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AUTOMATION

Wireless Comunication Method for Morningstar Tristar MPPT Off Grid Solar Controller

Bancoş Marius,
Department of Automation
Tehnical University of Cluj-Napoca
Cluj-Napoca, Romania
mail: mariusb57@gmail.com

Abstract - **This paper proposes the implementation of a simple method for reading the parameters of a domestic photovoltaic power plant production, built around a solar charging controller Morningstar Tristar MPPT (Maximum Power Point Tracking), MT MPPT . The described solution allows reading of all operating parameters of the domestic photovoltaic plant production, in real time, to store it and display the parameters that can be used, processed and displayed to a home automation application, in order to supervise the photovoltaic installation and reduce electricity consumption. The solution consists of a hardware device that connects the solar charging controller MT MPPT to a wireless communication network, standard 802.11, and a software component required to access MT MPPT using a Python script.**

Keywords : Morningstar Tristar MPPT; modbus TCP ; ESP 8266; NodeMCU; Homeseer .

I. INTRODUCTION

Morningstar's MT MPPT solar controller with TrakStar Technology is an advanced maximum power point tracking (MPPT) battery charger for off-grid photovoltaic (PV) systems up to 3kW (Fig. 1). The controller provides the industry's highest peak efficiency of 99% and significantly less power loss compared to other MPPT controllers. The MT MPPT features a smart tracking algorithm that maximizes the energy harvest from the PV by rapidly finding the solar array peak power point with extremely fast sweeping of the entire I-V curve.

Figure 1. Morningstar MT MPPT controller

The MT MPPT provides several communication options. The MT MPPT uses a proprietary protocol for the MeterBus network and the non-proprietary open standard MODBUS RTU and MODBUS TCP protocols for RS-232, EIA-485, and ethernet networks. Additionally, HTTP, SMTP, and SNMP are supported for web page, email, and network message support. Morningstar's MSView PC software provides system monitoring and logging capabilities via RS-232, EIA-485, and ethernet. MSView PC software is available for free.

Morningstar's proprietary MeterBus protocol allows communication between compatible Morningstar products. The MT MPPT communicates over an EIA-485 network and through the serial port via the open standard MODBUS protocol. Connect the MT MPPT to the serial port on a PC to:

• program custom charge settings with MSView PC software
• view real-time data with MSView PC software
• log real-time data with MSView PC software
• configure ethernet settings
• update controller firmware with MSLoad firmware utility.

The Ethernet port supports HTTP, MODBUS TCP, SMTP, and SNMP protocols to provide a fully web-enabled interface between the MT MPPT and a LAN/WAN network or the internet. The ethernet port is available just for TS MPPT-60 model [1].

To read parameters of electricity production plant, built around such a device, is necessary a physical connection to it, with a cable connected through one of the ports described above. All data is read using MSView, software running on a PC with Windows.

There are situations in which data connections cable between PC that running monitoring software and the device TS MPPT, cannot be achieved for various reasons, or exceed the maximum length, requiring regeneration devices. For processing data they provide TS MPPT device, with an application for home automation. Those data need to be delivered in a particular format, which MSView application is not able to deliver it at a time. There are also situations where the user has an available PC with Linux or Mac OS operating system, or has only devices without ethernet port without being able to benefit from the support HTTP, SMTP or SNMP. Models TS-30 and TS MPPT-45 MPPT are not equipped with Ethernet port.

To avoid the above situations, is necessary a very simple wireless communication device, able to communicate via open protocol MODBUS TCP, with the serial port of the solar controller. The software component that queries the device is a Python script that uses the Pymodbus library.

II. MODBUS PROTOCOL

Prototype And Operation Of A Gait Analysis Device

A. T. Popescu, L. Miclea
Department of Automation, Faculty of Automation and Computer Science
Technical University of Cluj-Napoca
Cluj-Napoca, Romania
Alexandru.POPESCU@aut.utcluj.ro

***Abstract*—The paper presents the progress in designing a prototype of a gait analysis device that has the function of collecting inertial and geometric data of the right leg during human subject locomotion and calculating the dynamic force vectors applied to the knee joint due to body mass for use in finite element method analysis.**

***Keywords*—gait analysis; dynamic force; inertial measurement unit; rotational transducer; Arduino; 3D printing;**

I. INTRODUCTION

The article presents the principle of operation of a gait analysis device and the progress made with the constructed prototype [1]. The final purpose of this device is to analyze inertial data and provide the information necessary to calculate the force vector of maximum stress applied to the knee joint during a locomotion situation.

Gait analysis is a study of human locomotion that measures body movements and uses human body mechanics to assess the way an individual moves. This can give hints to the quality of life and can provide information of the evolution of diseases like Parkinson's [2], systemic diseases that affect movement, cases with sequalae from stokes or diseases caused by age, thus helping treatment and rehabilitation [3]. For data gathering, non-subjective methods of gait analysis exist [4], these are based on:

- Image processing

  Stereoscopic vision, time-of-flight systems, structured light and infrared thermography

- Floor sensors

- Wearable sensors

  Pressure and force sensors, inertial sensors, goniometers, ultrasonic sensors and electromyography

The prototype device uses inertial sensors and goniometers, further referred to as Inertial Measurement Units (IMU's) and rotational transducers, to collect data which is to be used for researching the effects and causes of knee joint degradation by performing Finite Element Method (FEM) analysis on 3-dimensional bone models [5-7]. The same dataset can be useful in designing more efficient prosthesis [8,9] and possibly help generate patient specific 3D printed (additive manufactured) implants that better fit individual geometry and locomotion particularities.

