



# **2023 27<sup>th</sup> International Conference on System Theory, Control and Computing (ICSTCC)**

**October 11 - 13, 2023  
Timisoara, Romania**

## **PROCEEDINGS**

**Editor:  
Radu-Emil Precup**

**CATALOG NUMBERS:  
ISBN 979-8-3503-3798-3, IEEE Catalog Number CFP2336P-ART**

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(ICSTCC)**

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# General Program

## Wednesday, October 11, 2023

**Registration (8<sup>30</sup> – 13<sup>00</sup>, 14<sup>45</sup> – 16<sup>45</sup>)**

09<sup>00</sup> – 09<sup>20</sup> Opening ceremony WeOC1

09<sup>20</sup> – 10<sup>20</sup> Plenary talk WeP1: *Florian Dörfler*

10<sup>20</sup> – 10<sup>50</sup> Coffee break

10<sup>50</sup> – 11<sup>50</sup> Plenary talk WeP2: *Mirjana Ivanović*

11<sup>50</sup> – 12<sup>50</sup> Parallel sessions WeA1 – WeA3

12<sup>50</sup> – 14<sup>00</sup> Lunch (Ibis Hotel Restaurant)

14<sup>00</sup> – 15<sup>40</sup> Parallel sessions WeB1 – WeB3

15<sup>40</sup> – 16<sup>10</sup> Coffee break

16<sup>10</sup> – 17<sup>50</sup> Parallel sessions WeC1 – WeC3

19<sup>00</sup> – 23<sup>00</sup> Welcome Party (Ibis Hotel Restaurant)

## Thursday, October 12, 2023

**Registration (8<sup>30</sup> – 13<sup>00</sup>, 14<sup>45</sup> – 16<sup>45</sup>)**

09<sup>00</sup> – 10<sup>00</sup> Plenary talk ThP1: *Ming Cao*

10<sup>00</sup> – 10<sup>30</sup> Coffee break

10<sup>30</sup> – 12<sup>30</sup> Parallel sessions ThA1 – ThA3

12<sup>50</sup> – 14<sup>00</sup> Lunch (Ibis Hotel Restaurant)

14<sup>00</sup> – 16<sup>00</sup> Parallel sessions ThB1 – ThB3

19<sup>00</sup> – 23<sup>00</sup> Conference Dinner (Ibis Hotel Restaurant)

## **Friday, October 13, 2023**

### **Registration (09<sup>00</sup> – 12<sup>15</sup>)**

09<sup>00</sup> – 09<sup>50</sup> Round table FrRT1: Challenges and Solutions – Women in Engineering

09<sup>50</sup> – 10<sup>20</sup> Coffee break

10<sup>20</sup> – 12<sup>00</sup> Parallel sessions FrA1 – FrA3

12<sup>00</sup> – 13<sup>00</sup> Closing ceremony FrCC1

13<sup>00</sup> – 14<sup>00</sup> Lunch (Ibis Hotel Restaurant)



## 2023 27th International Conference on System Theory, Control and Computing (ICSTCC)

October 11-13, 2023, Timisoara, Romania

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Last updated on September 6, 2023. This conference program is tentative and subject to change

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09:00-09:20 Pop Rock + Blues + Jazz Room WeOC1  <a href="#">Opening Ceremony</a>		
09:20-10:20 Pop Rock + Blues + Jazz Room Plenary talk WeP1  <a href="#">Florian Dörfler: Online Feedback Optimization</a>		
10:50-11:50 Pop Rock + Blues + Jazz Room Plenary talk WeP2  <a href="#">Mirjana Ivanović: Influence of Federated Learning on Contemporary Distributed Machine Learning Research</a>		
11:50-12:50 Pop Rock + Blues + Jazz Room Room Regular session WeA1  <a href="#">Linear Systems</a>	11:50-12:50 Folk Room Regular session WeA2  <a href="#">Education and Training - I</a>	11:50-12:50 Disco Room Invited session WeA3  <a href="#">Monitoring, Guidance and Control of Space Vehicles - I</a>
14:00-15:40 Pop Rock + Blues + Jazz Room Room Regular session WeB1  <a href="#">Nonlinear Systems</a>	14:00-15:40 Folk Room Regular session WeB2  <a href="#">Education and Training - II</a>	14:00-15:40 Disco Room Invited session WeB3  <a href="#">Monitoring, Guidance and Control of Space Vehicles - II</a>
16:10-17:50 Energy Room Regular session WeC1  <a href="#">Computer Vision</a>	16:10-17:50 Folk Room Regular session WeC2  <a href="#">Control System Design</a>	16:10-17:50 Disco Room Regular session WeC3  <a href="#">Control Applications</a>

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ICSTCC 2023 Technical Program Thursday October 12, 2023		
Track T1	Track T2	Track T3
09:00-10:00 Pop Rock + Blues + Jazz Room Plenary talk ThP1  <a href="#">Ming Cao: Network Games and Collective Decision-Making</a>		
10:30-12:30 Pop Rock + Blues + Jazz Room Regular session ThA1  <a href="#">Optimization</a>	10:30-12:30 Folk Room Regular session ThA2  <a href="#">Robotics</a>	10:30-12:30 Disco Room Invited session ThA3  <a href="#">Cloud Computing: Algorithms, Services and Applications</a>
14:00-16:00 Pop Rock + Blues + Jazz Room Regular session ThB1  <a href="#">Predictive Control</a>	14:00-16:00 Folk Room Regular session ThB2  <a href="#">Advances in Control and Computing</a>	14:00-16:00 Disco Room Regular session ThB3  <a href="#">Machine Learning</a>

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ICSTCC 2023 Technical Program Friday October 13, 2023		
Track T1	Track T2	Track T3
09:00-09:50 Pop Rock + Blues + Jazz Room FrRT1  <a href="#">Round Table on Women in Engineering - Challenges and Solutions</a>		
10:20-12:00 Pop Rock + Blues + Jazz Room Regular session FrA1  <a href="#">System Identification and Modeling</a>	10:20-12:00 Folk Room Regular session FrA2  <a href="#">Software Engineering</a>	10:20-12:00 Disco Room Regular session FrA3  <a href="#">Cyber-Security</a>
12:00-13:00 Pop Rock + Blues + Jazz Room FrCC1  <a href="#">Closing Ceremony</a>		



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### Technical Program for Wednesday October 11, 2023

To show or hide the keywords and abstract (text summary) of a paper (if available), click on the paper title.

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**WeOC1** Pop Rock + Blues + Jazz Room

Add to My Program ☐

#### [Opening Ceremony](#)

Chair: [Precup, Radu-Emil](#)

Politehnica University of Timisoara

Co-Chair: [Barbu, Marian](#)

Dunarea De Jos University of Galati

**WeP1** Plenary talk, Pop Rock + Blues + Jazz Room

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#### [Florin Dörfler: Online Feedback Optimization](#)

Chair: [Barbu, Marian](#)

Dunarea De Jos University of Galati

**WeP2** Plenary talk, Pop Rock + Blues + Jazz Room

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#### [Mirjana Ivanović: Influence of Federated Learning on Contemporary Distributed Machine Learning Research](#)

Chair: [Marcu, Marius](#)

Politehnica University of Timisoara

**WeA1** Regular session, Pop Rock + Blues + Jazz Room Room

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#### [Linear Systems](#)

Chair: [Danciu, Daniela](#)

University of Craiova

Co-Chair: [Matcovschi, Mihaela-Hanako](#)

Gheorghe Asachi Technical  
University of Iasi

11:50-12:10, Paper WeA1.1

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#### [Lyapunov Functions for Discrete-Time Arbitrary Switching Linear Systems - Joint Setting for Mode Dependent and Independent Constructions](#)

[Pastravanu, Octavian-Cezar](#)

Gheorghe Asachi Technical  
University of Iasi

[Matcovschi, Mihaela-Hanako](#)

Gheorghe Asachi Technical  
University of Iasi

**Keywords:** [Hybrid Systems](#), [Linear Systems](#), [Nonlinear Systems](#)

**Abstract:** The paper aims to present and prove a general result regarding the usage of Lyapunov functions in testing the global exponential stability of equilibrium (0) for discrete-time arbitrary switching linear systems. The generality consists, on the one hand, in the possibility of working with both mode-dependent and mode-independent Lyapunov functions, and on the other hand, in the diversity of available concrete expressions (weighted vector norms). The flexible mathematical formulation allows the retrieval of several stability criteria that had been reported by separate articles, as various particular cases included in the generality of our new result. From this general result, individual criteria are derived by considering extended state-space representations for the description of systems dynamics, as well as several types of absolute norms in the definition of Lyapunov functions.

12:10-12:30, Paper WeA1.2

Add to My Program ☐

#### [On \(Exponential\) Stability for Systems with Propagation Phenomena](#)

[Danciu, Daniela](#)

University of Craiova

[Popescu, Dan](#)

University of Craiova

[Rasvan, Vladimir](#)

University of Craiova

**Keywords:** [Linear Systems](#), [Industrial Applications](#), [Control Systems Design](#)

**Abstract:** It is considered the problem of stabilizing the torsional vibrations of a distributed flexible beam using boundary control. A Lyapunov functional obtained by modifying the energy functional is introduced, thus allowing to obtain exponential stability under quite mildly restrictive conditions. The bounded peaking problem is also discussed within the same framework. The paper ends by pointing other research problems which might be revisited within the aforementioned Lyapunov framework.

12:30-12:50, Paper WeA1.3

Add to My Program ☐

#### [Tensor Product-Based and State Feedback Control Solutions for Cart Position Control of Pendulum-Cart Systems](#)

[Hedrea, Elena-Lorena](#)

Politehnica University of Timisoara

[Precup, Radu-Emil](#)

Politehnica University of Timisoara

[Roman, Raul-Cristian](#)

Politehnica University of Timisoara

[Hedrea, Ciprian](#)

Politehnica University Timisoara

**Keywords:** [Control Systems Design](#), [System Identification and Modeling](#), [Linear Systems](#)

**Abstract:** In this paper the design and validation of ten control system (CS) structures for the cart position control of pendulum-cart systems (PCSs) are presented. In the first step the derivation of a Tensor Product (TP) model and four linear models for the PCS is conducted. In the second step, for each model a Single Input-Single Output CS structure is designed. The first CS structure includes a TP-based controller, and the other four CS structures include state feedback controllers. All controllers are tuned using the Linear Matrix Inequality & Parallel Distributed Compensation technique aiming the same system performance specifications. The five CS structures do not ensure zero steady-state control error; therefore they are included in cascade control system structures with Proportional-Integral controllers in the outer control loops. The same experimental scenario is used to test all CSs. Finally, a comparative analysis is conducted by computing five performance indices, namely the absolute value of the control error, the mean square error, the mean

square control effort, the settling time and the overshoot.

