Lehrstuhl Steuerung, Regelung und Systemdynamik

Master Thesis
Experimental, Programming

Synchronization of FPGA measurement boards for localization of Acoustic Emission sources

Keywords: Acoustic Emission, damage localization

Conditions:

Duration: 6 months
Requirements: Strong knowledge and programming skills in HDL and C++
Language: English/German
Target group: Master students (EE, CS, Automation)

Contents:

In context of Structural Health Monitoring, Acousic Emission (AE) is used as an nondestructive testing method. In case of mechanical damages in CFRP energy is released in form of elastic waves. These waves are called Lamb waves and can be measured by piezoelectric transducers. The transducer signal is digitalized by a field programmable gate arry (FPGA) board. The FPGA board has a sampling rate of 5 MHz and is able to process the data in real time.

The existing SRS system is described here: https://www.mdpi.com/1424-8220/18/6/1775
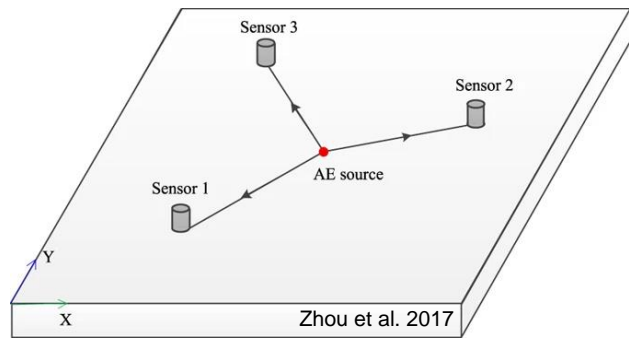
To localize the AE source several sensors must be used. Based on the time of arrival of the measured waves the signal source can be calculated. In a sensor network each sensor is connected to a single FPGA board. To be able to compare the time of arrival at each sensor, a highly precise time synchronization of the FPGA boards must be established. For testing simple experiments must be designed to validate the synchronization results. After the synchronization was successful established, first experiments have to be conducted to localize signal sources.
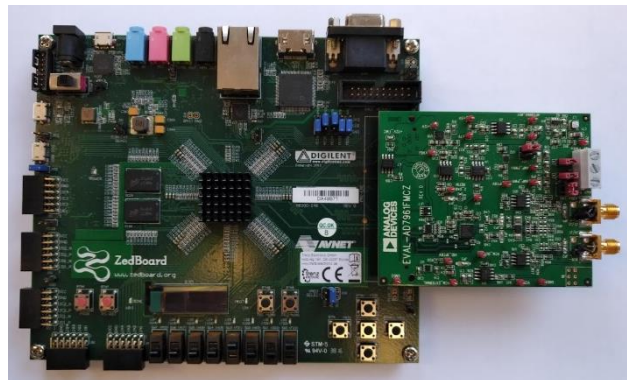
The goals of this work are:
- Analysis of the existing solution approaches
- Time synchronization of four FPGA boards
- Design of experiments to verify the synchronization
- First experiments to localize Acoustic Emission sources
- Complete and detailed documentation/presentation of the research results

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