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DEPARTMENT OF ELECTRICAL ENGINEERING
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ABSTRACTS

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Past, Present and Future of Teaching Mechatronics at the Faculty of Mechanical Engineering and Informatics of the University of Miskolc

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Keywords:
mechatronics, innovation, education

Abstract:

The paper presents the development of and changes in teaching mechatronics at the Faculty of Mechanical Engineering and Informatics of the University of Miskolc starting in the 1960s. It is easy to see how fast the University responded to the technical changes in the world, what directions it followed and how it became involved in solving industrial problems of a mechatronic type, and how all that affected engineering education and training. Presenting a novel example of cooperation between the industry and higher education, which amounts to an innovative solution, will also display the extensive opportunities for evolution of a specialist field.

Extending WS-Security to Implement Security Protocols for Web Services

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Keywords:

ws-security, security protocols, Web services

Abstract:

Security protocols are "communication protocols dedicated to achieving security goals" (C.J.F. Cremers and S. Mauw, 2005) [1] such as confidentiality, integrity or availability. Existing technologies such as the Security Assertions Markup Language [2] or WS-Security [3] provide a unifying solution for the authentication and authorization issues through the use of predefined protocols. By implementing these protocols, Web services authenticate users and provide authorized access to resources. However, in order to integrate new protocols, such as key-exchange or confidentiality protocols, we need to extend the WS-Security standard with new components.

In this paper we propose several extension to the WS-Security standard including name types, key and random number extensions. The extensions were used to implement existing protocols such as ISO9798 [4], that makes use of the Diffie-Hellman [5] key exchange protocol with digital signatures, or the Kerberos V5 [6] symmetric key-based security protocol. The advantages of using these implementations rather than the existing, binary ones, are inherited from the advantages of using Web service technologies. From these we mention extendibility and end-to-end security across multiple environments that do not support a connection-based communication. The implementations were done according to the specifications of the SOAP [7] standard, that embodies the WS-Security components in its header. The execution timings revealed the possible use of these protocols in a variety of systems ranging from e-commerce to multimedia streaming.

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Certificate-Based Single Sign-On Mechanism for Multi-Platform Distributed Systems

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Keywords:

single sign-on, authentication, security protocols, cryptography

Abstract:

In this paper we propose a single sign-on mechanism based on certificates generated on request for client applications. Single sign-on mechanisms ensure the use of user credentials for accessing multiple resources where the user is requested to enter it's credentials only once. This ensures a reduction of the number of passwords used which can significantly improve security of systems by minimizing the likelihood of a password being compromised [1]. Communication between client applications and servers is done using secure channels based on security protocols. In order to minimize the overhead needed for accessing multiple servers, instead of using protocols such as SSL [2] or its more recent version TLS [3], we designed a set of new protocols based on Guttman's authentication tests [4, 5]. The protocols have been implemented using the existing security library OpenSSL [6], which, together with the protocol descriptions, ensures the correct implementation of the designed protocols.

In order to provide a minimal effort for developing single sign-on mechanisms in distributed systems, we developed a middleware that implements the proposed security protocols and single sign-on mechanism. Existing single sign-on mechanisms are either implemented to function on a single platform, such as Active Directory [7] for Microsoft Windows or eDirectory [8] for Unix systems, or they rely on a centralised directory structure such as LDAP [9], to which servers must be connected in order to authenticates users. The novelty of our middleware lies on the use XPCOM

[10] components provided by the Mozilla platform to encapsulate the communication layer. This way, we do not only provide a single sign-on mechanism for a single platform, but a mechanism that can be used on every platform where Mozilla is available.

