

COMPUTER SCIENCE

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Determining Human Leukocyte Antigens – Cytomegalovirus disease correlation based on Probabilistic Functional Dependencies

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Abstract—Using historical data is of great importance for obtaining predictive medical assessors. The current paper presents an analysis of medical data using concepts of database theory combined with medical statistics. We evaluated the association of Cytomegalovirus (CMV) disease and particular Human Leukocyte Antigens (HLA) genotype's in recipients after transplantation. Out of 670 kidney transplant recipients in transplant center ICUTR Cluj-Napoca, only those tested for HLA-A, -B, -DR.

Keywords—probabilistic databases; functional dependencies; HLA.

I. INTRODUCTION

Cytomegalovirus (CMV) is an important pathogen that leads to significant morbidity and mortality. With more patients undergoing transplants, along with the expanding indications for immune-modulating agents, the number of patients at risk for developing CMV disease is increasing. CMV is a double-stranded DNA virus of approximately 220 kb (kilo-base) and is a member of the beta class of human herpesviruses. Human cytomegalovirus-human herpesvirus 5 belongs to order Herpesvirales, family Herpesviridae, subfamily betaherpesvirinae, genus Cytomegalovirus, species Human herpesvirus 5 [1].

MHC (Major Histocompatibility Complex) is a group of genes on a single chromosome that codes the MHC antigens. Major as well as called transplantation antigens) mediate rejection of grafts between two genetically different individuals. HLA (human leukocyte antigens) are the MHC antigens of humans, and called so because they were first detected on leukocytes. The essential role of the HLA antigens lies in the induction and regulation of the immune response and defense against microorganisms. The physiologic function of MHC molecules is the presentation of peptide antigen to T lymphocytes. These antigens and their genes can be divided into three major classes: class I, class II and class III. The HLA resides in the short arm of chromosome 6 and overall size of the HLA is approximately 3.5 million base pairs. The class I gene complex contains three loci A, B and C. The class II gene complex also contains at least three loci, DP, DQ and DR. Many alleles of each locus permit thousands of possible assortments. There are currently 14,409 HLA and related alleles described by the HLA nomenclature and included in the IMGT/HLA

Database. Even single allele may consist of multiple variants resulting in tremendous polymorphism [2].

The HLA system plays a key role in human immunity. It can be expected that some alleles may alter the immune response. CMV infection is the most important cause affecting the survival rate of transplanted organ after transplantation. The occurrence of CMV infection after transplantation is associated with many factors. It suggests that genetic mutation between hosts and CMV may play a role in occurrence and development of CMV disease. CMV can alter both the quantity and even the quality (structure) of HLA molecules. We evaluated the association of CMV disease and particular HLA genotype's in recipients after transplantation. Out of 670 kidney transplant recipients in our transplant center ICUTR Cluj-Napoca, only those tested for HLA-A, -B, -DR. HLA-A and -B typing was performed by CDC method using magnetic beads for cell isolation and monoclonal typing trays (One Lambda, USA), while HLA-DR alleles were determined by PCR-SSP technique (Olerup, Sweden).

II. TESTING FOR CMV AND CLASSICAL BIOMEDICAL STATISTICS

In [3] CMV was monitored by the Human Cytomegalovirus Phosphorylated matrix protein (pp65). In [4] Qualitative data were analyzed using Chi-square test and Fischer's exact test. Odds ratios were estimated using conditional logistic regression and served as measures of relative risk (RR). Odds ratio (OR) is also known as relative odds and approximate relative risk. It is the ratio of the odds of the risk factor in a diseased group and in a non-diseased (control) group (the ratio of the frequency of presence / absence of the marker in cases to the frequency of presence / absence of the marker in controls). The interpretation of the OR is that the risk factor increases the odds of the disease 'OR' times. OR is used in retrospective case-control studies (relative risk (RR) is the ratio of proportions in two groups which can be estimated in a prospective -cohort- study). These two and relative hazard (or hazard ratio) are measures of the strength/magnitude of an association. As opposed to the P value [5], these do not change with the sample size. OR and RR are considered interchangeable when certain assumptions are met, especially for large samples and rare diseases. Odds ratio is calculated as ad/bc where a, b, c, d are the entries in a 2x2 contingency table (hence the alternative definition as the