**WeA2** Regular session, Folk Room

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**Education and Training - I**

Chair: [Popescu, Elvira](#)

University of Craiova

Co-Chair: [Opritoiu, Flavius](#)

Politehnica University of Timisoara

11:50-12:10, Paper WeA2.1

Add to My Program ☐

[Systolic Array Architecture for Educational Use](#)

[Opritoiu, Flavius](#)

Politehnica University of Timisoara

[Vladutiu, Mircea](#)

Politehnica University of Timisoara

**Keywords:** [Computer Architectures](#), [Computer Science Education and Training](#), [Machine Learning](#)

**Abstract:** This paper presents a systolic array architecture for General Matrix Multiplication. The system was designed and verified using the Verilog description language. The architecture was constructed for educational use aiming to complement the practical activities of Computer Architecture classes. The proposed solution can be used as a design space exploration tool for evaluation of matrix multiplication accelerators based on non-stationary systolic arrays. Both the width and format of the processed operands as well as the number of stages of the systolic array's Processing Elements can be customized. As a case study, the design and performance of a systolic array for accelerating the multiplication of square matrices of signed, 8-bit integers, is presented. The overall architecture was synthesized for the Altera DE2 FPGA board in order to evaluate its performance.

12:10-12:30, Paper WeA2.2

Add to My Program ☐

[Enthusing Engineering Students Over Multi-Agent Systems Control Via Human-Robot Interaction](#)

[Petit-Magat, Victor](#)

CentraleSupélec

[Lhachemi, Hugo](#)

CentraleSupélec

[Stoica, Cristina](#)

CentraleSupélec/L2S

[Thakker, Aarsh](#)

L2S, Univ. Paris-Saclay

[Da Silva, Miguel](#)

L2S, Univ. Paris-Saclay

**Keywords:** [Automatic Control Education and Training](#)

**Abstract:** This paper reports an easily reproducible experiment that can be used in class to illustrate fundamental concepts on Multi-Agent Systems (MAS) via human-robot interactions. In this context, the primary objective of this paper is to provide teaching resources to motivate students taking engineering courses on Robotics and MAS control that involve humans in the loop interactions. A leader-follower approach with a human being as a leader and a 4-degree of freedom robotic manipulator as a follower is proposed. An illustrative video is provided to highlight the first experimental results. Furthermore, the proposed experiments are further intended to popularize Robotics and Control to broad public during Open Days events in universities.

12:30-12:50, Paper WeA2.3

Add to My Program ☐

[Investigating Students' Experience with Peer Assessment in Two Computer Science Courses - a Longitudinal Study](#)

[Badea, Gabriel](#)

University of Craiova

[Popescu, Elvira](#)

University of Craiova

**Keywords:** [Computer Science Education and Training](#), [Software Engineering](#)

**Abstract:** The effects of peer assessment on students' learning experience over time are scarcely examined in the literature. The current research performs a longitudinal study that explores the use of LearnEval, a comprehensive peer assessment platform, in two computer science courses in two consecutive years. Both courses followed a Project-Based Learning (PBL) approach, allowing a peer assessment component to be easily integrated. In 2020-2021 academic year, 78 students participated in the process in a 3rd year Web Applications Design course. In the following year, a subset of the same students (54) participated in the activity in a 4th year Human-Computer Interaction course. A quantitative analysis of the outcomes in the two years was performed and the results were compared. Furthermore, the LearnEval usability was assessed. Therefore, the current work addresses two research questions: (1) How do the outcomes of the peer assessment activity in the 4th year course compare to the previous year when the students attended the process for the first time? (2) How did the students perceive LearnEval usability in the two years? The main findings show that the results were slightly improved in the second year of attending the peer assessment process in terms of involvement, reviewing skills, grades assigned and quality of the feedback provided.

**WeA3** Invited session, Disco Room

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**Monitoring, Guidance and Control of Space Vehicles - I**

Chair: [Lungu, Mihai-Aureliu](#)

University of Craiova

Co-Chair: [Barbulescu, Lucian-Florentin](#)

University of Craiova

Organizer: [Lungu, Mihai-Aureliu](#)

University of Craiova

Organizer: [Barbulescu, Lucian-Florentin](#)

University of Craiova

Organizer: [Larco, Ciprian-Marius](#)

Military Technical Academy

Organizer: [Vidan, Cristian](#)

Military Technical Academy

11:50-12:10, Paper WeA3.1

Add to My Program ☐

[Nonlinear Model Predictive Control of a Satellite Attitude Dynamics in  \$SO\(3\)\$  \(I\)](#)

[Sánchez Medel, José Antonio](#)

CIO

[Aldana, Noé](#)

Universidad Iberoamericana León

[Lungu, Mihai-Aureliu](#)

University of Craiova

[Flores, Gerardo](#)

Center for Research in Optics

**Keywords:** [Control Systems Design](#), [Predictive Control](#), [Nonlinear Systems](#)

**Abstract:** This research study centers around the development of a nonlinear model predictive control (NMPC) model based on the special orthogonal group of dimension 3,  $\mathbf{SO}(3)$ , to achieve precise tracking of a desired satellite orientation in the presence of exogenous disturbances. Furthermore, this approach aims to optimize energy and fuel consumption by effectively minimizing the tracking and configuration error functions and the control input, promoting sustainability in satellite missions. The critical contribution of our approach lies in integrating the  $\mathbf{SO}(3)$  framework, which enables the construction of a comprehensive control model. This integration allows for an accurate representation of the satellite's orientation dynamics, avoiding singularities and enhancing the precision and robustness of the control system. Through extensive simulations, we provide compelling evidence of the effectiveness and practical viability of the proposed approach.

12:10-12:30, Paper WeA3.2

Add to My Program ☐

[Wavelet Denoising Method for Improving the Accuracy of Attitude Determination in Miniaturized Space Applications \(I\)](#)

<a href="#">Antofie, Bianca-Gabriela</a>	Military Technical Academy "Ferdinand I"
<a href="#">Vidan, Cristian</a>	Military Technical Academy "Ferdinand I"
<a href="#">Boglis, Ioana-Carmen</a>	Military Technical Academy
<a href="#">Larco, Ciprian-Marius</a>	Military Technical Academy
<a href="#">Teodor Lucian, Grigorie</a>	Universitatea POLITEHNICA Din Bucuresti

**Keywords:** [Instrumentation](#), [Signal Processing](#), [Embedded Systems](#)

**Abstract:** This paper presents a new approach for improving the attitude determination precision of small satellite systems by filtering the data acquired from their MEMS inertial sensors. The growth in the global space sector requires innovative solutions that can guarantee the successful integration of emerging technologies. While miniaturization may appear ideal for space missions because of the reduction in dimension and cost, the enhanced sensitivity to external factors usually compromises the accuracy of navigation information. The core of this research lies in finding a way to preserve the valuable attitude information from the noise-corrupted signals provided by a cluster of MEMS gyros. The proposed method for processing the perturbed signals was the powerful tool of wavelet multiresolution analysis (WMRA). The procedure was software implemented with the help of MATLAB apps Simulink and Wavelet Analyzer which ensured the implementation of a gyro model, an attitude determination algorithm and the wavelet decomposition of the simulated signals. To fully validate the use of wavelets in enhancing attitude estimation, the study was conducted in two distinct phases: local and global validation. The results of the simulations showed the effectiveness of each wavelet function and level of decomposition for noise reduction and attitude angles accuracy improvement.

12:30-12:50, Paper WeA3.3

Add to My Program ☐

[Adaptive Control of the Relative Position for Space Vehicles in the Rendezvous Missions \(I\)](#)

<a href="#">Lungu, Romulus</a>	University of Craiova
<a href="#">Butu, Florentin-Alin</a>	University Politehnica of Bucharest
<a href="#">Lungu, Mihai-Aureliu</a>	University of Craiova
<a href="#">Chen, Mou</a>	NUAA

**Keywords:** [Automotive Control Systems](#), [Adaptive Control](#), [Signal Processing](#)

**Abstract:** This paper addresses the relative orbit control problem and proposes an adaptive control approach using the estimation of the orbital parameters. The control architecture consists of three derivative-free model reference adaptive control systems and a Kalman filter to estimate the parameters of the elliptical orbit. The design also involves PD controllers, reduced-order observers, second-order reference models, and Lyapunov equations. The stability of the three control systems is briefly analyzed via the Lyapunov theory. The carried out numerical simulations prove that the rendezvous mission is successfully accomplished, the designed control architecture being able to accurately drive the chaser vehicle to the imposed position, as well to cancel the position, speed, and acceleration errors.

**WeB1** Regular session, Pop Rock + Blues + Jazz Room Room

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[Nonlinear Systems](#)

Chair: <a href="#">Hedrea, Elena-Lorena</a>	Politehnica University of Timisoara
Co-Chair: <a href="#">Zorzi, Mattia</a>	Universita Degli Studi Di Padova

14:00-14:20, Paper WeB1.1

Add to My Program ☐

[Cascaded Sliding-Mode Control of a Vapor Compression Cycle](#)

<a href="#">Husmann, Ricus</a>	University of Rostock
<a href="#">Weishaupt, Sven</a>	University of Rostock
<a href="#">Aschemann, Harald</a>	University of Rostock

**Keywords:** [Nonlinear Systems](#), [Robust Control](#), [Control Systems Design](#)

**Abstract:** This paper presents a cascaded control structure based on a sliding-mode controller for the trajectory tracking control of a vapor compression cycle. For this purpose, an existing high-order system model is split into a linear as well as a nonlinear subsystem and both are described by reduced-order models. The linear outer subsystem is controlled by an output feedback control in conjunction with a disturbance observer. The nonlinear subsystem, however, is controlled via a sliding-mode controller to address model uncertainty. The stability of the internal dynamics of the input-output linearisation, which serves as the basis of the sliding-mode controller, is ensured by input constraints w.r.t. the outer control-loop. The proposed control structure is tested on the full high-order simulation model and compared to a previously presented controller based on input-output linearisation. The comparison indicated a significant improvement of control performance as well as robustness concerning disturbances and model uncertainty.

14:20-14:40, Paper WeB1.2

Add to My Program ☐

[High Gain Embedding Observer Design: Combining Differential Geometry and Algebra with Machine Learning](#)

<a href="#">Röbenack, Klaus</a>	TU Dresden
<a href="#">Fiedler, Julius</a>	TU Dresden
<a href="#">Gerbet, Daniel</a>	TU Dresden

**Keywords:** [Nonlinear Systems](#), [Control Systems Design](#), [System Identification and Modeling](#)

**Abstract:** High gain observers are often used for the real-time estimation of the state of nonlinear systems. Several design methods are based on normal forms, which are based on differential geometric considerations. The embedding into a higher dimensional state could be advantageous regarding existence conditions and convergence. However, computation and implementation of such embedding observers is usually significantly more challenging. In this paper, we circumvent some of these problems by employing machine learning. The required functions for the implementation of the observer are approximated by neural networks.

