Linnéuniversitetet
Linnaeus University

Degree Project Proposal
Department of Computer Science

Thesis Topic

Robotic additive manufacturing — communication interfaces and real-time applications

Degree level

Bachelor or Master

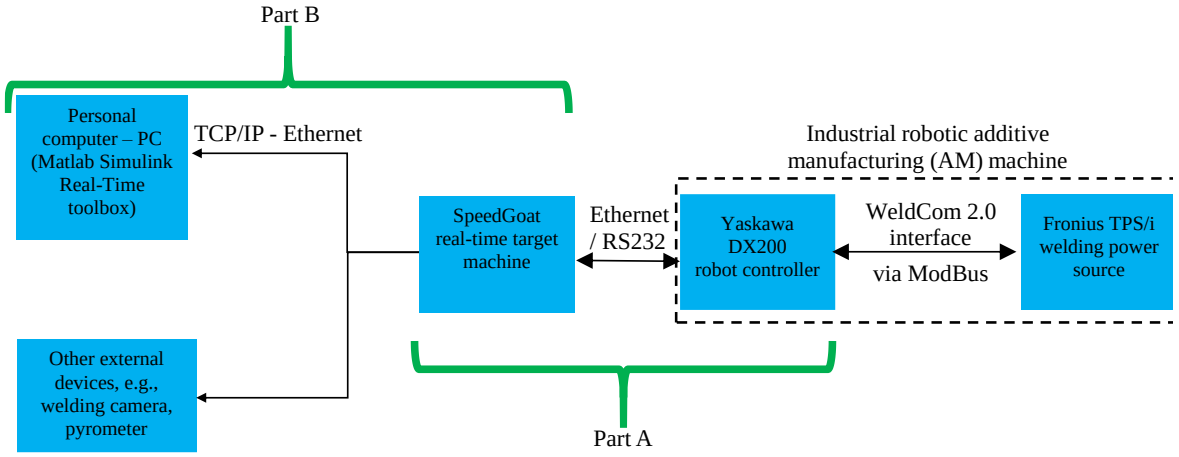
Company

Mechanical Engineering Robotics Lab at LNU

Description

Synopsis: Robotic additive manufacturing (AM) is an advanced manufacturing technology based on robotics and traditional methods such as arc welding with metal wire. Within the industrial internet of things (IIoT) architecture, digital twins are used to simulate manufacturing processes. A digital twin captures the physical process' states and is considered a digital copy/replica of the process. For the development of an AM digital twin, data from the process (e.g., arc voltage, arc current, wire feed speed) and the robot manipulator (e.g., position, orientation, speed, acceleration) are needed. At present, these data are measured by various sensors in an industrial AM machine. In this project, communication interfaces and real-time applications are created to extract relevant process and robot data from an industrial AM machine.

The project's goal is to receive and send both robot parameters and process parameters between a personal computer, PC, and the robot control system in real-time. These parameters are then logged and saved on the PC.



Part A - Communication interface
The first communication interface is between a SpeedGoat real-time target computer and a Yaskawa robot controller. SDKs (Software Development Kit), based on DLLs (Dynamic Link Library), are provided by the robot manufacturer. These SDKs enable functionality for access to the robot system through, e.g., Ethernet server protocol (HSES - High-Speed Ethernet Server) or RS232 interface.

Part B - Real-time application
With Matlab's Simulink Real-Time toolbox, real-time applications are built from Simulink models. These Simulink models are then deployed on the SpeedGoat real-time target computer, which in turn is connected to the physical system (i.e., the industrial AM machine). The created Simulink models should send and receive I/O signals between the PC and the real-time target machine, as well as registration (logging) of these signals.

Objectives

The project includes

- Designing and building of a communication interface between a real-time target machine and a robot control system.
- The communication interface should include functionality to map robot parameters (e.g., position, speed, orientation, acceleration) and process parameters (e.g., wire feed rate, arc voltage, arc current) to relevant signals.
- Creating Simulink models for 1) sending and receiving I/O signals between a PC & the real-time target machine, and 2) registration (logging) of these signals.
- Deployment of Simulink models on the target machine for running real-time simulations.
- Documentation of the created communication interfaces - how they are structured, which communication protocols are used, and how they relate to industrial hardware (client/server, master/slave). The documentation must also include visual diagrams showing I/O connections and I/O mapping.
- Execution of the AM test runs to verify whether the created communication interfaces function correctly with the hardware (robotic AM machine).
- Carrying out simple network performance tests (e.g., network speed, delays).
- Documentation of above-mentioned tests.

Requirements

Skills in: C/C++ programming, Matlab Simulink, communication protocols, dynamic link libraries - DLL

Contact persons

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