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Application of Hybrid c-Means Clustering Models in Inhomogeneity Compensation and MR Brain Image Segmentation

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Keywords:

c-means clustering, image segmentation, intensity non-uniformity

Abstract:

Intensity inhomogeneity or intensity non-uniformity (INU) is an undesired phenomenon that represents the main obstacle for MR image segmentation and registration methods. Various techniques have been proposed to eliminate or compensate the INU, most of which are embedded into clustering algorithms. This paper proposes a hybrid c-means clustering approach to replace the FCM algorithm found in several existing solutions. The novel clustering model is assisted by a pre-filtering technique for Gaussian and impulse noise elimination, and a smoothening filter that helps the c-means algorithm at the estimation of inhomogeneity as a slowly varying additive or multiplicative noise. The slow variance of the estimated INU is assured by a smoothening filter that performs a context dependent averaging, based on a morphological criterion. The experiments using 2-D synthetic phantoms and real MR images show that the proposed method provides more accurate and more efficient segmentation than the FCM based approach. The produced segmentation and fuzzy membership values can serve as excellent support for 3-D registration and segmentation techniques.

Fine tuning of algorithms using the à trous wavelet transform in confocal microscopy line scan image analysis

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Keywords:

calcium sparks, wavelets, à trous wavelet, confocal microscopy

Abstract:

Calcium sparks are intracellular events in muscle cells studied by confocal microscopy using line scan imaging. The large quantity of images involve automatic detection procedures based on image processing methods. The traditional detection and analysis of this images used thresholding methods, recently wavelet based methods were also introduced. We have implemented the à trous wavelet transform in MATLAB, and used it for denoising and event detection with user adjustable parameters on line scan images. The denoising and detection phase depended on user adjustable parameters. Various tests were run to establish parameter limits for both denoising and event detection. Simulated images with calcium sparks were used to determine the detection rate and the reliability of the algorithm. The background noise in confocal line scan images frequently presents structures which are detected as false positive events: limits for the parameters of the algorithm in order to avoid false positive detections were studied.

The Mojette Transform Tool and it's Feasibility

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Keywords:

Mojette Transform, MoTIMoT, MTTool, performance test, image processing, software development.

Abstract:

The Mojette Transformation Tool (MTTool) is an implementation of the Direct Mojette transform and it's inverse in .Net environment. The possibility to test the Mojette Transform is achieved in several different ways on different image sizes and image types. From these implementations we hope to gain many valuable information and with the help of this information we could realize an optimized hardware or to optimize the already existing one, the MoTIMoT. In contrast to the hardware development, the software development provides us with the endless possibility of different variations of the Mojette Transform in a shorter time frame and on lower costs. Also the testing with such a tool is much more easier and it's also better for demonstrations and training purposes. This paper tries to outline how the MTTool could be helpful for further developments both in software and in hardware development.

Lyapunov-Based Frequency-Shift Power Control of Induction-Heating Converters with Hybrid Resonant Load

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Keywords:

Induction heating, resonant inverter, energy in the increment, Lyapunov stability, d-q model.

Abstract:

The frequency-shift method is an attractive choice for power control of induction-heating inverters due to the simplicity of the power circuit. However, frequency-shift control proves to be a challenging task in case of practical resonant loads with high quality factor and uncertain circuit parameters. The paper presents a bilinear large-signal model of the induction-heating inverter with hybrid LLC resonant load. A control law is proposed based on the Lyapunov stability theory. Moreover, an adaptive control method is presented to handle the uncertainty concerning the nominal values of the state variables. The theoretical results are illustrated by numerical simulation.

Comparative Analysis of Speed and Flux Control Structures for Induction Motor Drives

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Keywords:

Vector/scalar control, direct/indirect flux control, direct/indirect field-orientation.

Abstract:

The paper deals with an overview of the adjustable speed induction motor drives. A synthesis about DC-link frequency converters, pulse modulation procedures and analytical expressions of the flux-controlled induction motor steady-state characteristics are included. There are presented scalar-control strategies based on direct and indirect flux regulation versus vector-control strategies with direct and indirect field-orientation, for voltage- and current-source fed drives. There are treated characteristic details regarding generation, computation and identification of the feedforward and feedback control variables. Performance analysis based on simulation results is made.