14:40-15:00, Paper WeB1.3

Add to My Program ☐

[Sliding-Mode-Based Input-Output Linearization of a Peltier Element for Ice Clamping Using a State and Disturbance Observer](#)

<a href="#">van Rossum, Felix</a>	Leuphana University Lueneburg
<a href="#">Haus, Benedikt</a>	Leuphana University Lüneburg
<a href="#">Mercorelli, Paolo</a>	Leuphana University of Lueneburg
<a href="#">Aschemann, Harald</a>	University of Rostock

**Keywords:** [Manufacturing Systems](#), [Industrial Applications](#), [Nonlinear Systems](#)

**Abstract:** This paper deals with an input-output linearization for a nonlinear ice clamping system based on a Peltier element used in an innovative manufacturing system. For this model-based design, a third-order state-space model is derived based on physical principles, and an input-output linearization is proposed with an asymptotically stable internal dynamics. Accordingly, a robust sliding-mode tracking control is designed to accurately track a desired cold side temperature even in the presence of disturbances. Unknown states as well as disturbances are estimated by a gain-scheduled nonlinear state and disturbance observer that can be assigned a linear error dynamics. Meaningful simulation results are shown that point out the effectiveness of the proposed control approach.



15:00-15:20, Paper WeB1.4

Add to My Program ☐[Control of a Three-Axis Robot with Super Twisting Sliding Mode Control](#)[Rehbein, Jan-Philip](#)University of Applied Science  
Leipzig[Haus, Benedikt](#)

Leuphana University Lüneburg

[Mercorelli, Paolo](#)

Leuphana University of Lueneburg

**Keywords:** [Industrial Applications](#), [Robotics](#), [Nonlinear Systems](#)

**Abstract:** This paper shows the Lagrangian-based modelling of a fully actuated three-axis robot and a control application using a variant of Super Twisting Sliding Mode Control (STSMC) in which the robot is subject to disturbances and model uncertainties to demonstrate the robustness of the proposed method. The stability of the control system is proven with the help of the direct Lyapunov method. In particular, the robustness of the results is validated through computer simulations in which impulsive disturbances are simulated together with a model mismatch due to an uncompensated mechanical friction.

15:20-15:40, Paper WeB1.5

Add to My Program ☐[Robust Extended Kalman Smoothing under Model Uncertainties](#)[Yi, Shenglun](#)

University of Padua

[Zorzi, Mattia](#)

Universita Degli Studi Di Padova

**Keywords:** [System Identification and Modeling](#), [Nonlinear Systems](#), [Signal Processing](#)

**Abstract:** This paper proposes a robust extended Kalman smoothing approach in the case that there is a modeling mismatch between the given nominal nonlinear state-space model and the actual one. The resulting algorithm follows a linearization process and takes the form of a robust fixed-lag smoother. At each time step the computation of the smoothing gain of the linearized model is required. The latter is derived from a dynamic game: one player selects the least favorable model in a prescribed "ball" centered about the nominal linearized model in Kullback-Leibler (KL) divergence topology, and the other selects the optimal smoothing gain. Finally, some numerical experiments show the effectiveness of the proposed algorithm.

**WeB2** Regular session, Folk RoomAdd to My Program ☐[Education and Training - II](#)Chair: [Marian, Marius](#)

University of Craiova

Co-Chair: [Sbirna, Liana Simona](#)

University of Craiova

14:00-14:20, Paper WeB2.1

Add to My Program ☐[\(Re\)CreativeRobot: Popularizing Workshop to Promote Control and Mobile Robotics for Kids](#)[Stoica, Cristina](#)

CentraleSupélec/L2S

[Bertrand, Sylvain](#)

ONERA

[Thakker, Aarsh](#)

L2S, Univ. Paris-Saclay

[Chevet, Thomas](#)

ESIGELEC

[Gombert, Julien](#)

CentraleSupélec

[Ngnie-Tekou, Yvan](#)

CentraleSupélec

[Godoy, Julia](#)

CentraleSupélec

[Bourgeois, Justine](#)

CentraleSupélec

**Keywords:** [Automatic Control Education and Training](#)

**Abstract:** This paper focuses on the Workshop "(Re)Creative Mobile Robotics for Kids -- (Re)CreativeRobot" for popularizing Control and Mobile Robotics for children. Inspired from the "Girls in Control" workshop, this education activity allows children to individually implement basic Control algorithms on mobile robots via Scratch programming. Its first occurrence was held during the French science festival "Fête de la Science" 2022 edition. A second occurrence was held in a primary school in the Paris region, allowing small groups of kids to collaboratively develop Scratch algorithms for mobile robots. This paper shows some insights and perspectives of this perennial interactive Control Education activity.

14:20-14:40, Paper WeB2.2

Add to My Program ☐[Implementation and Performance Analysis of Sequential versus Parallelized Algorithms for Solving Multivariate Equations of CFD Poisson Processes](#)[Sbirná, Sebastian](#)

Technical University of Denmark

[Sbirna, Liana Simona](#)

University of Craiova

**Keywords:** [Software Engineering](#), [Computer Science Education and Training](#), [Theory of Algorithms](#)

**Abstract:** The present work aims to find computationally-efficient models for solving discretized partial differential equations. To accomplish that, we implement and compare the performance of a series of algorithmic models, both sequential and parallelized (using OpenMP libraries), which may be used for solving convergence problems. For demonstrating the results upon a real-world case scenario, the work introduces a CFD (computational fluid dynamics) Poisson process, which is numerically discretized and approximated using Jacobi and Gauss-Seidel algorithms. Performance of the parallelized implementations will be measured against a baseline, and the consequent model optimizations will be described. Finally, the scalability of the parallelized algorithms will be compared together, with regards to CPU thread count and memory handling. The results show that, compared with a sequential version, a parallelized Jacobi algorithm shows good performance and scalability when introducing more threads. At the same time, a parallelized version of the Gauss-Seidel algorithm did not present substantial increases in performance over its sequential counterpart.

14:40-15:00, Paper WeB2.3

Add to My Program ☐[A Study on the Perception of Digitalization and Use of Digital Technologies in Higher-Education Institutions](#)[Marian, Marius](#)

University of Craiova

[Borcosi, Ilie](#)

"Constantin Brancusi" University

[Ganea, Eugen](#)

University of Craiova

[Corina-Ana, Borcosi](#)

Constantin Brancusi University

[Popescu, Dorin](#)

University of Craiova

[Cusman, Adelin](#)

Centrul De Calcul S.A

**Keywords:** [Computer Science Education and Training](#)

**Abstract:** Correlating the education and training system with the evolution of today's technologies is a complex but necessary process for training, improvement, and lifelong learning. Digital technologies are present today in all fields, and have become increasingly necessary in higher education institutions, not only to attract students, to bring them into a familiar environment, but also to initiate and improve their skills in what is an evolution in science. The digitalization of education services is necessary to have a more accessible, interactive, and personalized educational process and this also involves the use of digital technologies, elements that contribute to people's self-education, and education outside

of schools' walls. In this paper we present aspects related to the digitalization of education, both from the perspective of educators and learners. It is a study carried out in two Romanian universities, the University of Craiova and the "Constantin Brâncuși" University of Târgu Jiu. The purpose of this work is to emphasize the necessity of digitalization, its importance, but also to emphasize the stage in which the two universities are now, in relation to what is meant by digitalization, who should be involved in the digitalization of the institution, what activities should be digitalized, knowledge of the digital signature concept or whether respondents use machine learning tools such as ChatGPT, or others. The results of this study reflect the opinion of the teachers and students of the two universities.

15:00-15:20, Paper WeB2.4

Add to My Program ☐

[Trigger Systems: Reusability and Applicability in Serious Games](#)

[Grosu, Mihai-Alexandru](#)

University Politehnica Timișoara

[Brumar, Raul](#)

University Politehnica Timișoara

[Nicola, Stelian](#)

University Politehnica Timișoara

[Ciocarlie, Horia](#)

Department of Computer Science/Polytechnic University

**Keywords:** [Virtual and Augmented Reality](#), [Computer Science Education and Training](#), [Human - Computer Interface](#)

**Abstract:** The integration of technology in education has provided a more interactive and engaging experience through the creation of Serious Games. By using 3D virtual environments and Virtual Reality, interactive experiences which simulate real-life situations and environments can be created. The development process of such applications often proves to be slow and cumbersome. However, the addition of a trigger system or scenario editor could enable educators to easily create scenarios for students without requiring much programming knowledge. Designing the trigger system should be based on the principles of reusability, applicability and extensibility. This paper focuses on the creation of such a trigger system and its uses throughout the development of a 3D VR Serious game called Visit UPT. This game enables students to explore the university campus and simulate small scientific experiments.

15:20-15:40, Paper WeB2.5

Add to My Program ☐

[Towards a Talking Tiny Cognitive Architecture for the Study of Spoken Language Evolution](#)

[Kaje, Smitha](#)

Department of Electrical and Computer Engineering, Stony Brook U

[Saviour, George Madathil](#)

Department of Electrical and Computer Engineering, Stony Brook U

[Doboli, Alex](#)

Stony Brook University

**Keywords:** [Embedded Systems](#), [Digital Design](#)

**Abstract:** Understanding spoken language evolution can offer important insight that is needed to devise intelligent systems with speech capabilities. However, existing work mostly focuses on mathematical and software models that are insensitive to naturalistic conditions, even though such conditions are essential in the evolution of real languages. This paper discusses the implementation of Talking Tiny Cognitive Architecture proposed to study language evolution in more naturalistic conditions. The architecture can generate new words that are verbally communicated to describe environment conditions. It also attempts to understand and learn words verbally communicated by another architecture. Experiments describe the performance of the implementation as an embedded system.

**WeB3** Invited session, Disco Room

Add to My Program ☐

[Monitoring, Guidance and Control of Space Vehicles - II](#)

Chair: [Lungu, Mihai-Aureliu](#)

University of Craiova

Co-Chair: [Barbulescu, Lucian-Florentin](#)

University of Craiova

Organizer: [Lungu, Mihai-Aureliu](#)

University of Craiova

Organizer: [Barbulescu, Lucian-Florentin](#)

University of Craiova

Organizer: [Larco, Ciprian-Marius](#)

Military Technical Academy

Organizer: [Vidan, Cristian](#)

Military Technical Academy

14:00-14:20, Paper WeB3.1

Add to My Program ☐

[Robust Optimal Control of Spacecraft During the Rendezvous Missions Using  \$H^\infty\$  Control Method \(I\)](#)

[Lungu, Romulus](#)

University of Craiova

[Butu, Florentin-Alin](#)

University Politehnica of Bucharest

[Lungu, Mihai-Aureliu](#)

University of Craiova

[Wang, Rui](#)

Northwestern Polytechnical University

**Keywords:** [Automotive Control Systems](#), [Nonlinear Systems](#)

**Abstract:** This work tackles the relative orbital control problem and presents the development of an  $H^\infty$  controller in terms of the Riccati algebraic matrix equations. The nonlinear Tschauner-Hempel equations associated with rendezvous missions involving elliptical orbits are easily transformed into a linear time-varying dynamics, the resulting optimal control problem being solved by designing an  $H^\infty$  robust controller that guarantees the asymptotical stability regardless of the uncertainties and existence conditions. The theoretical validation of the novel controller is accompanied by simulations proving the successful tracking of the target-chaser relative position and the cancel of the relative position and speed errors.