Computer Network Monitoring System Using The Embedded Event Manager

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Abstract—The need for implementing a network monitoring system capable of detecting the problems that occur, in the shortest possible time, increases with the size and complexity of the network. The paper proposes a computer network monitoring system with several important features that assists system engineers to detect problems due to erroneous connections, incorrect network devices configurations or network devices and/or links failures. Each network device collects and processes information about itself and its neighbor devices. The information is transmitted to a server where is stored and processed. The server displays the current network topology which can be compared with the designed network topology. Also, the system is capable to detect and highlight devices with reachability issues, even when these devices are not capable to transmit information to the server. The server gathers the missing information from adjacent network devices. The experimental tests proved the functionality of the proposed network monitoring system features and the advantages of using a visual tool, both for medium and for large scale networks, to provide faster detection of network failures and errors.

Keywords—Computer networks; Monitoring system; Embedded Event Manager

I. INTRODUCTION

In a computer network, detecting failures, identifying the causes and remedying them must be accomplished as soon as possible. For this reason, continuous network monitoring is required. Incorrect connection of network devices, the occurrence of link or network devices failures, problems caused by MAC addresses, routing tables, or by network policies implementations, involve intensive analysis for system engineers to address these issues. These efforts increase with the number of connected network devices, links between them and the services provided by them. For this reason, a network monitoring system capable of detecting, in the shortest possible time, the problems that occur in a computer network is required to be implemented in medium and large networks.

This paper proposes a computer network monitoring system with several features. First, displaying the current network topology that compared with the designed topology allows system engineers to detect problems due to erroneous connection of network devices or network links or devices failures. Second, detecting and highlighting network devices with reachability issues even if these devices are not capable to transmit information to the server. These problems can be caused by MAC address, routing tables or network policies implementations.

II. THEORETICAL CONSIDERATIONS

Network devices such as switches, routers, access points, and firewalls use an operating system called a network operating system. A network operating system enables device hardware to function and provides an interface for users to interact. The Cisco Internetwork Operating System (IOS) is a generic term for the collection of network operating systems used by Cisco networking devices. The portion of the operating system that interacts directly with computer hardware is known as the kernel. The portion that interfaces with applications and the user is known as the shell. The user can interact with the shell using a command-line interface (CLI) or a graphical user interface (GUI). GUIs may not always be able to provide all of the features available at the CLI. Additionally, the CLI is less resource intensive and more stable when compared to a GUI. For these reasons, network devices are usually accessed through a CLI.

Cisco Discovery Protocol (CDP) [1] is primarily used to obtain protocol addresses of neighboring devices and discover the platform of those devices. CDP can also be used to display information about the interfaces that the network device uses. CDP is media- and protocol-independent, and runs on all Cisco-manufactured equipment including routers, bridges, access servers, and switches. Each network device configured for CDP sends periodic messages, called advertisements. Each device also listens to the periodic CDP messages sent by other network devices in order to gather information about neighboring devices and determine when their interfaces to the media go up or down.

Embedded Event Manager (EEM) [2] has been designed to provide event management capability directly in Cisco IOS devices. EEM offers the ability to monitor events and take any desired action when the monitored events occur or when a threshold is reached. An EEM policy or event subscriber is an entity that defines an event and the actions to be taken when that event occurs.

EEM is a framework that supports in-box monitoring of different components of the system with the help of software agents known as core event publishers or event detectors. Event publishers screen events and publish them when there is a match on an event specification that is provided by the event subscriber. Event detectors notify the EEM server when an event of interest occurs. The EEM policies implement the actions for the given event. An EEM policy is an entity that defines an event and the actions to be taken when that event occurs. There are two types of EEM policies: an applet or a script. An applet is a policy that is defined within the CLI configuration. A script is a policy that is written in Tool Command Language (Tcl) [3].