Subjective Video Quality Measurements of Digital Television Streams with Various Bitrates

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Keywords:

subjective and objective quality, statistical multiplexing, transport stream

Abstract:

In the past few years we have dealt with subjective and objective picture quality measurements of digital television streams in the Digital Television Laboratory of the Department of Automation. After we had analysed the results of our subjective tests and drawn the conclusions, we started new subjective quality measurements focusing on the video quality of the digital television streams, so called transport streams, which have different bitrates.

Compression methods for digital television use different compression algorithms. Quality measurements are used to find the best compression method. There are two main categories of comparison methods: the objective video quality evaluation method based on mathematical calculations and the subjective video quality evaluation methods based on tests performed by an audience.

Digital television streams, however, are compressed according to the MPEG-2 or MPEG-4 standards. Nowadays digital television broadcasting systems often use statistical multiplexers. In statistical multiplexing, the communication channel is divided into an appropriate number of variable bit-rate digital channels or data streams. Our goal is to determine the

bitrates, which are just acceptable. In other words, observers will study the digital television streams which have various coding parameters and then evaluate, which streams have appropriate quality. Here we use quality measurements to find the compression parameters, which still result in acceptable video quality.

This paper first presents the most important standardised subjective quality assessment methods described in the ITU-R BT.500 standard. Then we briefly summarise why these subjective tests are so important in our situation. Finally we discuss the structure and implementation of the subjective video quality measurements of the impaired digital quality television programs. Our aim is to improve these subjective picture quality assessment methods to get sophisticated results which better correlates with the objective picture quality test results. We would like to develop some objective picture quality measurements in the future.

Rate Control in Open-Loop MPEG Video Transcoder

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Keywords:

Video, MPEG, bitrate, transcoder, DVB, codec

Abstract:

Many of today video services and multimedia applications are expected to use preencoded video for storage and transmission. Video transcoding is intended to provide transmission flexibility to preencoded bit streams by dynamically adjusting the bit rate of these bit streams according to new bandwidth constraints that were unknown at the time of encoding. What makes transcoding different from video encoding is that the transcoding has access to many coding parameters and statistics that can be easily obtained from the input compressed video stream. They may be used not only to simplify the computation, but also to improve the video quality. In this paper, we propose a low complexity rate-control method for open loop MPEG-2 video transcoders, working entirely in the frequency domain. The open-loop transcoders are computationally efficient, since they operate directly on the DCT coefficients, so they are mainly used in systems with real-time requirements. However, they suffer from the drift problem. Rate control determines quantization parameters and is responsible for maintaining consistent video quality while satisfying bandwidth, delay, and memory constraints.

Partially Serialized Computation in Networks of Pulse-based Artificial Neurons

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Keywords:

Spiking neural networks, hardware implementation, embedded microcontrollers, FPGA.

Abstract:

Artificial neural networks attempt to understand the essential computations that take place in the dense networks of interconnected neurons making up the central nervous systems in living creatures. This paper demonstrates that artificial spiking neural networks, – built to resemble the biological model – encoding information in the timing of single spikes are capable of computing and learning clusters from realistic data. It shows how a spiking neural network based on spike-time coding and Hebbian learning can successfully perform unsupervised clustering on real-world data. A temporal encoding of continuously valued data is developed: input variables are encoded in a population code by neurons with graded and overlapping sensitivity profiles. These models are then used to develop a suitable hardware implementation on FPGA circuits. The fully parallel implementation of such neural networks would give the highest performance, but it also consumes significant hardware resources. Hence, a partially serialized solution is given, that makes use of embedded soft-core microcontrollers to implement some of the most resource-consuming components of the artificial neural network. Details of the implementation are given, with test bench description and results of the most important components.

Text Conditioning and Statistical Language Modeling Aspects for Romanian Language

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Keywords:

Romanian statistical language modelling, natural language processing, text conditioning, ARPA-MIT language model format, n-gram language model, smoothing, perplexity.