14:20-14:40, Paper WeB3.2

Add to My Program ☐

[Software and Hardware Platform Using Dynamic Inversion and Neural Networks for the Launch Vehicles \(I\)](#)

[Butu, Florentin-Alin](#)

University Politehnica of Bucharest

[Lungu, Romulus](#)

University of Craiova

[Lungu, Mihai-Aureliu](#)

University of Craiova

[Barbulescu, Lucian-Florentin](#)

University of Craiova

**Keywords:** [Automotive Control Systems](#), [Adaptive Control](#), [Nonlinear Systems](#)

**Abstract:** This work deals with development of a software and hardware technological platform, with applications to the control of the launch vehicles. The software and hardware platform has two main experimental modules: 1) a virtual model of the launch vehicle, implemented as software simulator in a dedicated computer having communication capabilities; 2) a control unit (single-board computer), with specific hardware and dedicated software, which implements the control laws based on dynamic inversion technique and neural networks. The validation of the experimental platform was performed both by numerical simulations and tests in lab conditions as MIL – Model in the Loop (the space vehicle simulator as well as the control system run on the same computer) and HIL – Hardware in the Loop (the control system is embedded in an experimental control unit that communicates with the simulator).

14:40-15:00, Paper WeB3.3

Add to My Program ☐

[A Model for Mapping Burned Areas from Multi-Spectral Images \(I\)](#)

[Becheru, Alexandru](#)

University of Craiova

[Cara, Cosmin](#)

Cs Group - Romania S.a

[Nicola, Laurentiu](#)

Cs Group Romania

**Keywords:** [Machine Learning](#), [Real Time Applications](#), [Software Engineering](#)

**Abstract:** This paper discusses a model for detecting burned areas based on a time series of multi-spectral optical images. The model employs a two-class Gaussian Naive-Bayes classification algorithm on a set of literature proven burned area indexes, e.g. Mid-Infrared Burned Area Index. The area of study, training and validation mainly comprises geographically diverse sites, scattered in and around the Romanian territory; Nevertheless, several over the seas sites are included, e.g. Evia Greece. We show that the model provides fast and reliable detection of burned areas. despite its computational simplicity.

15:00-15:20, Paper WeB3.4

Add to My Program ☐

[On the Computation of the Albedo Force Perturbation on Low Earth Orbit CubeSats \(I\)](#)

[Barbulescu, Lucian-Florentin](#)

University of Craiova

[Butu, Florentin-Alin](#)

University Politehnica of Bucharest

[Mamuleanu, Madalin](#)

University of Craiova

[Radulescu, Virginia](#)

University of Craiova, Faculty of Automation, Computers and Elec

**Keywords:** [Software Engineering](#), [Other Topics](#), [Modeling](#), [Simulation and CAD Tools](#)

**Abstract:** The development of CubeSat technology provided the possibility for universities to design and launch small satellites in Earth's orbit in order to run scientific experiments. Typically, CubeSats are small satellites, in the form of a cube with a side of 10cm and a weight of about 1 kg and don't normally have their own propulsion. Once placed in orbit around our planet, usually at altitudes under 700 km, their trajectory is influenced by various external forces, one being the effect of the solar radiation reflected by Earth called Albedo perturbation. While often ignored for larger satellites due to their small value compared to other forces, the albedo perturbation has a greater effect on CubeSats because they are in closer proximity to Earth. This paper presents an early version of a software component that computes the effect of the Albedo perturbation on small CubeSats on different Low Earth Orbits.

15:20-15:40, Paper WeB3.5

Add to My Program ☐

[Cooperative Localization of an UAV Fleet Using Distributed MHE with EKF Pre-Estimation and Nonlinear Measurements](#)

[Borelle, Matthieu](#)

University Paris-Saclay

[Bertrand, Sylvain](#)

ONERA

[Stoica, Cristina](#)

CentraleSupélec/L2S

[Alamo, Teodoro](#)

Universidad De Sevilla

[Camacho, Eduardo F.](#)

University of Sevilla

**Keywords:** [Linear Systems](#), [Optimization](#)

**Abstract:** This paper proposes a Distributed Moving Horizon Estimation (DMHE) with an Extended Kalman Filter (EKF)-based pre-estimation to solve the constrained cooperative localization problem for a Multi-Agent System (MAS) using nonlinear measurements. The proposed DMHE strategy uses a fused arrival cost obtained by a consensus among neighbors to efficiently spread the relevant estimation information across the communication network. The EKF pre-estimation enables to reduce the number of optimization variables and, thus, the computation time of the constrained nonlinear optimization problem over the horizon length, while preserving the accuracy of the estimation. A simulation case study of cooperative localization of a fleet of Unmanned Aerial Vehicles (UAVs) is proposed. Comparison with existing distributed estimation methods is carried out to confirm the effectiveness of the proposed DMHE algorithm in terms of estimation accuracy, computation time, and constraints handling.

**WeC1** Regular session, Energy Room

Add to My Program ☐

[Computer Vision](#)

Chair: [Roman, Raul-Cristian](#)

Politehnica University of Timisoara

Co-Chair: [Micea, Mihai](#)

Politehnica University of Timisoara

16:10-16:30, Paper WeC1.1

Add to My Program ☐

[Exploring the Potential of OCR Integration for Object Detection in Invoices](#)

[Bulzan, Andrei](#)

Politehnica University Timisoara

[Cernăzanu-Grăvan, Cosmin](#)

Politehnica University Timisoara

[Marcu, Marius](#)

Politehnica University of Timisoara

**Keywords:** [Computer Vision](#), [Machine Learning](#), [Other Topics](#)

**Abstract:** This paper investigates the impact of incorporating Optical Character Recognition (OCR) information into object detection models for extracting key information fields from invoices. We propose a method that adds a fourth channel to the input images, representing text presence, derived from two OCR models. Our experiments show that while larger models do not benefit from the additional text localization information, smaller models exhibit significant accuracy improvements and accelerated learning. In particular, we observe a substantially higher mean average precision (mAP) by epoch 20 out of 100 when including the fourth OCR information channel. This research demonstrates the potential benefits of incorporating OCR information into object detection models, particularly for smaller models with limited resources, by enhancing not only accuracy but also the speed of convergence during training.

16:30-16:50, Paper WeC1.2

Add to My Program ☐

[A Brief Overview on Deep Learning-Based Person Re-Identification](#)

[Andreescu, Mihai](#)

Politehnica University Timisoara

[Căleanu, Catalin Daniel](#)

Politehnica University of Timisoara

[Mirsu, Radu](#)

Department of Applied Electronics, Politehnica University Timiso

**Keywords:** [Computer Vision](#), [Machine Learning](#)

**Abstract:** Person re-identification (Re-ID) has attracted considerable attention within the field of biometrics in recent times, driven by an escalating demand in public communities, marketing and banking endeavors, and social media networks. Moreover, the rapid advancement of deep learning has introduced a wide range of effective tools for addressing person re-identification tasks. The result is more precise and faster processing compared to the video surveillance performed manually by human operators. This article provides an overview of recent Re-ID studies by highlighting the challenges and issues, proposing a taxonomy of Re-ID methods, and comparing the performances of the most representative deep learning-based approaches.

16:50-17:10, Paper WeC1.3

Add to My Program ☐

[Representation of Coherent Structures from Volume Data Using Quality-Oriented Features and Genetic Optimization](#)

[Gavrilescu, Marius](#)

Gheorghe Asachi Technical University of Iasi

[Leon, Florin](#)

Gheorghe Asachi Technical University of Iasi

**Keywords:** [Computer Vision](#), [Optimization](#), [Intelligent Systems](#)

**Abstract:** Representing relevant information from volume data sets is a problem often faced in visualization. Generating meaningful images from highly-complex volume data sets is a challenging, tedious task requiring specialized knowledge of the distribution and properties of the data. Traditionally, this task has been carried out manually via specialized user interfaces. We propose a volume visualization pipeline which facilitates the automatic generation of high-quality images from volume data sets. Our method involves a direct volume renderer which generates images from volume data based on visual mappings provided by a transfer function. Central to our approach is a quality-focused descriptor which exploits the properties of the distribution of gradient orientations of an alpha-bounded surface within the volume. This feature is useful for determining transfer functions that result in the rendering of corresponding images depicting various details from the volume. We show that by using this feature as an optimization objective, the generation of high quality images can be automated. Using simple genetic algorithms, we can automatically generate sets of images illustrating coherent, easily-distinguishable and high-quality surfaces of relevant structures from volume data.

17:10-17:30, Paper WeC1.4

Add to My Program ☐

[FoodMedicine - Android-Based Food Recognition App for Guiding Patients with Nutritional Diseases](#)

[Blajovan, Bianca-Lucia](#)

Politehnica University of Timișoara

[Chirila, Oana Sorina](#)

University Politehnica Timisoara

[Stanescu, Daniela Natalia](#)

Politehnica University of Timisoara

[Marcu, Marius](#)

Politehnica University of Timisoara

**Keywords:** [Biomedical Engineering](#), [Computer Vision](#), [Machine Learning](#)

**Abstract:** People with dietary restrictions caused by certain gastrointestinal pathologies and by certain physiological conditions need permanent monitoring of their food intake. Besides this, they are also required to meet certain nutritional values during the day for keeping themselves healthy. Hence, many such diagnosed patients use mobile apps and other intelligent systems for food detection, tracking, and nutritional value intake. We propose an intelligent mobile application that uses a Deep Neural Network (DNN) for on-device food classification. Therefore, we protect the user's privacy and never send the images taken by the user to the cloud server (e.g., conform with GDPR regulations). Our results show over 70% accuracy on Food101 dataset using two state-of-the-art DNNs, i.e., ResNet50 and EfficientNet-b0, the latter one being more suitable for on-device deployment due to its reduced complexity. The proposed mobile application is a simple yet effective food monitoring app with minimal input from the user which can suggest avoiding and/or help the user better estimate the nutritional values of the served dishes.

17:30-17:50, Paper WeC1.5

Add to My Program ☐

[A Comparative Study of Car Tracking Algorithms for Road Traffic Surveillance Applications](#)

[Brad, Ana](#)

Politehnica University of Timisoara

[Brad, Maria](#)

Politehnica University of Timisoara

[Micea, Mihai](#)

Politehnica University of Timisoara

**Keywords:** [Machine Learning](#), [Computer Vision](#)

**Abstract:** In this paper, we approach the important topic of video surveillance systems which automatically identify and track moving vehicles in different environments. A comparative evaluation has been performed on four algorithms which have been adapted for tracking and counting vehicles passing through a line, using both contour detection and feature detection techniques over a region of interest in the input video frames. YOLO and Haar Cascades were also considered in view of the efficiency comparison of Machine Learning algorithms. The proposed algorithms have been implemented and tested on a set of video sequences and an accuracy measure was computed to determine the most effective algorithm. The results show that the YOLO-based algorithm has the best average accuracy, while Algorithm 1, which is based on frame difference moving object detection and tracking, with an initial calibration phase, has the most consistent performance.