From a mechanical engineering view, FEM analysis is a method of strain approximation for a mathematical model by discretizing it into many subdomains named finite elements. In the case of the knee joint, FEM is needed because of the geometrical irregularity of the bones that form the joint. After concluding the force derivation part of the research and assessing the most important cases to be studied, this method will be used to provide detailed information on the bone parts which are more prone to failure and/or degradation.

In the future, using FEM with very high resolution models created by micro-architectural bone imaging and powerful computing algorithms will provide datasets on an unprecedented detail [10].

In this research, we try to compute the vector of the maximum dynamic force exerted on the knee joint. This vector can have greater magnitude than one derived from static forces, thus greater impact on degradation. Another important fact is that while the orientation of a static force vector is parallel to the gravity vector, giving a simple scenario, dynamic forces can give vectors with orientation that varies based on locomotion case. This combined with greater magnitude, can strain sensible areas of the bones.

The gait analysis device was designed to be attached to the right leg of a patient and trough collected inertial data from above and below the knee, it must be able to sense differential acceleration between the tibia and femur. With this and by estimating corresponding masses, a force can be calculated and then introduced in the FEM analysis as pressure on the contacting surfaces of the 3-dimensional bone models.

II. CONSTRUCTION

The prototype was designed using Autodesk Inventor and constructed using a mix of conventional machining, 3D printing and electronics design.

SCADA System Architectures Based on SIMATIC WinCC in Wastewater Treatment Plants

R. Butuza, I. Nascu, O. Giurgioiu, N. Beu
Department of Automation
Technical University of Cluj-Napoca
G. Barițiu 26-28, 400027, Cluj-Napoca, Romania
alexbutuza@gmail.com, ioan.nascu@aut.utcluj.ro, octavian.giurgioiu@gmail.com, dachinicu@gmail.com

Abstract – **The efficient administration and treatment of municipal and industrial wastewater is important to ensure community health, but also for having a clean and safe environment. Applying standard SCADA solutions has a positive impact on the operations, maintenance, process development and savings for the wastewater treatment plants (WWTP). This paper describes a SCADA software application implemented on Alba Iulia wastewater treatment plant relating to the system architecture, the interface to the process hardware, the functionality and capabilities to create a comprehensive real-time applications management environment for a modern wastewater operation.**

Keywords — SCADA (Supervisory Control and Data Acquisition), PLC (Programmable Logic Controller), HMI (Human Machine Interface), System architecture, Single station, Redundant station, Server, Client.

I. INTRODUCTION

SCADA (Supervisory Control and Data Acquisition) is a software system, for control, operating and data acquisition, usually used for industrial automated systems, which allows process control and operation and also process parameters and alarms logging. In most cases, SCADA is linked with a programmable logic controller (PLC), using a communication channel and different protocol types such as: PROFIBUS, PROFINET, MPI, ETHERNET, MODBUS, etc. System architectures based on SCADA systems can be realized from a single station and one process controller to multi-stations architecture consisting of redundant SCADA servers and / or controllers and a multitude of regular or web clients.

High availability systems are required for wastewater treatment plants controlling, in order to handle the multitude of chemical and biological processes belonging to this area [1][2]. For this reason, the developers of SCADA systems in wastewater treatment plants, started to improve the efficiency of automation systems by creating different types of architectures [3], starting from small application with a single controller, usually a PLC, and one single station to complex applications with more than one controller, each of them having different numbers of decentralized peripheries, each periphery used for controlling a well-defined part of the system and more than one SCADA servers.

Each country has its own rules for the effluent quality coming out from a wastewater treatment plant that is way the complex SCADA system used in this area must have an integrated component, for archiving and reporting the parameters of the effluent and by this the efficiency of the wastewater process.

In this context, Siemens SCADA system, called WinCC, was developed with an optional package, called User Archive, which is handling the problems regarding the archiving.

Another important optional package for SCADA WinCC systems is Web Navigator. This package allows monitoring and control the plant from a remote computer, even using a personal computer placed at thousands of kilometers away from the site [4]. The SCADA client that accesses the server using this package uses the INTERNET network for connecting to SCADA server / servers.

WinCC Server package makes a single user system a powerful client / server system. It allows multiple coordinated operator stations to be operated together with networked automation systems. [5]

WinCC Redundancy package is used for increasing the availability of SCADA system. On the failure of one of the servers, the second server assumes control of the entire system. When the failed server resumes operation, the contents of all message and process values archives are copied back to the restored server. [6]

The paper is organized as follows. The second section deals with theoretical considerations regarding the system used in this paper: WinCC configuration, client server configuration, single station configuration, redundancy, user archives.
The developed SCADA system for a wastewater treatment plant is described in section 3. Finally in section 4 the conclusions are drawn.

II. SIMATIC WINCC SYSTEM ARCHITECTURES

Basically, Simatic WinCC configuration tool allows two types of system architectures: single user project or single station and multi user project, which is a distributed system, based on client – server architecture.