Abstract:

In this paper we present a synthesis of the theoretical fundamentals and some practical aspects of statistical (n-gram) language modeling which is a main part of a large vocabulary statistical speech recognition system. There are presented the unigram, bigram and trigram language models as well as the Good-Turing estimator based Katz back-off smoothing algorithm. There is also described the perplexity measure of a language model used for evaluation.

The practical experiments were made on Romanian Constitution corpus. There are also presented the text normalization steps before the language model generation. The results are ARPA-MIT format language models for Romanian language. The models were tested and compared using perplexity measure.

Finally some comparisons were made between Romanian and English language modeling and conclusions are drawn.

FPGA Implementation of Fuzzy Controllers and Simulation Based on a Fuzzy Controlled Mobile Robot

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Keywords:

FUZZY control, mobile robot

Abstract:

Fuzzy controllers are a simple method system control. Combining the simplicity of fuzzy systems with the parallel implementation on FPGA circuits, we can obtain a very fast controller. In the paper we present a fuzzy controller implemented on an FPGA circuit, relating about the implementation of the membership functions, table of rules, the inference system and of the defuzzyfication modules on this hardware tool. In the last part of the paper we will exemplify the control of a mobile robot with a fuzzy controller.

A Weighted Patient Specific Electromechanical Model of the Heart

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Keywords:

active appearance motion model, electro-mechanical heart model, evolutionary computation, parameter reduction, patient specific analysis

Abstract:

This paper presents a patient specific deformable heart model that involves the known electric and mechanic properties of the cardiac cells and tissue. The accuracy and efficiency of the algorithm was tested for anisotropic and inhomogeneous 3D domains using ten Tusscher's and Nygen's cardiac cell models. During propagation of depolarization wave, the kinetic, compositional and rotational anisotropy is included in the tissue, organ and torso model. The applied patient specific parameters were determined by an evolutionary computation method. An intensive parameter reduction was performed using the abstract formulation of the searching space. This patient specific parameter representation enables the adjustment of deformable model parameters in real-time. The validation process was performed using measured ECG and ultrasound image records that were compared with simulated signals and shapes using an abstract, parameterized evaluation criterion.

Marginal Product Model Assisted Local Search

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Keywords:

Marginal product model, local search, adaptive neighbourhood structure

Abstract:

We extend the classical local search optimization framework with machine learning techniques in order to infer and exploit search variable interactions. We show that sampling according to a learnt marginal product model enables local search techniques to solve hard problems characterized by multivariate interactions, which are intractable using fixed representation and operators.

Investigating a novel model of human blood glucose system at molecular levels from control theory point of view

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Keywords:

diabetes, nonlinear analysis, model reduction, physiologic steady points

Abstract:

According to the data provided by the World Health Organization (WHO) diabetes has become an endemic of these days. There are several nonlinear models describing the dynamic of glucose-insulin of diabetes mellitus, like the simplest one with only three state variables, also known as the model of Bergman, and the most complex with 19 state variables, the model of Sorensen. Their common characteristic is they describe type I diabetes physiologically.

A recently published theoretical model is capable of describing the human blood glucose system at molecular levels. This paper is based on its analysis from control theory point of view with multiple purposes: nonlinear analysis, rank reduction possibilities with physiological explanations, defining physiological steady points for further polytopic modelling, analysing control properties of the linear systems in the defined working points.

ADAPTED DISCRETE WAVELET FUNCTION DESIGN FOR ECG SIGNAL ANALYSIS

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Keywords:

wavelet analysis, decomposition and reconstruction filter banks, multiresolutrion analysis, discrete wavelet transform

Abstract:

The main task in wavelet analysis (decomposition and reconstruction) is to find a good analysing function (mother wavelet) to perform an optimal decomposition. The goal of most wavelet research is to create a set of basis functions and transforms that will give an informative, efficient and useful description of a signal. It's better, if the analysing function is adapted to the signal, because using adapted wavelet functions the computational costs can be reduced and more accurate analysis can be obtained. This paper presents a discrete wavelet function synthesizer, which starts from an arbitrary, discretized sequence, to obtain the reconstruction and decomposition filters. The followed criterion is to minimize the reconstruction error between a first or second order approximation and the original signal.

