Possibilities of the common research-development action in the field of automated logistical engines

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Možnosti spoločného výskumu v oblasti automatizácie a logistiky motorov

The paper briefly presents the R&D cooperation of the Department of Materials Handling and Logistics and Departments of Automation. The main fields of cooperation are introduced. Different kind of Linear Motor (hereafter LM) drives are being developed and tested for warehouse and rolling conveyor systems. Modern control strategies using AI methods are being investigated and tested for Automated guide vehicle. Wireless communication methods are being searched and developed for mobile material handling devices. Application possibilities of voice recognition and image processing are being tested for control of material handling robots and devices. Application of process visualization programs are being developed and investigated. Multi-level industrial communication system is being developed for the laboratories of the cooperating departments.

Key words: *intelligent control strategies, wireless communication, distance control via internet.*

Introduction

The results of fast developments in microelectronics, microprocessor and signal processor techniques, image and voice processing, wired and wireless telecommunications, modern control theories are more and more used in the industry. At the Department of Materials Handling and Logistics the automated logistical laboratory has more than 15 years history. The laboratory is used both for education and Research activities. Typical automated logistic system's tasks and problem solutions can be demonstrated. The devices give excellent background for education and also for R&D activities. Currently high warehouse, warehouse server equipment, automated guide vehicle, rolling conveyor system, robots and the related control systems are operated in the Logistic laboratory. The different devices are controlled by PLC systems, those are connected to their supervisor IBM PCs. The PCs are all connected to the Ethernet LAN, as it can be seen in Fig.1.

Applications of AI methods in industrial control systems, Digital Signal Processors and microcontrollers, industrial communication syst–ems, image and voice processing are the main R&D fields of the Department of Automation. The Process control, Digital system, Image and Voice processing and Process visulization laboratories of the Department provide the devices for these R&D activities. The results of these fields can be used in the automated logistical processes as well. In order to increase the efficiency of the research activities of the departments decision has been made about R&D cooperation between the Department of Materials Handling and Logistics and the Department of Automation. The cooperation possibilities and fields are introduced in the following paragraphs.

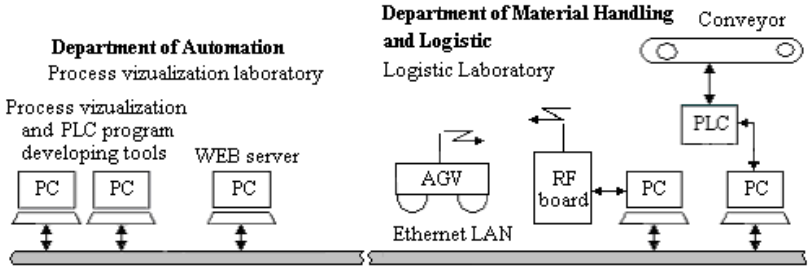

Fig.1. LAN connection between the laboratories.

Design of direct electrical drives (Linear Motors) for warehouse and rolling conveyor systems

Currently the high warehouse has a server equipment with induction motor electrical drives. The three-dimensional movement is carried out by separated induction motor drives. The possibilities of replacing the conventional rotational induction motor drives and the transmission systems with LM is under consideration.

The other possible application fields of LMs are conveyor drives. Conveyors are also driven by induction motors. The rotational movement is translated into linear movement by chain-transmission systems. Different type of LMs with different geometry and dimension could be used also for conveyors. Different types of LM (Synchronous, asynchronous, synchronous reluc–tance, single side induction motors) has been developed and tested at the Department of Electrical and Electronic Engineering. A cylin–drical LM cross-section is shown in

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(Recenzovaná a revidovaná verzia dodaná 19.11.2003)

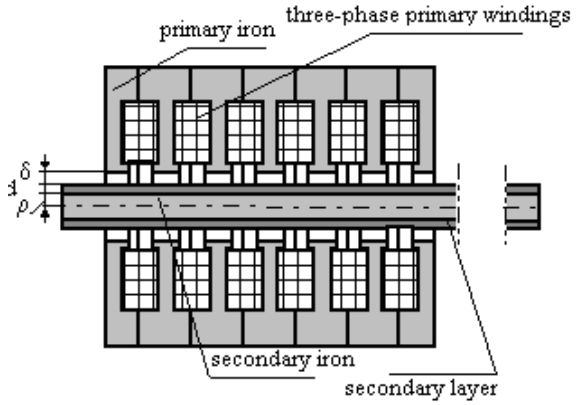

Fig.2. Experimental Cylindrical Linear Induction Motor.

Fig. 2. The primary moving part is connected to the palette, and the secondary part is fixed to the conveyor frame. Application of LM drives could result simplest, more robust and more reliable solutions. DSP based digital position controller has been developed for the LM too.