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About Security in Cyber-Physical Systems

Laura Vegh
Faculty of Automation and Computer Science
Technical University of Cluj-Napoca
Romania
Email: Laura.Vegh@aut.utcluj.ro

Liviu Miclea
Faculty of Automation and Computer Science
Technical University of Cluj-Napoca
Romania
Email: Liviu.Miclea@aut.utcluj.ro

***Abstract*—Security is a major issue when living in a world that relies on technology in so many aspects of everyday life. Cyber-physical systems are complex systems that bring together both physical and cyber components. Their unique traits and the critical nature of applications in which they are used increase their need for a solid, complex security architecture. In the present paper, the authors research some of the most interesting works in the area of cyber-physical systems. Also, they present a short summary of the main security methods used at the moment, in order to find the most suitable ones for cyber-physical systems.**

Keywords - cyber-physical systems, security, cryptography, steganography, access control, hierarchy

I. INTRODUCTION

We live in a world where technology is present in almost every aspect of our lives. With the fast advances made everyday and our reliance on technology, it is obvious we need powerful security architectures. An area in continuous research, security will always be needed. Technologies may come and go, but regardless of the type of systems we have, we will always need to ensure that they are secure, the data transmitted and the identity of those involved in the communication are safe. Cyber-physical systems are a new paradigm gaining more and more attention from researchers. They are designed as a network of interconnected devices with physical input and output. CPS bring an addition to the traditional real-time systems - their cyber and physical components are integrated for learning and adaptation, self-organization and performance [1] [2]. We will discuss details about cyber-physical systems, including their security in section 2.

The main goals of security are prevention, detection and recovery. Through prevention it is intended to prevent attackers from violating security policy. Detection means detecting attacker's violation of security policy while recovery means stopping an attack, asses and repair damages in such a way that the system can still be functional even if the attack succeeded. In information security the main focus is on ensuring confidentiality, integrity and availability of information. Just as important are properties such as accountability, non-repudiation, authenticity and reliability.

At the moment, there are many types of security available, each suitable for certain needs - if we want to communicate secret code we have cryptography, if we want to hide data we can chose steganography. Integrity and authentication can be ensured by the use of either cryptography or digital signatures. There is no best method, we just have to chose the one that will be suitable for the system we want to secure. Figure 1 presented the most important data protection methods when it comes to ensuring a system's security.

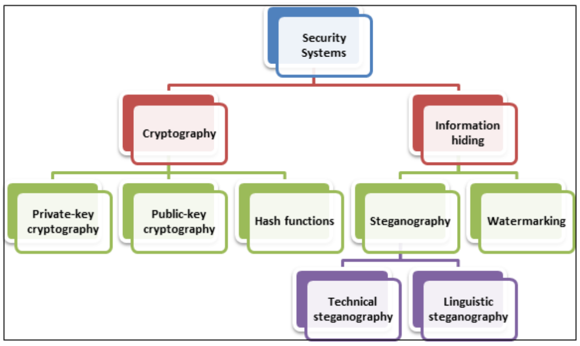


Fig. 1: Data protection methods

In the present paper our focus will be on cryptography and steganography which we will discuss in detail in sections 3 and 4 respectively. In section 5 we will discuss access control and ensuring the integrity of a system while section 6 will be dedicated to the conclusions.

II. CYBER-PHYSICAL SYSTEMS SECURITY

A. Overview

During recent years, the security of cyber-physical systems has become a real concert. This is due to the fact that they are used in many critical applications such as control of transportation, healthcare, power and energy systems and so on. Literature offers some solutions, but the research is ongoing. In complex systems such as CPS security is not an easy tasks as systems are interconnected. The aim is to find an architecture that will allow one to specify and prioritize the security requirements of a system after a thorough analysis. CPS such as SCADA systems have several layers and securing each layer as well as the communication between them is crucial.

CPS have a series of feature that make them unique, complex systems. As such, they are integrations of physical and computational processes. Also, they are distributed systems with scales and devices highly varied. Moreover, the software is embedded in each component, an aspect that often times becomes a disadvantage as the resources such as bandwidth are limited. An important property of CPS is that they can dynamically reconfigure and reorganize.

Due to the many advantages of cyber-physical systems - efficiency, individual entities are allowed to work together and so on - they are used in wide variety of application domains. As such, we can find them in critical infrastructures such as aviation and defense where security is a critical issue. They can also be found in energy control systems, water resources management, transportation, all critical applications

Discrete Event Controller Synthesis for Cyber-Physical Systems with Evolutive Algorithms

Attila O. Kilyen
Dept. of Automation
Technical University of Cluj-Napoca
Romania
Email: kilyen.attila.ors@gmail.com

Maria M. Santa
Dept. of Automation
Technical University of Cluj-Napoca
Romania
Email: Maria.Santa@aut.utcluj.ro

Tiberiu S. Letia
Dept. of Automation
Technical University of Cluj-Napoca
Romania
Email: Tiberiu.Letia@aut.utcluj.ro

***Abstract*—To control cyber-physical systems the used software has to answer to internal and external asynchronous discrete event and also to has to control continuously changing variables. The current paper presents a method based on evolutive algorithms to synthesize the event component of such hybrid control system. Time Petri Nets (TPNs) are used to model the discrete control components. The TPNs can model the component concurrent structures and their implementation behaviours too. These models can be described by an Enhanced Time Petri Nets based language(ETPNL). The component descriptions are transformed into Lisp expressions that allow the use of genetic programming to guide the component software evolution according to some performance criteria. To exemplify the method the application of synthesis of a discrete event controller for a self-shifting transmission vehicle is exemplified. The controller receives events from the driver and also from the motor of the vehicle, and it has to control the transmission and has to select which continuous controller apply.**