Enhancing throughput on high bandwidth, high latency WANs using a MultiSocket framework

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Abstract—The paper proposes a new multi-socket framework with the aim of providing support for the development of client-server applications that can achieve high network throughput over high bandwidth, high latency wide area networks. MultiSocket provides a simple API for transmitting data on multiple parallel sockets, based on a configurable routing table and routing information associated to each message. In the experimental setting, the results have shown that on a high bandwidth network with simulated high latency, the throughput is increased compared with a standard Java socket, by using multiple connections between the sender and the receiver.

Keywords—TCP, socket, framework, BDP, WAN, scalability

I. INTRODUCTION

TCP protocol was designed to work well over a variety of Internet paths, but with the introduction of fiber optics the fastest paths are moving out of the domain for which TCP was originally engineered [1]. Several extensions of the TCP protocol were designed to improve performance over large bandwidth-delay product paths and to provide reliable operation over very high-speed paths, both on soft and hardwires. [2][3]

The bandwidth-delay product (BDP) is the fundamental concept in any window-controlled transport protocol, and it represents the product between the channel capacity or bandwidth of the bottleneck link of a path, and the Round-Trip Time (RTT) of the path between the sender and the receiver [4]. In order to achieve a maximum throughput, the size of the effective window of the connection has to be equal to BDP, and therefore the smaller of the two socket buffers (send and receive) has to be equally large as BDP. As defined in [5], channel capacity refers to the maximum rate, in bits per second (bps), at which data can be transmitted over a given communication path. The Round Trip Time or delay is defined in [1] as the time elapsed between sending a data octet with a particular sequence number and receiving an acknowledgment that covers that sequence number.

A wide area network (WAN) is a network that covers a large geographical area. It consists of several interconnected switching nodes responsible with moving data from node to node until they reach their destination [5]. WANs are used to transmit data over long distances and to interconnect LANs and other types of networks.

Many distributed systems use TCP for reliable data transfers. TCP performance plays an important role in data intensive applications, sometimes affecting the overall performance of the system. The performance of TCP depends upon BDP, which measures the amount of unacknowledged data that TCP must handle in order to keep the pipeline full [1]. One of the performance issues of TCP over high BDP paths is that it uses a 16 bit field for window size, resulting in a windows size

limit of 64KB. To solve this problem a new TCP option called Window Scale was defined in [1]. This extension expands the TCP window definition to 32 bits and the maximum window size to 1GB.

Achieving maximum throughput over a high BDP path is not an easy task. So far, there are two different solutions to this problem. The first one (figure 1 a, b) is a system level solution based on tuning the TCP window size, while the second one (figure 1 c), is an application level solution, based on striping data transmissions across multiple TCP connections.

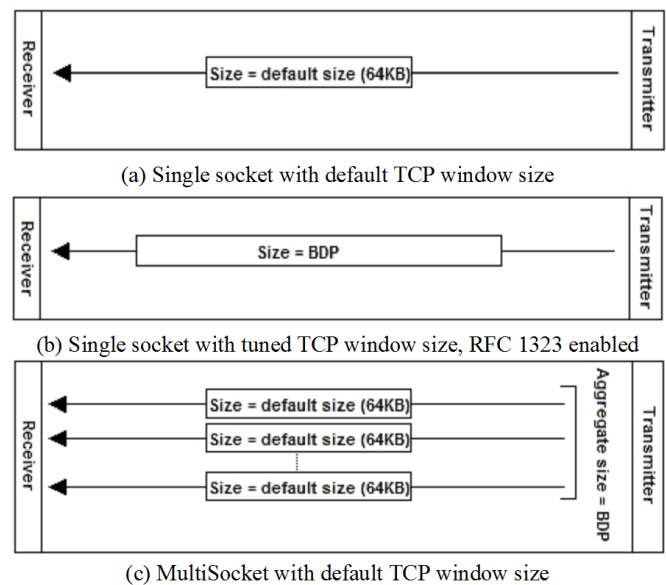


Fig. 1. TCP window state at a given time

The MultiSocket framework aims to provide support for quick and easy development of client-server applications that can achieve high network throughput over high bandwidth high latency in wide area networks. In order to improve TCP throughput, it uses the second solution mentioned above. It opens multiple connections between parties and transmits each message on a specific connection, based on a routing table.