WeC2 Regular session, Folk Room

Add to My Program ☐

[Control System Design](#)

Chair: [Lupu, Ciprian](#)

Politehnica University of Bucharest

Co-Chair: [Aksikas, Ilyasse](#)

Qatar University

16:10-16:30, Paper WeC2.1

Add to My Program ☐

[Error-Feedback Regulation of a Distributed Parameter Cracking Process by Using a Spectral Approach](#)

[Aksikas, Ilyasse](#)

Qatar University

**Keywords:** [Control Systems Design](#), [Linear Systems](#), [Other Topics](#)

**Abstract:** The focus of this paper is to control a distributed parameter cracking process by utilizing state and error feedback regulators. The main aim is to track a desired output while dealing with disturbances originating from a distributed parameter exosystem. At first, a stabilizing regulator with state feedback is developed to drive the process output towards the reference trajectory. The second goal is to develop a dynamic controller that takes the tracking error as input, for which it is proven that the closed-loop system is exponentially stable and that the tracking error gradually approaches zero over time. The effectiveness of the regulators is demonstrated through numerical simulations.

16:30-16:50, Paper WeC2.2

Add to My Program ☐

[Structured Linear Quadratic Regulator Design](#)

[Schaub, Philipp](#)

Technische Universität Darmstadt

[Konigorski, U.](#)

Technische Universität Darmstadt

**Keywords:** [Control Systems Design](#), [Optimization](#), [Linear Systems](#)

**Abstract:** In this paper, we study linear quadratic regulator (LQR) design subject to linear equality constraints in the controller parameters. Necessary solvability conditions are provided, and a method for choosing the weighting matrices in the quadratic objective function minimized by the constrained LQR is presented. To this end, the problem at hand is transformed into a set of polynomial inequalities that can be solved using Bernstein polynomials. We explicitly show how the requirement of input-output decoupling can be transformed into a set of linear equations in the controller parameters. All control structures that can be transformed into a set of linear equality constraints, e.g. output feedback control, decentralized control, or combinations thereof, can be determined with our method. We demonstrate the proposed method by designing structured optimal controllers for a three-tank system.

16:50-17:10, Paper WeC2.3

Add to My Program ☐

[Some Remarks on the Pendulum Stabilization, Multiple Delays & Decay Rate Assignment](#)

[Remadna, Amira](#)

Université Badji Mokhtar Annaba

[Boussaada, Islam](#)

University Paris Saclay &amp; IPSA

[Bedouhene, Fazia](#)

Mouloud Mammeri University of Tizi-Ouzou

[Niculescu, Silviu-Iulian](#)

University Paris-Saclay, CNRS, CentraleSupélec, Inria

[Benchettah, Azedine](#)

Annaba University



**Keywords:** [Control Systems Design](#), [Linear Systems](#)

**Abstract:** A series of recent works have highlighted the interest of multiplicity varieties in the characterization of the exponential decay rate for the solution of linear dynamical systems represented by delayed differential equations. In fact, it has been shown in the case of a single delay that a sufficiently high multiplicity spectral value tends to be dominant, in what is now known as the multiplicity-induced-dominancy property (MID). Despite the many existing results in such a configuration, only a few concern the case of multiple delays. Through this work, we propose a first characterization of the MID property for second-order systems controlled by a two-delay "block". As an application of the results obtained, we consider the problem of stabilization of the classical pendulum with exclusive access to the delayed position.

17:10-17:30, Paper WeC2.4

Add to My Program ☐

[Consideration on RT Software Implementation for Algorithm Switching in MM Structures \(I\)](#)

[Lupu, Ciprian](#)

Politehnica University of Bucharest

[Secuianu, Catinca](#)

University Politehnica of Bucharest

[Luu, Duc Lich](#)

Politehnica University of Bucharest

**Keywords:** [Real Time Applications](#), [Industrial Applications](#), [Control Systems Design](#)

**Abstract:** Real-time (RT) implementation of control systems for non-linear processes raises numerous theoretical and practical challenges. Multi-model structures (MM) represent one of the successful solutions for these processes. However, switching of control algorithms constitutes the specific problem of MM structures. Even if reducing the sampling period can increase the precision in the control of some processes, for the case of algorithms switching in the MM structures is not improving significantly. The tests carried out in this work confirm this behavior for some numeric PIDs algorithms. Moreover, these tests can be an example for reducing the computational effort by changing the sampling period up to a maximum limit, specific to the process. However, superior performances in switching control algorithms can be obtained by using a common database for all switched algorithms in the respective MM structure. The architecture proposed in the paper and the tests performed on a laboratory implementation prove these solutions.

17:30-17:50, Paper WeC2.5

Add to My Program ☐

[Glucose Level Control in Type 1 Diabetes Patients](#)

[Pintea, Paul-Andrei](#)

Technical University of Cluj-Napoca

[Mihaly, Vlad Mihai](#)

Technical University of Cluj-Napoca

**Keywords:** [Biomedical Engineering](#), [Nonlinear Systems](#), [Control Systems Design](#)

**Abstract:** The main objective of this paper is to design a suitable control strategy which solves the the so-called Artificial Pancreas Problem, which affects patients with Type 1 Diabetes Mellitus. The theoretical background consists in using the exact feedback linearization technique. Using a suitable change of coordinates paired with a designed input signal create a linear map between input and output which is further used to design a control law. Moreover, the input is computed to perform a disturbance decoupling. The resulting linear model is used within the optimal control approach. Conclusively is presented a comparison between a patient using the open loop control and a patient with the present control law.

**WeC3** Regular session, Disco Room

Add to My Program ☐

[Control Applications](#)

Chair: [Kreutmayr, Fabian](#)

HAWE Hydraulik SE

Co-Chair: [Ortmann, Jan](#)

University of Siegen

16:10-16:30, Paper WeC3.1

Add to My Program ☐

[An Experimental Verification for Hegselmann-Krause Opinion Dynamics](#)

[Srivastava, Trisha](#)

University of Sannio

[Bernardo, Carmela](#)

Linköping University

[Baccari, Silvio](#)

Università Della Campania

[Vasca, Francesco](#)

University of Sannio

**Keywords:** [Agent - Based Systems](#), [Distributed Systems](#), [Networked Control](#)

**Abstract:** The Hegselmann-Krause (HK) model belongs to the class of bounded confidence opinion dynamics. The concepts of iterative averaging and homophily that characterize the HK model can be used for the design of synchronization strategies in multi-agent systems. In this paper, the application of this technique for the synchronization of an electronic circuit is proposed. The experimental setup consists of electronic integrators, representing the agents of the model, which interact through a microcontroller that implements the iterative averaging process. Similarly to the agents in the HK model, two integrators interact if the difference between their output voltages, i.e., the agents' opinions, does not exceed a constant confidence bound. Experimental results show transient and steady-state behaviors of the system and sensitivity to confidence thresholds, by also discussing on the robustness of corresponding numerical solutions. Experiments confirm the typical phenomenon of decreasing in the number of clusters and convergence time by increasing the confidence thresholds.

16:30-16:50, Paper WeC3.2

Add to My Program ☐

[Robust Gain-Scheduled Controllers for Nonlinear Systems Based on Simplified Additive Nonlinear Autoregressive Exogenous Models](#)

[Kreutmayr, Fabian](#)

HAWE Hydraulik SE

[Ament, Christoph](#)

Universitaet Augsburg

**Keywords:** [Adaptive Control](#), [System Identification and Modeling](#), [Nonlinear Systems](#)

**Abstract:** When working with real world systems, their usually nonlinear behavior results in great challenges. Hence, effects like hysteresis and friction are often not or only partly modeled. This causes the need for suitable system identification methods that result in analytical models that are easy to analyze and interpret with known control methods. Moreover, robust controllers are needed to guarantee a sufficient performance at any working point. Hence, this work uses neural networks in a simplified additive nonlinear autoregressive exogenous (SANARX) structure. Those can be reformulated in a linear parameter-varying model. Afterwards,  $H_\infty$  synthesis is used to get a robust gain-scheduled controller. The suitability of this method is evaluated on a hydraulic benchmark system.

16:50-17:10, Paper WeC3.3

Add to My Program ☐

[Adaptive Torque Feedforward Algorithm to Compensate Perturbations Using Stochastic Optimization Methods](#)

[Ortmann, Jan](#)

University of Siegen

[Klein, Christoph](#)

Vocational Technical Institute of Siegen

**Keywords:** [Adaptive Control](#), [Linear Systems](#), [Robust Control](#)

**Abstract:** This paper presents a novel approach to compensate periodic perturbations that occur in a vast variety of production processes. Typically, these perturbations interrupt the steady-state motion of mechanical systems, resulting in production inaccuracies. To address that problem, an adaptive torque feedforward algorithm is employed to systematically reduce unknown perturbations effects on the mechanical system. The algorithm is inherent stable and purely based on stochastic values. Therefore, the adaptation process uses only gradient-free optimization methods. All presented results can be, without any means, incorporated into a state-of-the-art programmable logic controller.

Correctness of the stated algorithm is verified by simulation on the widely used two non-rigid coupled rotational masses spring-damper system corrupted by periodic perturbations on the load-end.

17:10-17:30, Paper WeC3.4

Add to My Program ☐

[Analysis of the Quantization Effects in the Implementation of Numerical Filters](#)

[Sim, Simona](#)

[Lendek, Zsoltia](#)

[Dobra, Petru](#)

Technical University of Cluj-Napoca

Technical University of Cluj-Napoca

Technical University of Cluj

**Keywords:** [Signal Processing](#), [Digital Design](#), [Modeling](#), [Simulation and CAD Tools](#)

**Abstract:** The paper analyzes the efficiency of fixed-point implementation and the effect of quantization of coefficients and signals in the implementation of numerical filters on the STM32 Nucleo-64P development board. Discretization methods are also analyzed. By modelling the effects of quantization, it is possible to indicate how the system responds. Proper quantization can increase the performance. We model the quantization error as stochastic noise. The results show that the quantization of the coefficients and the fixed-point processing minimally change the response of the digital filter compared to the analog one, thus achieving very good results at high sampling frequencies. Also, through this analysis, the most efficient implementation can be chosen, taking into account the system and the characteristics of the development board.

17:30-17:50, Paper WeC3.5

Add to My Program ☐

[An Analysis towards Integrated Control of Wastewater Collecting and Treatment Systems](#)

[Vasiliev, Iulian](#)

[Luca, Laurentiu](#)

[Barbu, Marian](#)

[Vilanova, Ramon](#)

[Caraman, Sergiu](#)

Dunarea De Jos University of Galati

Dunarea De Jos University of Galati

Dunarea De Jos University of Galati

Universitat Autonoma De Barcelona

Dunarea De Jos University of Galati

**Keywords:** [Modeling](#), [Simulation and CAD Tools](#), [Nonlinear Systems](#)

**Abstract:** This paper deals with an analysis regarding the effect of Sewer Network operation on the performances of the integrated wastewater collecting and treatment system. The analysis is done by considering various control actions for the output storage tank of the sewer network, comparing a series of performance indicators defined for both subsystems with their "no control" value. Two cases have been considered regarding the control actions for the output storage tank of the sewer network: 1. keeping the output valve at a constant opening and 2. keeping the output valve at the maximum opening possible such as the outflow is limited to a constant value. While the second case did not prove advantageous, the first one showed that lowering the sewer network output valve opening would improve the integrated system performances.