I. Introduction

Nowadays hardware for complex robotic systems becomes cheaper and cheaper, smart homes and self driving machines are becoming every day reality rather than dreams of the futures. The Internet of Things (IoT) is in the focus of researchers and software developers. These bio-metric sensors built in jewelries, everyday electronics like refrigerators and washing machines, lighting and heating of a houses will communicate with each other and form complete grid of smart electronics around a person or a family. Terabytes of data will be recorded en every second, other system will decided to turn on the air conditioner or not, however there is a single problem: who will write all of the swear necessary for these things? How can we write software so flexible and also optimal? How can machines learn what to communicate with each other? And based on terabytes of information which are the correct decisions? One possible answer is evolutionary computing. These techniques are capable to yield programs to solve a specific problem without human interaction. If a framework exist the entire control algorithm of a factory can be regenerated and reprogrammed on daily bases, according to the needs of owners and the available resources. If a framework exist an optimal algorithm of heat control can be generated for every family based on sensors they have, and based on their past habits. From our point of view these evolutionary algorithms like Genetic Programming can provide a flexibility and robustness needed for the visioned future.

This article aims to provide bases for further research on the filed of automatically producing controllers which can respond not only to event but also to continuous signals as well. In this article a complete method is described of producing Discrete Event Controllers (DTC) using evolutionary algorithms.

II. Related Works

A. Software program synthesis

Automatic program synthesis is defined as automatic executable code generation and this is usually associated with some program verification techniques. The approaches differ from the information used to proceed the synthesis as well as the desired program description, or by the used methods and algorithms.

The automatic program synthesis or construction can be generally approached or domain specifically approached. The current research refers to the control domain approach.

In an early paper, reference [1] proposes that the input data for the synthesis process should be assumed to be a complete listing of the program to be synthesized. Agents performing program synthesis will be called inductive inference machines. The synthesizers should use an explicit description of the behavior of desired programs as the input and not some more abstract problem description.

Ref. [2] describes the principal approaches to program synthesis based on deductive technique. Their goal is to mechanically synthesize correct and efficient computer code from declarative specifications.

Ref. [3] defines the generative programming that has the goal to model software system families, to build software modules with the aim to obtain on demand highly customized and optimized intermediate or end products using particular requirements (specifications).

Ref. [4] proposes cross-cutting features as logical invariants to use generative techniques for producing a kind of code that is usually manually written in Aspect-Oriented Programming.

Ref. [5] proposes a template base technique for program transformation with the goal to improve the program performances.

Ref. [6] approaches the automatic synthesis of loop-free programs using a combination of oracle-guided learning from examples, and constraint-based synthesis from components. Subsection text here.

B. DEC synthesis

Many methodologies have been conceived for the DES modelling mentioned in [7]. Later, the number of approaches in this field was increased significantly.

Automatic Synthesis of Control Components for Cyber-Physical Systems

Attila O. Kilyen
Dept. of Automation
Technical University of Cluj-Napoca
Romania
Email: kilyen.attila.ors@gmail.com

Maria M. Santa
Dept. of Automation
Technical University of Cluj-Napoca
Romania
Email: Maria.Santa@aut.utcluj.ro

Tiberiu S. Letia
Dept. of Automation
Technical University of Cluj-Napoca
Romania
Email: Tiberiu.Letia@aut.utcluj.ro

***Abstract*—Cyber-physical systems usually include some hardware components endowed with sensors and actuators that integrate software (control) components. These control components have to react to internal and external asynchronous discrete events as well as to change continuously some variables as a consequence of the changing of their environment. The general demands of such kind of hybrid control systems should be implemented by communicating concurrent tasks. The research related to the current paper had the goal to construct a method to automatically synthesize the software control components of the cyber-physical systems. Enhanced Time Petri Nets (ETPNs) are an extensions to regular Time Petri nets and are used to model not only the desecrate event part but also the continuous component of a hybrid control system. The evolutionary system is used to perform the component adaptations to their specific environments. To exemplify the application of the method the automatic synthesis of the control component of the longitudinal move of an independent vehicle is solved. The controller receives as inputs the driver demands (speed reference or deceleration reference), the engine state variables. The controller has to change the gears and to act on the fuel admission or brakes such that the car behaves optimally according to the provided (specified) performance functions.**

I. INTRODUCTION

The cyber-physical systems link different kinds of entities (software and hardware) together with human actors. They can be thought of as being composed of some hardware components endowed with sensors and actuators and including software (control) components that have to react and adapt to the changing environment. The cyber-physical applications are usually included in physical devices. Humans do not interact directly with all these devices but by using a cyber-physical layer that implements some complex control functions.

The control components have to react to internal and external asynchronous discrete events as well as to continuously change some variables. The general demands of such kind of hybrid control systems should be implemented by communicating concurrent tasks.

