Practical use of FPGA Chips for Implementation of Linear Motor Control System

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I. Abstract

This paper describes design and implementation of control system for a Linear Motor EZ Limo EZC6E030M–C and its control unit ESMC–C2. These parts were supplied with control application, that was insufficient for research team of Laboratory of Biomechanics, Department of Mechanics, Biomechanics and Mechatronics, Faculty of Mechanical Engineering, CTU in Prague.

The Linear Motor should be used for measuring mechanical parameters of various samples or should be used as a universal pulsator for simulating flow inside blood–vessels or heart beating.

The new control system has been designed and developed to satisfy all requirements of research team of Laboratory of Biomechanics. These requirements include execution of complex trajectories with high dynamic range of speed and distance, cooperation with other equipment in Laboratory (synchronization), make the system fail-safe and reliable.

This functionality is required for precise measuring of mechanical parameters of biological and synthetic samples. Control system implementation benefits from advantages of FPGA chips for reaching precise timing, deterministic behaviour and high reliability at high speed.

Control system is implemented as a systolic algorithm (Fig.1), where all parts are interconnected by queves. Main module is realized by complex FSM, that can handle 27 different instructions for performing complex movements and setting configuration for system. System can recognize and handle 22 events with 8 priority levels. Every unexpected state result in system stop to prevent destruction of system or measured samples.

The control system has been split into software part (control/manipulation application) and hardware part (new advanced control unit implemented on Xilinx's FPGA). The control system and all its parts were exhaustly tested under full operational conditions. The control system actually does not meet EMC directives. New printed circuit board is currently under development to meet the EMC directives.

The whole control system is part of larger project NT13302 (The Optimalization of Physical Characteristics of Vascular Substitutes for Low Flow).

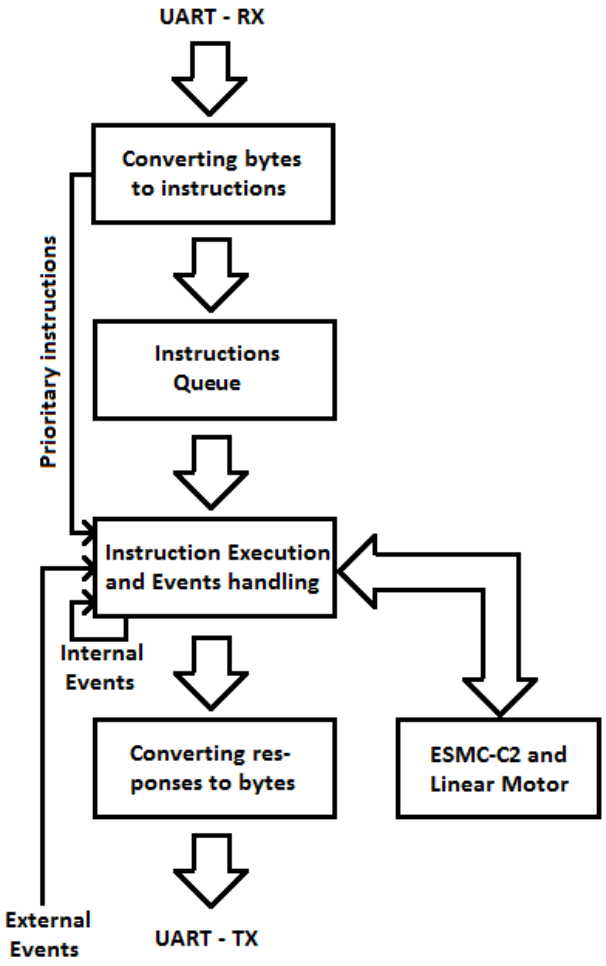

Fig. 1. Control System Architecture — Block Diagram