## 2023 27th International Conference on System Theory, Control and Computing (ICSTCC)

October 11-13, 2023, Timisoara, Romania

[Program at a Glance](#) [Wednesday](#) [Thursday](#) [Friday](#) [Author Index](#) [Keyword Index](#) [My Program](#)

Last updated on September 6, 2023. This conference program is tentative and subject to change

### Technical Program for Thursday October 12, 2023

To show or hide the keywords and abstract (text summary) of a paper (if available), click on the paper title.

[Open all abstracts](#) [Close all abstracts](#)

**ThP1** Plenary talk, Pop Rock + Blues + Jazz Room

Add to My Program ☐

[Ming Cao: Network Games and Collective Decision-Making](#)

Chair: [Selisteanu, Dan](#)

University of Craiova

**ThA1** Regular session, Pop Rock + Blues + Jazz Room

Add to My Program ☐

[Optimization](#)

Chair: [Pariakci, M. N. Alpaslan](#)

Istanbul Bilgi University

Co-Chair: [Susca, Mircea](#)

Technical University of Cluj-Napoca

10:30-10:50, Paper ThA1.1

Add to My Program ☐

[Two Discrete-Time Data-Driven Sliding Mode Controllers for Tower Crane Systems](#)

[Borlea, Anamaria-Ioana](#)

Politehnica University of Timisoara

[Precup, Radu-Emil](#)

Politehnica University of Timisoara

[Roman, Raul-Cristian](#)

Politehnica University of Timisoara

**Keywords:** [Control Systems Design](#), [Adaptive Control](#), [Optimization](#)

**Abstract:** This paper merges the advantages of data-driven control and sliding mode control in terms of applying and modifying two combinations of model-free adaptive control and sliding mode control suggested by Ebrahimi et al. in 2018 to the position control of tower crane systems. The modifications concern the classical definition of the control error or the tracking error and appropriate proofs are adapted and summarized. The two controllers are validated experimentally and compared in the control of the three positions specific to tower crane system laboratory equipment.

10:50-11:10, Paper ThA1.2

Add to My Program ☐

[On the Inverse Optimality of a Class of PWA Functions through Liftings](#)

[Yang, Songlin](#)

Université Paris-Saclay

[Olaru, Sorin](#)

CentraleSupélec

[Rodriguez-Ayerbe, Pedro](#)

CentraleSupélec

**Keywords:** [Predictive Control](#), [Optimization](#)

**Abstract:** This paper focuses on the (re-)construction of the optimal solution for the multi-parameter quadratic programming (mpQP) problems. Optimization problems of this nature are widely employed in the formulation of model-based predictive controllers (MPC) for discrete linear systems, wherein input and state constraints are imposed. This study examines the geometric characteristics of the explicit solution of an mpQP problem and introduces a novel convex-concave lifting technique to synthesize an equivalent mpQP problem. Whenever the solution corresponds to a PWA function, the present approach maintains the structure and control laws for the original systems. A new (less complex) cost function and a corresponding feasible domain are constructed through lifting for the equivalent optimization problem. The effectiveness of this strategy is demonstrated through an illustrative example.

11:10-11:30, Paper ThA1.3

Add to My Program ☐

[Sliding Surface Optimization Via Regional Pole Placement for a Class of Nonlinear Systems](#)

[Arican, Ahmet Cagri](#)

Gazi University

[Copur, Engin Hasan](#)

Necmettin Erbakan University

[Inalhan, Gokhan](#)

Cranfield University

[Salamci, Metin U.](#)

Gazi University

**Keywords:** [Nonlinear Systems](#), [Control Systems Design](#), [Robust Control](#)

**Abstract:** In this paper, a new approach is introduced which combines Eigenvalue Assignment, State Dependent Riccati Equation (SDRE) and Sliding Mode Control (SMC) methods for nonlinear systems. In the classical SDRE based SMC (SDRE-SMC) approach, a nonlinear system is frozen at each time instant to obtain a linear-like structure model that is used to design a sliding surface (SS) at each time instant. This mechanism produces a state-dependent SS to hold the states on the SS. The approach proposed here is built on this mechanism and offers a new way to design a state-dependent SS for nonlinear systems so that the pointwise eigenvalues of the closed-loop system matrix of the control-free dynamics in the regular form can be kept in a specified disk. This gives a great advantage to shape the transient response characteristics. The performance of the nonlinear controller approach proposed here is investigated in simulations.

11:30-11:50, Paper ThA1.4

Add to My Program ☐

[Discrete Optimal Tracking Problem for Linear Systems with Variable Disturbances](#)

[Botan, Corneliu](#)

Gheorghe Asachi Technical University of Iasi

[Ostafi, Florin](#)

Gheorghe Asachi Technical University of Iasi

**Keywords:** [Optimization](#), [Linear Systems](#), [Control Systems Design](#)

**Abstract:** The paper deals with an optimal tracking problem in the presence of disturbances. A linear system in discrete time is considered. The paper presents a procedure with computational advantages. Step variant functions are used for approximation of the disturbance and reference variables. Simulation results are indicated.

11:50-12:10, Paper ThA1.5

Add to My Program ☐

[Robust H-Infinity Control of Linear Discrete-Time Systems with Uncertainties and Disturbances](#)

**Keywords:** [Control Systems Design](#), [Linear Systems](#), [Optimization](#)

**Abstract:** This paper presents an enhanced approach for synthesizing a robust static output feedback H-infinity controller for linear discrete-time systems with polytopic uncertainties and external disturbances. While this problem has been extensively studied in the literature, the proposed method distinguishes itself through the utilization of parameter-dependent Lyapunov functions and novel bounding techniques for bilinear terms. By employing a more flexible and accurate characterization of system dynamics and uncertainties, our approach achieves improved controller performance with less conservatism compared to existing methods. The formulation of the controller design problem involves converting the nonconvex optimization into a convex minimization one using a congruent transformation and the cone complementarity technique. This leads to a set of linear matrix inequality conditions that guarantee the existence of an effective robust output feedback H-infinity controller capable of mitigating the effects of uncertainties and disturbances on the system. Numerical simulations show that our proposed method outperforms existing results in terms of disturbance attenuation rates.

12:10-12:30, Paper ThA1.6

Add to My Program ☐[Nonconvex Valid Uncertainty Modelling Approach for Robust Control Synthesis](#)[Susca, Mircea](#)

Technical University of Cluj-Napoca

[Mihaly, Vlad Mihai](#)

Technical University of Cluj-Napoca

[Dobra, Petru](#)

Technical University of Cluj

**Keywords:** [Robust Control](#), [Optimization](#), [System Identification and Modeling](#)

**Abstract:** This paper proposes an alternative nonconvex approach to fit single-input and single-output transfer function models on magnitude frequency-based response measurements, with additional constraints such as upper boundness, stability, minimum phase and validity with respect to provided data. The proposed solution presents an improvement over the established Log-Chebyshev convex fit which is used as a well-placed starting point and refines the optimization to become less conservative and feasible in cases where (near) singularities are present and limit its sole application. As such, our contribution provides advantages in cases such as in mu-synthesis where the uncertainty model should have a low order to guarantee no conservativeness of the structured singular value approximation. Two case studies are described and discussed which show brought improvements.

ThA2 Regular session, Folk Room

Add to My Program ☐[Robotics](#)Chair: [Filipescu, Adrian](#)

Lower Danube University of Galati

Co-Chair: [Burlacu, Adrian](#)

Gheorghe Asachi Technical University of Iasi

10:30-10:50, Paper ThA2.1

Add to My Program ☐[Analytic Inverse Kinematics Model and Trajectory Planning for an 18 DoF Quadruped Robot](#)[Bogdan, Muntean](#)

Transilvania University of Brasov

[Zaha, Mihai Valentin](#)

"Transilvania" University from Brasov

[Grigorescu, Sorin Mihai](#)

Transilvania University of Brasov

**Keywords:** [Robotics](#), [Modeling](#), [Simulation and CAD Tools](#), [Other Topics](#)

**Abstract:** Kinematics modelling of robotic systems is a fundamental requirement used by the underlying control system. In this paper, we introduce a complete and analytic direct and inverse kinematic model for an 18 DoF quadruped robot. The proposed solution, based on simple trigonometric functions, is analytically determined, allowing the full control of the translation and orientation of the footholds and of the body. Considering the fact that the dynamic model of the robot requires position, velocity and angular acceleration profiles as references, this article also presents the applicability of a trajectory generator with zero initial and zero final conditions for the first and second derivatives. As performance evaluation, we have determined the accuracy of the model by implementing a static gait controller on a A1 Unitree quadruped robot, where the trajectory of each foot is calculated based on Bsplines, given as reference to the inverse kinematics model.

10:50-11:10, Paper ThA2.2

Add to My Program ☐[Deep Reinforcement Learning for Mapless Navigation of Autonomous Mobile Robot](#)[Yadav, Harsh](#)

University of Luebeck

[Xue, Honghu](#)

University of Luebeck

[Rudali, Yan](#)

KION Group AG

[Bakr, Mohamed](#)

KION Group AG

[Hein, Benedikt](#)

Helmut-Schmidt-University

[Rueckert, Elmar](#)

Montanuniversität Leoben

[Nguyen, Ngoc Thinh](#)

University of Luebeck

**Keywords:** [Robotics](#), [Machine Learning](#), [Intelligent Systems](#)

**Abstract:** This paper presents a study on the mapless navigation of autonomous mobile robot using Deep Reinforcement Learning in an intralogistics setting. The task is to make an autonomous mobile robot learn to navigate to a goal without prior knowledge of the environment. In this paper, a controller using the Soft Actor-Critic algorithm is designed, trained, and applied for navigating the robot equipped with 360° LiDAR and front camera sensors. The controller is successfully validated in a fully observable environment under extensive simulations. Furthermore, we investigate the performance of the proposed controller in a partially observable environment and possible limitations. We use a 3D Temporal Convolution Network for processing the time series image data from visual observations. Besides Partial Observability, we also address the problem of sparse positive rewards in training the Deep Reinforcement Learning algorithm with a combined approach of Automatic Curriculum Learning and Dual Prioritized Experience Replay.

11:10-11:30, Paper ThA2.3

Add to My Program ☐[Active Search and Coverage Using Point-Cloud Reinforcement Learning](#)[Rosynski, Matthias](#)

Technical University of Cluj-Napoca

[Pop, Alexandru](#)

Technical University Cluj-Napoca

[Busoni, Lucian](#)

Technical University of Cluj-Napoca, Romania

**Keywords:** [Machine Learning](#), [Robotics](#), [Computer Vision](#)

**Abstract:** We consider a problem in which the trajectory of a mobile 3D sensor must be optimized so that certain objects are both found in the overall scene and covered by the point cloud, as fast as possible. This problem is called target search and coverage, and the paper provides an end-to-end deep reinforcement learning (RL) solution to solve it. The deep neural network combines four components: deep hierarchical feature learning occurs in the first stage, followed by multi-head transformers in the second, max-pooling and merging with bypassed information to preserve spatial relationships in the third, and a distributional dueling network in the last stage. To evaluate the method, a simulator is developed where cylinders must be found by a Kinect sensor. A network architecture study shows that deep hierarchical feature learning works for RL and that by using farthest point sampling (FPS) we can reduce the amount of points and achieve not only a reduction of the network size but also better results. We also show that multi-head attention for point-clouds helps to learn the agent faster but converges to the same outcome. Finally, we compare RL using the best network with a greedy baseline that maximizes immediate rewards and requires for that purpose an oracle that predicts the next observation. RL achieves significantly better and more robust results than the greedy strategy.