This paper is organized as follows. Section II provides some background information regarding related work, describes the Pockets library, and presents cases where the MultiSocket framework is effective. The architectural design and the implementation details of the MultiSocket framework are presented in Section III. Section IV discusses a set of experiments carried over a simulated high BDP network using MultiSocket framework, and section V concludes the paper.

A Survey on the Status of Test Automation

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Abstract—The process of test automation and its practices in industry need to be better understood, both for the industry itself and for the research community. We conducted an industry survey with a quantitative focus asking IT professionals to answer questions related to the area of test automation. The purpose of this survey is to identify the current approach regarding tool selection for test automation and metrics used to measure the success of test automation. The survey highlights that the benefits of test automation is tightly coupled with the test tools and utilities used. It was identified that some of the limitation in introducing test automation are related with the size of the project or technical expertise of the team. Additionally the results show that 60% of the respondents use commercial tools to aid the automated testing process. Finally, it was found that in 42% of the cases, the automated tests cover <30% of the total number of test cases designed. Most of the findings are in the area of test automation and are specific to small- to medium-sized companies, developing software applications in the web, desktop or mobile domain.

Index Terms—test automation, survey, status of test automation, testing

I. INTRODUCTION

Test automation is considered an integral part of software engineering and an enabler for an efficient and effective software development process. The increasing system size or complexity of today's applications, pose new challenges and increases the importance of an efficient automation process. Nevertheless, many organizations still do not have test automation practices in place. One reason for the lack of automation are the technical challenges and costs to support such an effort. As a consequence, software development projects suffer in terms of alignment and implementation efforts.

In this paper we present the results of a survey. We collected data to be used as a foundation for improving methods and tools. The survey was focused on IT professionals (testers, developers, managers) and asked them about their experience on test automation and tools in their current projects. In total, a number of 78 respondents answered our questions; working in small (less than 50 employees) to medium-sized (up to 300 employees) companies.

A. Related work

Next we discuss current findings and surveys related to the status of test automation. As far as we could tell, very few surveys cover the status of test automation at a given point in time [9], [14]. Most of the research covers individual aspects of test automation with one single point of focus on either quality metrics or test automation process at certain stages of the development life cycle [21] or the challenges concerning the gap between the academia and the practitioners' view on software testing [16].

Previous work in the area of test automation focuses on the effort of automation as part of regression testing strategies.

Damm et al. [4] talk about organizations that require a mature development process with management support. The test automation process requires a smooth integration within the development effort in general.

Many papers currently exist in the area of test automation, but very few try to identify current practices with focus on test tools, tools selection process and quality metrics. This is the main reason why we decided to investigate the status of testing, with respect to test automation, metrics and test tools.

Our findings, with respect to surveys in this area, consist of three studies that we also found to be particularly interesting. One study had a focus on regression testing [6], the other study looked at the current state (2007) of test automation and component reuse [22] and, finally, some results that present current practices and approaches used in industry are to be found in [13].

The CHAOS¹ reports and FLOSS² report are two major surveys, one focusing on identifying trends in the software industry and the other focusing on open source and free software. We believe that our survey is important to industry in order to identify and suggest areas of improvements with respect to the software testing processes, especially having test automation in mind.

The need for effective test automation and tool selection increases with the increasing use of iterative development strategies and systematic reuse during the software development life cycle. In a study performed by Chittimally and Harrold, it is indicated that 80% of testing costs is in regression testing and more than 50% of software maintenance cost is related to testing [3].

A different study performed by Brooks [2] concludes that testing is a very labor and resource intensive process that often accounts for between 40 and 80% of the total cost of software development. Understanding the time and resources that should be allocated to testing involves a trade-off among budget, time and quality [18]. In unsystematic development processes, testing continues until time runs out [11].