Phase Transformations in the Heat Treated and Untreated Zn-Al Alloys

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Keywords:

Zn-Al alloys, eutectoid reaction, dilatometric analysis, activation energy

Abstract:

Microstructure changes and phase transformations of Zn-Al based alloys have been systematically studied, using XRD, SEM and TEM techniques. The paper presents the results of experimental research concerning the eutectoid transformation in the Zn-Al system. The paper focuses on the determination of the activation energy for the eutectoid transformation in the binary Zn- (4, 8, 12, 22, 27) % Al system, using the values of the temperatures corresponding to the peaks on the derivatives of the dilatation curves.

Experimental Investigations on Cylinder-Head Gasket Materials Mechanical Properties Used In Numerical Analysis

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Keywords:

Mechanical Properties, Characteristic Curves, Cylinder-Head Gasket, Finite Elements Modeling

Abstract:

The authors performed several experimental tests regarding on establishing the mechanical properties of two type of materials used for cylinder-head gasket in Romanian truck industry. The cylinder-head gasket material was considered as some parallel connected elastic elements. Their elastic behaviors determine the final properties of the whole cylinder-had gasket material. These properties were used for Finite Element modeling of the stress-strain state evaluation of the cylinder-head gaskets.

Challenges in a Web-based Personalized IPTV Service

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Keywords:

IPTV, WebTV, internet/web-based television

Abstract:

Internet protocol television (IPTV), one of the most emerging services, offers multimedia streaming services with security, reliability, and relevant quality of service (QoS) / quality of experience (QoE). It provides added values to all the involving players including customers and also brings technical and business challenges to those players. For IPTV services, we expect to adopt the next generation network environment for high quality and the Web technologies for personalization to meet the customer's necessity. Web can provide an open, flexible, and agile platform. Therefore, in this paper, we propose personalized IPTV services based on Web-based open platform and present functional architecture for Web-based personalized IPTV services. Technical issues for deploying the proposed IPTV services using Web are also provided. The objective of this paper is to analyze the critical architectural and design issues for developing an attractive, high-quality, viable and feasible model for personalized IPTV service.

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Model and simulate mechanical systems with MathWorks tools

Somlay Gergely - Gamax Kft

In Model-Based Design, a system model is at the center of the development process from requirements capture and design to implementation and test. It is a well-established process that promotes team collaboration and supports the design and development of complex algorithms in coordination with the physical hardware.

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SimMechanics™ extends Simscape™ with tools for modeling three-dimensional mechanical systems within the Simulink® environment. Instead of deriving and programming equations, you can use this multibody simulation tool to build a model composed of bodies, joints, constraints, and force elements that reflects the structure of the system. An automatically generated 3-D animation lets you visualize the system dynamics. You can import models complete with mass, inertia, constraint, and 3-D geometry from several CAD systems.

This presentation will show how Simulink® enables faster and more effective development of electromechanical systems through simulation. We demonstrate how to build mechanical models using SimMechanics and SimScape. As a demonstration we will show you how to model a double pendelum. You will also see how to access both products through the Simulink interface, and how to integrate them with other tools that complement the MATLAB® and Simulink platforms.

These products enable efficient modeling and simulation of controlled electromechanical designs without relying on physical prototypes. This enables early and thorough testing of a design, leading you to explore options thoroughly, detect problems early, and save both time and money.

Linear guides with integrated measuring system

Alexandru Vava – BoschRexroth Sp.z.o.o. – reprezentance Romania

1. Product overview

The system delivers a perfect combination between the features of a robust rolling linear guides and advantages of a linear measuring system, incorporated into the moving element. Thus, no measuring inaccuracies occur due to deviation in parallelism between the measuring system and guideway.

The Rexroth linear guides who take advantage of this range extension are ball rail systems (size 20-45) and roller rail systems (size 35-65). The maximum length of the guide rail is 4.0m (up to 4.5m on request).