The research related to the current paper has the goal to construct a method to synthesize automatically the software control components of cyber-physical systems. The synthesizer has to receive as inputs the control components' interfaces, the controlled part models and the criteria for the structure and behavior evaluations. The evolutionary process used for searching the solutions needs to evaluate the improvements (i.e. the searching progress) instead of the fulfillment or non-fulfillment of the specified requirements .

The user of this method has the benefits to:

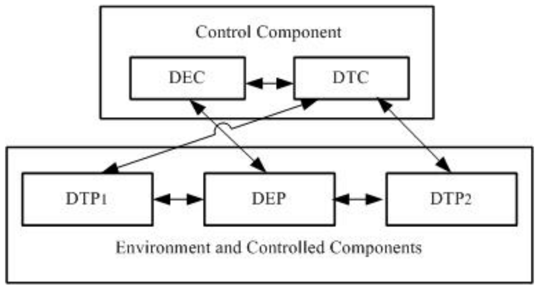


Fig. 1. A cyber-physical system structure

- diminish the designer effort for conceiving the control components of cyber-physical applications
- increase the performances of the cyber-physical applications compared to the human solutions due to the larger number of tests performed by the automatic synthesizer and
- guide the solution search using some proposed control traits for solving control problems by speeding up the cyber-physical program development.

A hybrid system is defined as a dynamical one with interacting continuous time and discrete event components. The hybrid systems have to be modelled using discrete event subsystems and continuous time subsystems. Their approach is difficult due to the necessity to integrate methods belonging to different theories. The continuous time systems are often modelled by discrete time models, that are more appropriate for computer implementation.

Figure 1 represents a system composed of Environment and Controlled Components that includes a Discrete Event Part (DEP) and two continuous time parts modelled by Discrete Time Part 1 (DTP_1) and Discrete Time Part 2 (DTP_2). The Control Component is composed of Discrete Event Controller (DEC) and Discrete Time Controllers (DTC). DEC and DTC receive information from the controlled parts and collaborate to fulfil the designer requirements.

The importance of these requirements has to emphasized, because the fulfilments of these can serve as the stopping condition for the proposed algorithm. Due to the nature of the heuristic methods used, one cannot prove the optimum of the result, only that result satisfies the user's request. The aim of the presented research is to find solution *good enough* using reasonable computing power and time, and not to find the best solution which could ever exists.

Generator-Converter Systems for Small Scale Low Cost Hydro and Wint Power Plant

S. Chetan, E. Dulf, C. Festila,
Department of Automation
Technical University of Cluj-Napoca
Cluj-Napoca, Romania
chetansergiu@yahoo.com

***Abstract*— The paper presents the opportunity of using small low cost hydro and wind generator systems taking into account the technology and resources needed to build and maintain such a system.**

Keywords-hydro-electricity; induction generator; wind power; claw pole synchronous generator; small scale water and wind turbines; power converter;

I. INTRODUCTION

The most cost effective way to generate electricity is with very large power plants because of the economics scale. This however is not always possible or even desirable. The distribution cost increases as well as the distribution losses in long power lines. For some remote locations it may be better or more economically useful a connection with the power grid. An alternative is the use of installations based on renewable energy sources, located were the resources are available. The complexity of these small scale systems depends on the nature of the energy supply and on the possibility of connection of this small scale equipment with the power grid.

The main renewable energy opportunities and applications are: hydro-electric power, wind power, solar power and geothermal power, with the mention that many other possibilities exist. The actual paper is focused only on the first two applications: the hydro-electric and wind power.

In any power station it is developed a conversion process of the primary energy in electricity. The primary power source-the prime mover- is the water or wind turbine. The final component of the small scale power plant is an electric generator with a proper power electronic converter.

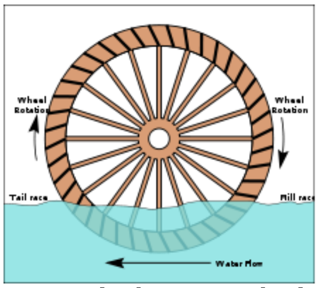
Following the idea of the low cost electric generation systems, the paper studies the most simple and reliable solution in domain.

The small scale power station may be operated in two modes: grid connected supply and stand alone (off the grid) systems. The paper develops only the version of the stand alone generating plant.

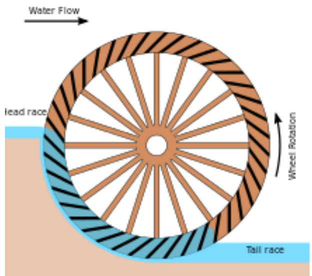
II. WATER AND WIND TURBINES

Hydroelectricity is the world's largest and cleanest source of renewable energy, operating 24h/day. The information about the smallest version of the technology is poor, despite it is the highest, most reliable and least expensive way to generate power off grid.