In his paper on software test processes and strategies Kasurinen [12] focuses on the components represented by a testing strategy; "human resources, test tools, test case selection, testing methods and the role of the management in the test process to name few of the major components." The preliminary conclusion of the study shows that "there exists room for improvements in testability of the software products and focusing the available test resources, problems which could be addressed by means of systematic process improvement and defining test strategy for the organization"

Researchers want to better understand the needs and practices in industry. Rooksby et al. [17] argue for the need for

¹<http://versionone.com/assets/img/files/ChaosManifesto2013.pdf>

²<http://floss2013.libresoft.es/>

LQR design for an electromechanical system

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Abstract—This paper focuses on designing and simulating a control algorithm for a mechanical system with two perpendicular axes. An energy-based technique is used to obtain the gain matrices in Linear Quadratic Regulator(LQR) control method. So, the gain matrix is obtained based on the energy of the system that we want to control. Closed Loop Pole Assignment algorithm is also used to obtain a controller in order to compare it with the Linear Quadratic Regulator. To implement and simulate the designed controllers, Matlab together with its graphical extension, Simulink is used.

Keywords—LQR, Pole Placement, MIMO, energy-based control, electromechanical system

I. INTRODUCTION

Recently, the required performances in control systems are stricter because of higher precision task and complex processes. In this paper there are designed and simulated two control techniques used to control the position of the rotors. In chapter 2, the mathematical model is identified according to the input and output signals from the process. Chapter 3 presents the methods for controller design. One of them is LQR method. The Linear Quadratic Regulator problem is a powerful design method and the precursor of several control design procedures for linear MIMO systems. The optimal controller assures a stable closed-loop system, achieves guaranteed levels of stability robustness and is simple to compute. The method used to obtain the optimal controller is based on the energy of the system. An energy based technique was also proposed to eliminate trial and error in finding the gain matrices for LQR. For example, this method this method is considered more efficient for the control of vibration in structures.[1] The last chapters deal with the experimental results for the two methods and conclusions.

II. MATHEMATICAL MODEL FOR POSITIONING SYSTEM

The positioning system consists of two perpendicular axes of translation, which are driven by brushless motors. The motors are controlled with a power driver with PWM signal. The angular velocity and the position of the rotor are measured based on the signals generated by the three Hall sensors placed in the motor.

The two axes are coupled with a rigid mechanical system and the behaviors of these axes depend on electrical and mechanical parts.

A convenient method to describe the process and to represent the relationship between the input and the output is by using transfer function.

The process described above can be represented, as presented in [2], by a MIMO system with two inputs and two outputs.

- Inputs: duty cycle of the two PWM signals used to control the motors;

- Outputs: the position of rotors of the two motors;

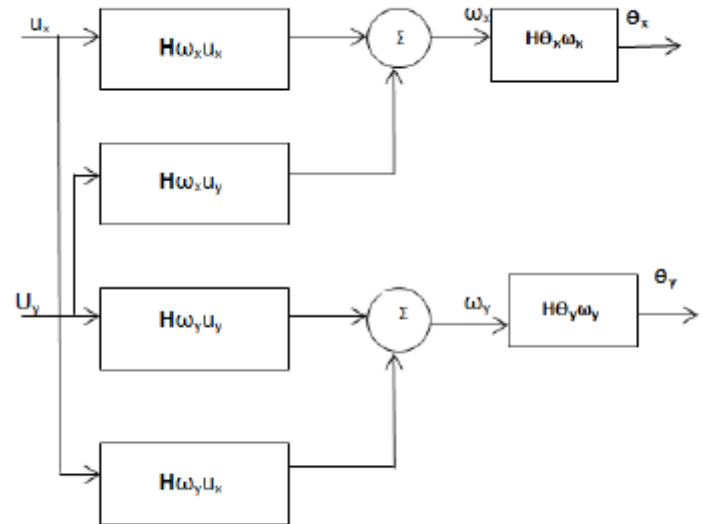


Fig. 1: Block diagram representation for the model used for parameters estimation

The block diagram in Fig 1 illustrates the dependency between electrical and mechanical subsystems. It can be observed that the whole system can be replaced by two subsystems, each one corresponding to one axis. These subsystems are not independent, but each one influences the other one. This is because of the fact that the connection of the two axes is not considered rigid and a mutual mechanical effect exists between the axes.