Inductive measuring system

- contact-free scanning (ca. 10µm gap) ensures zero maintenance
- insensitive to magnetic fields and vibrations

Incremental measuring principle

- high precision, comparable with optical measuring systems
- absolute measuring system: while scanning, the sensor delivers only ascending or descending numerical values, related to scanner resolution

Protection class IP67 and IP67*plus*, meaning,

- maximum protection against solid particles (dust)
- protection to temporary immersion in water
- IP67*plus* offers resistance to metalworking fluids

Maximum travel speed

- 5m/s, for scanner resolution bigger than 5µm
- 1m/s, for scanner resolution of 1µm
- 0.5m/s, for scanner resolution of 0.25µm

Operating temperature: 0-50°C.

Power supply of 5V, directly on sensor unit (not derivated from another device, e.g. CNC).

2. Definitions

Resolution = increment size (step) for which the sensor delivers a signal

Repeatability = the deviation from a specific target resulting from a certain number of attempts. The accuracy of the measuring system is made up of the following components:

- scale pitch accuracy
- deviation of the interpolation (fixed to ±3µm)

3. Runner block and scanner

The transducer is made up of two coils, one transmitter and one receiver. The transmitter coil generates a magnetic field which, depending on the existing iron (the integrated steel scale), generates a voltage into the receiver coil. By analogy is the magnetic measuring system, where the alternative North/South poles are read by direct contact by a sensor (e.g. obsolete audio tapes).

The output signal from the transducer is analogue (sinusoidal, with period T=1000μm and amplitude 1Vpp) or digital (TTL square wave, +5V), and results from real time analyzes of two incremental signals, overlapped and phase-shifted by p/4. The sinusoidal signal is crude signal and has the resolution of 1000μm (the steel scale pitch). This can be interpolated by means of external interpolator, e.g. the one of a CNC. TTL signal is interpolated internally and, depending on interpolation factor, offers the following resolutions: 0.25μm, 1μm, 5μm, and 10μm.

The sensor head is detachable, which provides a major economical advantage when it comes down to replacement of a wear runner block. The runner block types available for this measuring system are with flange, narrow or high, in standard length or long version.

4. Guide rail

The guide rail incorporates a graduated steel strip, with the pitch of 1000μm=1mm. The scale is spot welded at both ends into a groove on the rail and protected by a laser welded stainless steel band all the length down. Thus, the full protection against solid particles (e.g. metal chips) that could disturb the measure process is achieved. The thermal expansion coefficient of the scale is the same as the guide rail _ _ 11·10-6 [K-1].

The guide rail can be manufactured with partial measuring interval, with scale mounted on a specific zone on the rail. In order to be able to approach a specific position, an absolute reference point is necessary. This reference point is achieved by single or distance-coded reference marks.

The single reference mark is machined into the rail on the side opposite to the scale, and can be defined as desired by the customer. When the sensor passes through the reference mark, the system resets to zero and relative measurement begins. This situation means that every time the machine turns on, or after a power supply break-down, the moving carriage must travel over the reference mark for calibration.

- the distance-coded reference marks are machined into the rail on the side opposite to the scale, and consists of two sets of reference marks with different equidistant steps. When the sensor passes through any two reference marks, the system resets to zero and relative measurement begins. This is an advantage over the single reference mark, because the

system calibration is realized immediately after the carriage travels over any two consecutive reference marks on the rail.
- the reference system generates an electrical signal for every of the two states “inactive” and “active”.

5. Other topics

Linear guides with integrated measuring system are not the right choice for interpolated multi-axis applications (simultaneous drive, e.g. cutting out a closed outline) due to the fact that interpolation error of the measuring system is directly influencing the trajectory of the linear axis with the measuring system mounted on. The output signal is compatible with the most available CNC on the market (Rexroth, Siemens, GE Fanuc, etc.).

Design Mechatronic Systems Faster - Selecting the Right Tools for Embedded System Design

Vlad Zileriu – National Instruments