog code according to different kind of Hardware and how to adapt for example an SPI interface for an 18 Bit

transfer. Since it was the first time for me to work with Linux and GitHub I also learned a lot about the Linux OS and how to backup and work with GitHub. I learned and tested the efficiency of different ways to transmit data from the FPGA to the main Computer. I tested and wrote a server and client in Python to send, filter and receive data from the FPGA.

The internship was an enrichment not only workwise but also interpersonal. I met very skilled but also warm people, with which I had the chance to do activities like biking, kite surfing as well as outdoor climbing which all have been wonderful experiences and made this internship an unforgettable experience.