The designations used suggest the type of signals and the subsystems they belong. So, we have:

- u_x, u_y : duty cycle of the PWM signals used to control the speed of the motors that are driving each axis;
- Measured output signals:
 - ω_x, ω_y : speed of electrical actuators(angular velocity);
 - θ_x, θ_y : position of rotor of the two motors;

The transfer function of electrical part can be approximated with a first order transfer function and is, for each axis:

$$H_{\omega_x u_x} = \frac{K_{M_x}}{T_{M_x} s + 1}; H_{\omega_y u_y} = \frac{K_{M_y}}{T_{M_y} s + 1} \quad (1)$$

The transfer function of mechanical part is normally an integrator because it represents the relation between the speed and the position. In order to apply the energy-based LQR method which is proposed in this paper, we approximate this element with a first-order transfer function with a pole very

System identification in building heating control optimization

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Abstract—Building energy demand counts for a third of the global energy consumption. Space heating and cooling represent the majority of the building energy consumption. The aim of the first part of the study is to develop a system identification for a school building. The study investigates the potential for energy saving with respect to automation optimization of the heating system by using the thermal capacity of the building in relation with the weather and occupancy. The scope is to increase the performance of the heating system by improving the heating automation process.

Keywords—system identification, heating load; 4SID; subspace state space system identification

I. INTRODUCTION

Energy used in buildings represents 31% of the global energy consumption, of which space heating and cooling counts for 30% to 60% depending on the climate [1]. During the O&M throughout the lifespan of the building, the performance of the building decreases as the material and equipment fatigue. The amount of energy increases at a rate of 0.5 to 5% yearly in developed countries [2]. Potential for energy savings can be achieved with reduced costs by improving the control of the buildings heating, ventilation and air conditioning systems, hot tap water system, lighting.

Advance BMS systems than can control all the systems in a building, from security, lighting, HVAC (Heating, Ventilation and Air Conditioning), etc. to blind positioning have an increased energy saving potential when attempting to perform an integrated system control improvement. However, what about buildings that do not use such sophisticated systems? Many of old and existing buildings, are not equipped with complex air conditioning systems and are not cooled in the summer (e.g. HVAC rooftop) and it is unlikely that complex HVAC systems will be fitted in the future due to floor height and building construction constraints. This type of buildings, old administrative and educational buildings that are relatively large buildings and have a significant heating energy consumption, are generally fitted with a central heating system, gas fired boilers and radiators (possibly chiller and fan coil unit in case of space cooling, only for recent building refurbishment) and have a temperature based control loop. This sort of building services provide the basic interior comfort and are simple compared to building installations that provide a higher level of interior ambient quality. According to [1] heating and cooling represent the highest amount of energy

consumed in buildings thus measures and for reducing the heating and cooling energy consumption are prime.

The aim of the first part of this study to develop a system identification for a school building. A second part of the study will investigate the potential for energy saving with respect to automation optimization of the heating system by using the thermal capacity of the building, weather forecast and building occupation similar to the Opticontrol project [3]. The aim is to predict the trend of the interior temperature [4]. Siroky et al, 2010, [5] performed a comparison between weather compensated control and predictive control for an eight stories high building and concluded that predictive control was superior. Predictive control is highlighted on days when the controller was able to identify the gaps when no heating was needed thus reducing the energy consumption. Simulations and experiments that make use of the building thermal storage present significant energy saving potential [6] but design and implementation factors should not be overlooked: stability and feasibility of MPC, prediction uncertainty, convergence to suboptimal solutions, computational complexity [7], [8].

As previous stated the majority of old administrative and educational buildings are equipped with basic heating systems: central heating systems, gas fired boilers and radiators and do not have interior air cooling systems. This type of buildings are numerous, have significant sizes thus the total energy gas consumption during the heating season is considerable. Bianchini et al, 2016 focused their attention on buildings with centralized heating systems (e.g. government building) and proposed an optimization approach that allows the temperature based control system in large buildings to be integrated in a demand response program as part of model predictive control.

II. DESCRIPTION OF THE BUILDING

The three stories height, 2800 square meters school building is situated in a city in Romania. The building was constructed in 1970 and refurbished in 2008. The refurbishment consists of upgrading building envelope: thermal insulation and window replacement. The facade of the building has a window to wall ratio of 0.4. There are no exterior blinds fitted.

Description of buildings HVAC:

- Central heating system with gas fired boilers;
- Cast iron radiators, vertical distribution in basement, single speed heating pump;