11:30-11:50, Paper ThA2.4

Add to My Program ☐[\*Digital Twin Based a Processing Technology Assisted by a MCPRS, Ready for Industry 5.0\*](#)[Filipescu, Adrian](#)

Lower Danube University of Galati

[Minca, Eugenia](#)

Valahia University of Targoviste

[Cernega, Daniela Cristina](#)

Dunarea De Jos University of Galati

[Solea, Razvan](#)

Dunarea De Jos University of Galati

[Filipescu, Adriana](#)

Low Danube University of Galati

[Simion, Georgian](#)

"Dunărea De Jos" University of Galați

[Ionescu, Dan](#)

"Dunarea De Jos" University of Galati

**Keywords:** [Manufacturing Systems](#), [Robotics](#), [Real Time Applications](#)

**Abstract:** This paper deals with digital twin (DT) approach for a processing technology (PT) running on a mechatronic processing system (MPS) assisted by a mobile cyber-physical robotic system (MCPRS). The hardware architecture consists of the MPS, four workstation (WS), line-shaped, and MCPRS. MCPRS has in its structure a wheeled mobile robot (WMR) equipped with robotic manipulator (RM) having on the end effector a mobile visual servoing system MVSS). The workpiece (WP) is moved along the four stations for processing, and at the end, if it does not pass the primary quality test (PQT), it is picked up by the MCPRS, transported to the first station for reprocessing or scrapping. If the WP does not pass the second quality test (SQT), then it is stored as scrapped. WP that passes the SQT, through the same processing operations, will be brought to the quality standard. Thus, the WP will go through the MPS twice, for processing/reprocessing (P/R). The virtual world that serves as the subsystems of MCPRS. Additionally, the virtual world includes hybrid modeling with synchronized hybrid Petri nets (SHPN), simulation of the SHPN models, modeling of the MVSS, and simulation of the discrete-time trajectory-tracking sliding-mode control (DT-TTSMC) of MCPRS. The real world, corresponding to the virtual world, consists of communication, synchronization and control of the MPS and MCPRS's subsystems (WMR, RM and MVSS), the graphical user interface (GUI) and a supervisory control and data acquisition (SCADA) system, implemented on a remote PC.

11:50-12:10, Paper ThA2.5

Add to My Program ☐[\*Mixed Reality Framework for Eye-In-Hand Collaborative Robot-Human Interaction\*](#)[Sopon, Ionut](#)

Gheorghe Asachi Technical University of Iasi

[Tincu, Cristina](#)

Gheorghe Asachi Technical University of Iasi

[Ganciu, Aura](#)

Gheorghe Asachi Technical University of Iasi

[Burlacu, Adrian](#)

Gheorghe Asachi Technical University of Iasi

**Keywords:** [Robotics](#), [Virtual and Augmented Reality](#), [Automatic Control Education and Training](#)

**Abstract:** In recent years, the manufacturing sector has undergone a significant transition from a paradigm of robotic autonomy to human-robot collaboration. This approach allows operators from different domains to rapidly adapt to a new way of working and reduces redundant learning costs, while also enabling intuitive robot control. To further enhance this paradigm, integrating Mixed Reality (MR) technology has emerged as a promising approach to creating and working in a virtual workspace while having a safe environment for training. This work develops a framework, based on digital twin representation, to integrate the MR with real-life equipment and humans. This allows for the control of a collaborative robot in an environment with objects or humans perceived by the eye-in-hand visual sensor. The efficiency of the proposed framework is emphasized by a comparison of Unity simulations versus the real-time behavior of the collaborative robot.

12:10-12:30, Paper ThA2.6

Add to My Program ☐[\*Path Planning and Reference Tracking for a 18DoF Quadruped Robot\*](#)[Zaha, Mihai Valentin](#)

"Transilvania" University from Brasov

[Bogdan, Muntean](#)

Transilvania University of Brasov

[Grigorescu, Sorin Mihai](#)

Transilvania University of Brasov

**Keywords:** [Predictive Control](#), [Robust Control](#), [Robotics](#)

**Abstract:** Quadruped robots and many other types of legged robots have been gaining popularity in recent years due to their advantages over wheeled robots. Firstly, quadruped robots have excellent mobility and stability. With four legs, the quadruped robots can move more efficiently over rough terrain and uneven surfaces, making them a prime candidate for use in disaster response situations, search and rescue operations and exploration missions. Furthermore, quadruped robots don't have holonomic constraints, thus making them more maneuverable than any other type of robots. This makes them ideal for use in confined spaces. The problem of quadruped control can be divided in low level control and high level control, the former concerning each joint angle position, velocity, acceleration and torque to achieve a desired motion for each leg, while the latter is concerned with the required whole-body linear and angular velocities to follow a specified trajectory. In this paper we present a high level control strategy using Dynamic Window Approach (DWA) and a modified dynamic model for the whole-body dynamics of the quadruped. Furthermore, we study the effects of modified mass-inertia matrix on the overall performance of the algorithm. Our tests are conducted in a simulated environment and in real world.

**ThA3** Invited session, Disco RoomAdd to My Program ☐[\*Cloud Computing: Algorithms, Services and Applications\*](#)Chair: [Serban, Elena](#)

"Gheorghe Asachi" Technical University of Iasi

Co-Chair: [Amarandei, Cristian-Mihai](#)

"Gheorghe Asachi" Technical University of Iasi, Faculty of Automatic Control and Computer Engineering

Organizer: [Serban, Elena](#)

-

Organizer: [Amarandei, Cristian-Mihai](#)

-

Organizer: [Herghelegiu, Paul](#)

Technical University

Organizer: [Archip, Alexandru](#)

-

10:30-10:50, Paper ThA3.1

Add to My Program ☐[\*A Plagiarism Detection Architecture Based on OpenStack Services \(I\)\*](#)[Vodă, Georgian](#)

"Gheorghe Asachi" Technical University of Iasi

[Alexandrescu, Adrian](#)

Gheorghe Asachi Technical University of Iasi

**Keywords:** [Cloud Computing](#), [Distributed Systems](#), [Computer Science Education and Training](#)

**Abstract:** Plagiarism is a well-known problem that impacts the academic community. The escalation of source code plagiarism affects the quality of computer science and technology education. This article approaches a novel architecture for an academic plagiarism detection system focused on projects and source code. A part of the detection process is based on a few already existing open-source tools. All the system components use the OpenStack Cloud platform services for scalability, parallel processing of files, and load balancing. The solution also integrates with an identity and access management system, which contains users, roles, and cohorts. The proposed solution is an efficient approach for both organizing assignments at which students upload projects and for detecting plagiarism in all the submitted assignments.

10:50-11:10, Paper ThA3.2

Add to My Program ☐

[A Decentralized Paper Dissemination System Employing Blockchain Technology, Peer Review and Expert Badges. \(I\)](#)

[Barbuta, Delia Elena](#)

Gheorghe Asachi Technical University, Iasi

[Alexandrescu, Adrian](#)

Gheorghe Asachi Technical University of Iasi

**Keywords:** [Distributed Systems](#), [Software Engineering](#), [Cloud Computing](#)

**Abstract:** Peer review represents the status-quo when it comes to evaluating research articles that are submitted to conferences and journals. The significance of a computer science article is given by the prestige of the publication and is correlated with the inclusion in the ISI Web of Science index. This paper discusses the issues of the current paper publication paradigm and proposes a decentralized approach to the paper dissemination and the peer review processes. On the one hand, decentralization and transparency are obtained by employing smart contracts, through blockchain technology. On the other hand, an optimization of the paper rating system is obtained by employing a system of expert badges, based on NFTs, which ensure that the peer review process is just and that only specialists in the fields associated to the contributed paper offer proficient feedback. Other proposed facets include the remuneration of reviewers, a method of allowing the proposed system to expand based on the community's input, and a solution for allowing the organization of conferences.

11:10-11:30, Paper ThA3.3

Add to My Program ☐

[An OpenStack Cloud Solution for a Community Database with Handwritten Characters Used in Developing OCR Algorithms. \(I\)](#)

[Pavăi, Mihaela-Irina](#)

"Gheorghe Asachi" Technical University of Iasi

[Alexandrescu, Adrian](#)

Gheorghe Asachi Technical University of Iasi

[Archip, Alexandru](#)

"Gheorghe Asachi" Technical University of Iasi

**Keywords:** [Cloud Computing](#), [Databases and Data Mining](#), [Software Engineering](#)

**Abstract:** Most research addressing OCR through machine learning techniques is focused on the actual algorithms and on using the MNIST data set as the de facto benchmark. Little effort was made to extend the data set or to build an entirely new one. Furthermore, support for characters other than English ones is mostly limited. This paper presents an OpenStack based approach that aims to overcome this last limitation by providing a community-oriented solution for developing and maintaining richer, language agnostic, community-shared data sets for OCR based applications. The proposed architecture is integrated with OpenStack services and relies on new Cloud perspectives, such as Function-as-a-Service (FaaS), to achieve a greater degree of flexibility. The included modules allow users to upload their own data sets, select or fine-tune their desired pre-processing methods, and derive the required features for their target character set. Both the input and the output data are stored using OpenStack specific data services and are shared for all the users of the Cloud deployment. An interesting feature is that the underlying FaaS functionality would also allow interested parties to upload their own pre-processing and feature extraction stages.

11:30-11:50, Paper ThA3.4

Add to My Program ☐

[A Framework for Anything-As-A-Service on a Cloud Platform. \(I\)](#)

[Alexandrescu, Adrian](#)

Gheorghe Asachi Technical University of Iasi

[Mironeanu, Catalin](#)

Technical University "Gheorghe Asachi" of Iasi

**Keywords:** [Cloud Computing](#), [Distributed Systems](#), [Software Engineering](#)

**Abstract:** There is an increasing need for computational and storage capabilities for complex distributed applications. Existing solutions need to be deployed in an environment that allows for an increase in performance, scalability, and availability. This paper takes looks at the state-of-the-art regarding methods that take existing applications and make them more efficient by using Cloud services. The novelty of the paper consists of a proposed framework for deploying applications on three major Cloud providers (i.e., Amazon's AWS, Google Cloud and Microsoft Azure) and on the OpenStack open-source Cloud. After the main services from the four Cloud providers are identified, different deployment methods are described depending on the Cloud services and on the requirements of the application. Also, some examples of migrations are discussed with reference to specific Cloud provider services. The proposed solution for Anything-as-a-Service (YaaS) is a straightforward framework for taking different types of applications and migrating them to the Cloud. Therefore, the deployed applications benefit from Cloud features such as resource pooling, availability or scalability, while also being wary of the incurring costs.