An experimental controller has been deve–loped for the LM. The inputs of the controllers are the ω_{ref} speed and thee I_{mref} magnetic field current. The output voltages of the current regulator give the reference signals of the three-phase space vector PWM inverter. The controller is realized by a high performance PC board that has been developed specially for experimental realization of digital controllers. The LM is fed by three-phase intelligent IGBT inverter. The development system is supported by Matlab program.

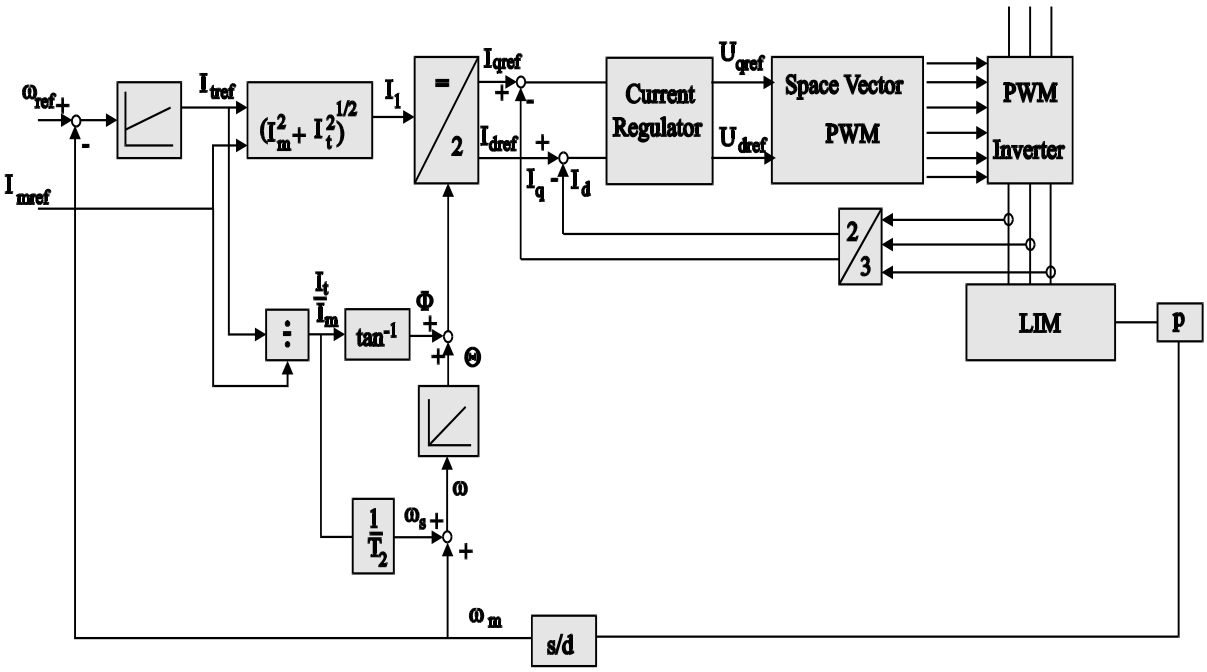

Fig.3. Vector control of LM.

At present both the warehouse system and the conveyors are controlled by PLCs that are connected to the LAN by PCs as it is shown in Fig.1. The PLC program developing systems run on the PCs. The laboratories of the cooperating departments are connected by the universities LAN, as it can also be seen in Fig. 1.

Intelligent controller for automated guide vehicles (AGV)

The AGV has two independent DC motor servo drives for the controlled front wheels. For the moment the servo drive is presently controlled by PLC that is connected to the on-board computer. The on-board computer communicates wireless with the laboratory's industrial communication system by RF interface card. The vehicle is able to track wire sticked on the floor and fed by high frequency signal. Additionally, it is able to recognize different target position signals. The main goals of the development works concerning the AGV are:

- develop test and compare different wireless communication methods (infrared or laser), test the reliability of the strategies in disturbed environment,
- develop different kind of tracking methods (CCD camera, ultrasound),
- develop adaptive , intelligent control strategies, using fuzzy, neuro-fuzzy controllers, in order to increase the efficiency and the reliability of the logistic system,
- develop control strategies for cooperation among mobile and stable materials handling devices.

The modern control strategies, such as neuro, fuzzy-neuro controllers will be realized by high performance DSP based controller board.

Connection between the Automated Logistic Laboratory and the laboratories of the Department of Automation using LAN

The distance between the Automated Logistic Laboratory and the Laboratories of the Department of Automation is about 500m. The connection is realized by the University LAN. The Process Control Laboratory, the PLC Laboratory and the Process Visualization Laboratory of the Department of Automation and the Automated Logistic Laboratory will be involved to the connection. The main goal of the connection of the laboratories is to demonstrate a hierarchical industrial communication system. Different kind of control tasks will be tested on the system. The problems and possibilities of distance control can be presented and tested. The process visualization systems can also be shown. Different kind of distance interventions are possible, depending on the access rights. The devices of the laboratories can be also accessed via internet.

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