The most simple and common solution as prime mover for generating electricity is the water wheel which converts the energy of the free flowing or falling water into mechanical power. In figure 1[1] there are presented three versions of the water wheel. The undershoot water wheel, fig.1.a. is a vertically mounted wheel which is rotated by water striking paddles or blades of the wheel. The breastshot wheel is rotated by falling water, fig 1.b. In the case of the overshoot water wheel, fig.1.c, it is rotated by falling water striking paddles, blades or buckets near the top of the wheel. Based on this principle a lot of simple solutions are presented as "home made" water wheels. On the other hand, many small or middle scale factories deliver water turbines in a large range of power with a proper electric generator. An example is given in fig.2, delivering 500W. [2]



1.a. Undershot water wheel



1.b. Breastshot water wheel

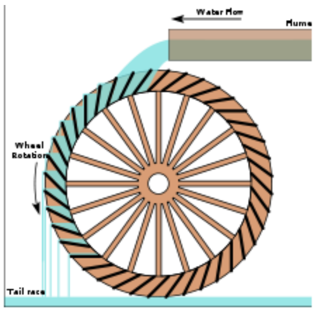

1.c. Overshot water wheel

Fig.1. Water turbines

A Virtual Training System for Upper Limb Myoelectric Prosthesis Control

Sorin HERLE
Department of Automation
Technical University of Cluj-Napoca
Cluj-Napoca, Romania
e-mail: Sorin.Herle@aut.utcluj.ro

***Abstract*—The challenging field of rehabilitation has many open problems that are addressed nowadays with a wide variety of strategies. Aiming at simple, robust and efficient training system for disabled persons that are using electrically-powered upper limb prostheses, this paper proposes a system architecture and a virtual environment for simulation. Electromyographic signals are collected from remaining muscles of the limb, processed and classified into four categories. The final purpose of the system presented is the generation of several control signals based on the acquired data that are to be sent to a graphical simulator able to illustrate the movements, thus assisting patients in training before using a prosthesis. The software application, although not very complex at the present time, is highly flexible and can be further improved with new functionalities.**

Keywords-EMG signal; finite state machine; signal processing; simulator

I. INTRODUCTION

Most of the current generations of artificial arms that help with an upper limb deficiency or other complex dysfunctions use electromyographic (EMG) signals acquired from the surface of the skin. Self-powered artificial limbs are actuated through small electrical motors controlled by EMG signals recorded from the remaining muscles of the limb or from other locations, [1].

The myoelectric control [2], [3], [4], [5], [6] is preferred because of it has several advantages over other control strategies. Among these advantages are the noninvasive detection of the signal on skin surface, without any injury for the patient, and the small muscle activity required to provide control signals, [7] .

The functionality requirement of the prosthesis increases with the level of amputation, and this demands more effort to control the device. To compensate for the burden, the challenge is to develop control systems able to assist the patient in using the prosthesis. Although it is expected that the use of biological signals would ease the device utilization for the patient, the prosthesis control is very unnatural and requires a great mental effort, especially during the first months after fitting, [8], [9].

The academic research in this field has progressed in the last decades from simple threshold control methods to sophisticated strategies, based on pattern recognition algorithms for signal classification, machine learning and adaptive techniques for prosthesis control.

Due to the stochastic characteristics of EMG signals, some processing techniques are required before signal classification, which mainly require an association between different patterns found repeatedly in the EMG signal and the corresponding member movements. Many of the previous reported applications use artificial neural networks for signal classification. Therefore, signal representations achieved by feature extraction and dimensionality reduction are vital for obtaining meaningful information for classification, [8].

From the point of view of a patient, one major problem is adapting to the control of the prosthesis. Since many people give up during the training period and aiming at increasing the rate of acceptance, one idea was to develop a system to assist the patient during this time.

There are several research studies in this area of the author approaching subjects related to the implementation of a control system that will assist the patient during training.

One focus of an early study was on analyzing and processing the EMG signal in order to discriminate among four motions of the forearm: extension, flexion, pronation and supination. A feed-forward neural network was used as classifier of the four movements. The inputs of the neural network have been obtained by processing experimental measurements of EMG signals from the biceps and triceps of several healthy persons and used to recognize forearm movements of persons who have experienced some form of trauma. The outputs of the network may be used as control inputs of a virtual prosthesis intended to assist a disabled person in training, [10].

Another approach was developed using a classifier for surface EMG signals based on an autoregressive (AR) model representation and a neural network. Two myoelectric control strategies based on finite state machine were also employed. The results have shown that combining a low-order AR model with a feed-forward neural network, a rate of classification ranging from 91% to 98% can be achieved, while keeping the computational cost low, [11], [12].

A hierarchical control architecture and the implementation of the high-level controller using finite state machine was also proposed. The solution is capable of controlling three joints (i.e. six movements) of the upper limb prosthesis. The inputs of the high-level controller are obtained from the classifier, while its outputs are applied as input signals for the low-level controller. The main advantage of the proposed strategy is the reduced effort required to the patient for controlling the prosthetic device, since he only has to initiate the movement that is finalized by the low-level part of the controller, [13].

This paper proposes an evolved system architecture that may be used during the training period for patients with upper limb prosthesis controlled via surface electromyographical (SEMG) signals. Data acquisition and signal processing strategy (features extraction and processing) presented in this paper are similar to the work previously reported [11], [12], [13], but the results are intended to be used in conjunction with a simulator that may assist patients in getting accustomed to a prosthesis. Also, the decision making system, mainly the finite state machine proposed, is developed in a

Lightweight Architecture for Distributed Road Traffic Monitoring

Radu Miron
Technical University of Cluj-Napoca
Automation Department
Cluj-Napoca, Cluj
radu.miron@aut.utcluj.ro

Mihai Hulea
Technical University of Cluj-Napoca
Automation Department
Cluj-Napoca, Cluj
mihai.hulea@aut.utcluj.ro

***Abstract*—This paper presents a solution for distributed road traffic monitoring using GPS and GSM technologies, with applications in the field of Intelligent Transportation Systems (ITS). A distributed software architecture has been design and implemented for being capable of handling hundreds of simultaneous connections. The system can scale horizontally in order to accommodate an increasing number of concurrent connections which can be experienced at peak traffic hours. A number of tests have been performed in order to demonstrate the performances of the system.**

Distributed systems; road traffic monitoring; web services

I. INTRODUCTION

The present paper proposes a solution for distribute road traffic monitoring using Global Positioning System (GPS) technologies. The presented work is part of a more complex system being integrated as part of a solution for the management of road traffic and other transportation systems. This type of systems are known in literature as Intelligent Transportation Systems (ITS) and are used as assisting tools for improving decisions made by network operators and users [1].

By using the GPS technology in monitoring solutions, precise details on traveling speed and location of traffic participants can be obtain, which then can be used as input in order to calculate or estimate various traffic characteristics. In [2], traveling speed is used in order to estimate arriving time to destination. A technique known as data floating can be used, where the speed and the travel time are recorded as a function of time and location on the road network. In [3], it is proposed a traffic control preemption system in which data receive from GPS is used to determine if a vehicle which approaches an intersection is allowed to travers it [4].

Vehicle GPS enabled devices are used for collecting location and travel speed. A large variety of such equipment can be used for this purpose – from regular smart phones to dedicated tracking devices. The coordinates of the vehicle are embedded in a NMEA sentence format. The National Marine Electronics Association developed the NMEA 0183 Interface Standard for data exchange between marine electronic devices. The NMEA 0183 Standard defines electrical signal requirements, data transmission protocol, timing and specific sentence formats for a 4800 baud serial data bus. Today, most GPS receivers use the NMEA interface for data exchange. The coordinates are packed in a NMEA RMC sentence format which is presented bellow in Table 1. Details of the NMEA formats can be found in [5].

TABLE I. THE NMEA RMC FORMAT OF THE GPS DATA

Token number	Explanation
1	Time of fix in UTC Time
2	Data status (V=Navigation receiver warning)
3	Latitude of fix
4	N or S
5	Longitude of fix
6	E or W
7	Speed over ground in knots
8	Track made good in degrees true
9	UT date
10	Magnetic variation degrees
11	E or W
12	Checksum

Example:
$GPRMC,172517.000,A,4723.3498,N,00832.7741,E,5.47,148.81,200106,,_0E

For transmitting the collected data, wireless communication networks based on GSM/GPRS/UTMS is used. Considering the amount of data which need to be sent (few kilobytes of data at periodic time intervals) a GPRS connection is enough, providing quick session setup, permanent connection, low cost and high data transfer rate. Furthermore, it is IP based, thus the transceiver is unnecessary in the management center, which is connected with the Internet. The transport protocols TCP and UDP are the options taken into consideration at the design stage for implementing the communication layer [6].

As TCP provides features such as congestion control, it would be the preferred protocol to use. Unfortunately, due to the fact that TCP is a reliable service, delays will be introduced whenever a bit error or packet loss occurs. This delay is caused by retransmission of the broken packet, along with any successive packets that may have already been sent. This can raise jitter to an unacceptable level making TCP unusable for real-time services [7]. On the other hand, the nature of the environment in which the system is used – where real-time constrains are not imposed (vehicles are transmitting position and speed at periodic time intervals measured in minutes) – it makes TCP an acceptable solution.

Identification and Modeling of Kinematic Couplings and Dynamic Control of TX90 STAUBLI Robot Joints

Slivinschi Igor
Automation and Computer science, Technical University of Cluj-Napoca,
Cluj-Napoca, street G. Baritiu nr.26-28, i.slivinschi@yahoo.com

Abstract - **This paper presents the identification and modeling of kinematic couplings and dynamic control of TX90 STAUBLI robot joints. It is proposed a theoretical description of the serial robot structure using an open kinematic chain and are presented the kinematic and dynamic parameters which influences the robot states.**

Keywords: kinematic and dynamic parameters, simulation, joint

I. INTRODUCTION

To create the system of command and control of a mechatronic system is needed to know the hardware structure of the mechanism and design of it. In designing the structure of command and control is necessary to know and determine some parameters that can be disturbed of the nominal value during operation. For an industrial robot control parameters needed are the kinematics and dynamics. Description and implementation of kinematic simulations will be made on a serial robot with six degrees of freedom model Staubli TX90. CAD model in SolidWorks robot is made and attach the necessary constraints joints then will export in Matlab / Simulink using SimMechanics Toolbox, will take control of each coupling structure of the control structure of the entire robot. It can achieve more control structures which can compare the result and choose the best option.

II. DESCRIPTION OF INDUSTRIAL ROBOT

The study of kinematic and dynamic variables will be made at a serial robot as mechatronic system in open chain Fig.1 with six degrees of freedom (d.o.f).[1][2][3]

The hardware structure of the robot is forwardly and distributive influenced by kinematic and dynamic variables that modify the control structure of mechatronic system at its base until the last couple.

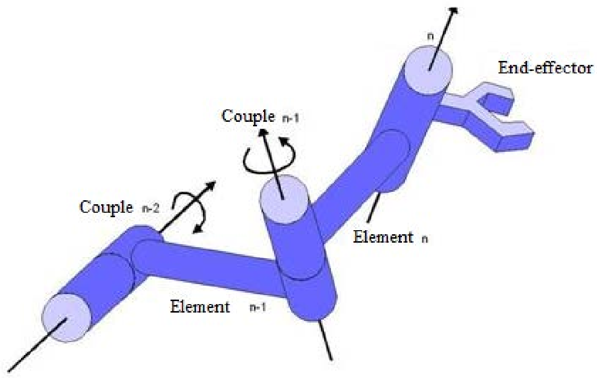


Fig. 1 Open Kinematic Chain

Generally, the hardware structure consists of mechanical and electrical system parts, are:

- *The robot arm*
- *Engines and their components*
- *Controller*
- *Console Software*
- *Installations for the operational safety assurance*
- *Internal system of sensors and transducers*
- *External System of sensors and transducers*

The mechanical system is responsible for handling the manipulated object from a starting point to an end point. In principle mechanical system consists of the robotic arm, actuators, and reduction system. The robot arm is an essential component of industrial robot, which is made up of individual mechanical parts called *link* connected by joints called *joint* which can be linear or rotational. The first 3 couplers are called *main*. Number of couplers defines the number of degrees of freedom, each couple is actually driven by a motor and that motor gives the degree of freedom. The structure of the mechanical system consists of several components show Fig.2.

New approach for interactive itinerary planning

Mihai Pop
Automation department
Technical University of Cluj Napoca
Cluj Napoca, Romania
Mihai.pop@aut.utcluj.ro

Camelia Avram
Automation department
Technical University of Cluj Napoca
Cluj Napoca, Romania
Camelia.avram@aut.utcluj.ro

Adina Aştilean
Automation department
Technical University of Cluj Napoca
Cluj Napoca, Romania
Adina.astilean@aut.utcluj.ro

***Abstract* - A personalized tour planning application in a multimodal transport network, minimizing the transport cost and time and respecting tourist preferences is presented in this paper. The proposed, corresponding, solution is based on a new approach, integrating genetic algorithms and Martins algorithm. Taking into account different personal options, genetic algorithms were utilized to obtain the sequences of the visited touristic objectives. The Martins algorithm was used to generate the most convenient, possible, routes among the visited interest points. Visiting hours and recommendations for visitors are also available for each destination. The application was tested on a virtual map, different cultural, entertainment and historical objectives being marked and a representative transport network being generated.**

Keywords- genetic algorithms, NSGA-II, Martins algorithm, tour planning, multimodal transport, multi-objective optimization

I. INTRODUCTION

A new tendency at the moment is the replacement of the information available on printed travel guides by personalized tour planning applications running on mobile devices. The customized plans should include not only the sequence of points of interests (POIs), corresponding to the tourist's preferences, but also convenient routes of travel among these POIs using the transport network of the city. It must be mentioned that the difficulty of establishing convenient routes for tourists is increased by the requirement that they have to be at given locations in specified time intervals. By taking into consideration multiple user preferences and the multimodal nature of transport networks, a tour planning application needs to solve more than one underlying multi-objective optimization problems. In this context, the main objective of this paper was the elaboration of scheduled tours in a multimodal transport network, minimizing the transport cost and time and respecting tourist preferences.

In order to solve the problem, a new approach, integrating genetic algorithms and Martins algorithm is proposed. Martins' algorithm was used to find the most convenient possible routes among interest points, based on different personal preferences. Genetic algorithms were utilized to establish the order of the visited touristic objectives. The proposed solution was tested on a virtual map, different interest points being marked and a representative transport network being generated.

II. RELATED WORK

Many research directions of this area were highlighted in [1], [2], [3], [4], [5], and different applications for tour planning were proposed over the years.

P-Tour, presented in [6] is a personal navigation system that allows preselecting of POIs and then computes an optimal route to visit most of them. P-tour navigation uses maps, is based on the server client architecture and offers the possibility to change the itinerary when unpredictable events occur. An important disadvantage is that travel time among POIs is not considered.

User preferences are taken into consideration by the Dynamic Tour Guide presented in [7] in which a mobile agent is employed to establish a city tour plan. This is computed on the server side based on user location and profile. No provision is made by the application on the transport routes between visited touristic objectives.

The agent based solution developed in [8] takes into consideration the interests of the tourist, opening hours of POIs and available time to visit, but has the shortcoming of focusing on single day routes and omitting the travel between POIs.

Multi-day routes are tackled in [9], application which includes a web and a mobile interface and plans sightseeing routes given user profile. The geographic distance of the POIs is taken into consideration when planning the route, but no complex transport between the POIs is planned.

Multimodal transport networks are considered in [4] where a genetic algorithm is used to find the shortest path in the transport network between POIs.

In this paper, the proposed approach combines itinerary planning with transportation planning in a multimodal transport network. A genetic algorithm is used to find the best possible route considering the available POIs and the constraints imposed by the user preferences and time windows of visitation. A shortest path algorithm is used to find the most effective transportation route between the POIs chosen by the route planner.

III. APPLICATION DESCRIPTION

The proposed application is capable of elaborating scheduled tours in a multi-modal transport network, taking into account tourist preferences and minimizing the transport cost and time. Its main components are presented in Fig. 1.