11:50-12:10, Paper ThA3.5

Add to My Program ☐

[Cloud-Based Architecture for Deploying a Distributed Ambient Assisted Living Environment. \(I\)](#)

[Botezatu, Nicolae Alexandru](#)

Gheorghe Asachi Technical University of Iasi

[Alexandrescu, Adrian](#)

Gheorghe Asachi Technical University of Iasi

**Keywords:** [Cloud Computing](#), [Distributed Systems](#), [Internet of Things](#)

**Abstract:** Ambient Assisted Living (AAL) is starting to become the norm as more and more smart devices and sensors are installed in people's homes. This is an important aspect in improving the quality of life, especially for the elderly and for people with disabilities.

The solution presented in this paper approaches this paradigm in a large scale deployment context, as it proposes an AAL architecture on three layers (Edge, Dew, and Cloud), which is capable of handling high amount of sensor data in near real-time. Using a distributed system of rules engines, the system is able to take actions based on the acquired data. An important novel concept is the "new home deployment", which facilitates the integration of the devices from a new installation site - the software setup of the new edge infrastructure is done by using a dedicated Cloud service. In order to showcase the practicality and efficiency of the architecture, this paper presents the intricacies of the employed services and service-interaction when deploying the solution on the OpenStack Cloud platform.

12:10-12:30, Paper ThA3.6

Add to My Program ☐

[Autoscaling MPI Cluster Using OpenMPI and OpenStack Cloud Services](#)

[Pavăi, Silviu-Dumitru](#)

"Gheorghe Asachi" Technical University of Iasi

[Amarandei, Cristian-Mihai](#)

"Gheorghe Asachi" Technical University of Iasi, Faculty of Autom

[Serban, Elena](#)

"Gheorghe Asachi" Technical University of Iasi

[Mironeanu, Catalin](#)

Technical University "Gheorghe Asachi" of Iasi

**Keywords:** [Distributed Systems](#), [Cloud Computing](#)

**Abstract:** In this paper, we present a novel architecture for an auto-scaling MPI cluster that leverages the capabilities of OpenMPI and OpenStack frameworks. Unlike traditional MPI clusters, which are typically static and expand to the maximum available resources, our proposed architecture aims to dynamically allocate resources in a cloud environment. This strategy is essential to mitigate high costs associated with static provisioning and ensure that the parallel tasks running on the cluster can fully benefit from the computational power of the cloud when needed.

By integrating OpenMPI, a high-performance MPI implementation, with the flexible resource management capabilities of

OpenStack, we enable the dynamic allocation and de-allocation of compute resources based on the cluster's workload demands. This auto-scaling mechanism allows the cluster to scale up or down in response to changing computational requirements, optimizing resource utilization and reducing costs.

**ThB1** Regular session, Pop Rock + Blues + Jazz Room

Add to My Program ☐

#### [Predictive Control](#)

Chair: [Iles, Sandor](#)

University of Zagreb, Faculty of Electrical Engineering and Computing

Co-Chair: [Caruntu, Constantin-Florin](#)

Gheorghe Asachi Technical University of Iasi

14:00-14:20, Paper ThB1.1

Add to My Program ☐

#### [Learning-Based Model Predictive Control Using Double Q-Learning](#)

[MoradiMaryamnegari, Hoomaan](#)

Free University of Bozen-Bolzano

[Frego, Marco](#)

Università Di Trento

[Peer, Angelika](#)

TU München

**Keywords:** [Predictive Control](#), [Machine Learning](#), [Adaptive Control](#)

**Abstract:** In this work, we present a new method to tune a Model Predictive Controller (MPC) with the help of a Reinforcement Learning (RL) algorithm called Double Q-Learning. In this algorithm, two function approximators with different sets of parameters are trained simultaneously. First, the nonlinear MPC is parametrized in the weights of its cost function and unknown parameters of its equality and inequality constraints. Then, it is defined as the action-value function of the Double Q-Learning algorithm. By randomly switching between two sets of parameters in the MPC, we show that the exploration of the proposed algorithm increases. Since model error terms are added to the baseline stage cost, thanks to more exploration, less model mismatch is obtained. With this, less bias in the MPC controller is achieved compared to an MPC-based Q-Learning algorithm. Simulation results on a coupled tanks system show that not only the training process resulted to be faster than observed for the MPC-based Q-Learning method, but also the final control performance was found to be more desirable.

14:20-14:40, Paper ThB1.2

Add to My Program ☐

#### [Stochastic Model Predictive Control with Dynamic Chance Constraints](#)

[Engelaar, Maico Hendrikus Wilhelmus](#)

Eindhoven University of Technology

[Haesaert, Sofie](#)

TU Eindhoven

[Lazar, Mircea](#)

Eindhoven University of Technology

**Keywords:** [Predictive Control](#), [Robust Control](#), [Linear Systems](#)

**Abstract:** This work introduces a stochastic model predictive control scheme for dynamic chance constraints. We consider linear discrete-time systems affected by unbounded additive stochastic disturbance. To synthesize an optimal controller, we solve two subsequent stochastic optimization problems. The first problem concerns finding the maximal feasible probabilities of the dynamic chance constraints. After obtaining the probabilities, the second problem concerns finding an optimal controller using stochastic model predictive control. We solve both stochastic optimization problems by reformulating them into deterministic ones using probabilistic reachable tubes and constraint tightening. We prove that the developed algorithm is recursively feasible and yields closed-loop satisfaction of the dynamic chance constraints. In addition, we will introduce a novel implementation using zonotopes to describe the tightening analytically. Finally, we will end with an example illustrating the method's benefits.

14:40-15:00, Paper ThB1.3

Add to My Program ☐

#### [Model Predictive Control of Hemodynamics During Intravenous General Anesthesia](#)

[Farbakhsh, Hamed](#)

Ghent University

[Yumuk, Erhan](#)

Ghent University

[BenOthman, Ghada](#)

Ghent University

[De Keyser, Robin M.C.](#)

Ghent University

[Copot, Dana](#)

Ghent University

[Birs, Isabela Roxana](#)

Technical University of Cluj-Napoca

[Ionescu, Clara](#)

Ghent University

**Keywords:** [Predictive Control](#), [Control Systems Design](#), [Biomedical Engineering](#)

**Abstract:** In the operating rooms and the intensive care unit, it is crucial to manage the patient's hemodynamic status, which includes factors like cardiac output and mean arterial pressure. Anesthesiologists confront a difficult task while monitoring high-risk patients. Cardiac output optimization has been found to enhance the result of high-risk patients in terms of hospital stay, mortality rate, post-operative problems, etc. The application of standard control approaches is restricted because the mean arterial pressure response of a patient using vasoactive medicines is modeled by a first-order dynamical system with time-varying parameters and a time-varying delay in the control input. In order to circumvent implementation challenges, this work develops an approximation technique that describes the system using a higher-order model. Predictive control is therefore used to comprehend the practical application of higher-order hemodynamic systems. The effectiveness of this strategy is demonstrated by the simulations and outcomes that are given.

15:00-15:20, Paper ThB1.4

Add to My Program ☐

#### [Autonomous Path Following Using Data-Driven Predictive Control](#)

[Kir Hromatko, Josip](#)

University of Zagreb Faculty of Electrical Engineering and Compu

[Svec, Marko](#)

University of Zagreb, Faculty of Electrical Engineering and Comp

[Iles, Sandor](#)

University of Zagreb, Faculty of Electrical Engineering and Comp

**Keywords:** [Predictive Control](#), [Automotive Control Systems](#), [Control Systems Design](#)

**Abstract:** Predictive control based on an informative system trajectory, instead of a physics-based model, has received significant attention in recent years. This paper investigates the potential of using such data-driven control for vehicle dynamics control and autonomous path following. By considering the path following problem in the error space, the underlying system is approximately linear and existing results for data-driven predictive control can be applied. Also, scheduling based on longitudinal speed can be readily included. The proposed control algorithm was tested on two different lane change maneuvers in a high-fidelity simulation environment.

15:20-15:40, Paper ThB1.5

Add to My Program ☐

#### [Cooperative Adaptive Cruise Control with String Stability Based on DMPC for Vehicle Platooning](#)

[Pauca, Ovidiu](#)

"Gheorghe Asachi" Technical University of Iasi

[Lazar, Mircea](#)

Eindhoven University of Technology

[Caruntu, Constantin-Florin](#)

Gheorghe Asachi Technical University of Iasi

**Keywords:** [Predictive Control](#), [Automotive Control Systems](#), [Control Systems Design](#)

**Abstract:** The cooperative adaptive cruise control (CACC) functionality received significant interest in the state-of-the-art due to its advantages in optimizing traffic flow. The model-based predictive control (MPC) strategy was used in various studies due to its advantages in improving the performance of the vehicles (reducing the travel costs, improving the quality of the travel by reducing sudden accelerations, and ensuring the stability of the platoons). Moreover, MPC solutions are built to maximize the advantages of vehicular communication by sharing predictions on states of vehicles (e.g., velocities, accelerations, trajectories). In addition, MPC is also used to compensate for the disturbances added by communications. Thus, this paper proposes a CACC strategy for a vehicle platoon. The solution is based on the distributed MPC (DMPC) strategy, and the controller is proposed in discrete time, ensuring predecessor-follower string stability for the whole platoon.

15:40-16:00, Paper ThB1.6

Add to My Program ☐

[Stochastic Optimization Problem Solved Using SVM Based Prediction for Photovoltaic Plants \(I\)](#)

[Colbu, Stefania Cristiana](#)

University POLITEHNICA of Bucharest

[Bancila, Daniel - Marian](#)

University POLITEHNICA of Bucharest

[Popescu, Dumitru](#)

Politehnica University of Bucharest

[Olteanu, Severus Constantin](#)

University POLITEHNICA of Bucharest

[Petrescu-Nita, Alina](#)

Faculty of Applied Sciences , University  
Politehnica of Buchares

**Keywords:** [Machine Learning](#), [Optimization](#), [Industrial Applications](#)

**Abstract:** In the current paper, a strategy for handling a stochastic optimization problem based on metaheuristic techniques is presented. This optimization problem is defined based on the impact of environmental factors such as temperature and irradiance on photovoltaic panels. The objective aims to solve the defined problem by finding an SVM model of a photovoltaic panel. To enhance the efficiency of power generation, this model will be utilized for the purpose of predicting the voltage linked to the Maximum Power Point of the panel.

ThB2 Regular session, Folk Room

Add to My Program ☐

[Advances in Control and Computing](#)

Chair: [Nicola, Stelian](#)

University Politehnica Timișoara

Co-Chair: [Roman, Raul-Cristian](#)

Politehnica University of Timisoara

14:00-14:20, Paper ThB2.1

Add to My Program ☐

[Trajectory Extraction from Online Mapping Platforms: Empowering Vehicle Dynamics and Intelligent Functionalities](#)

[Pauca, Georgiana-Sinziana](#)

Gheorghe Asachi Technical University of Iasi

[Caruntu, Constantin-Florin](#)

Gheorghe Asachi Technical University of Iasi

**Keywords:** [Automotive Control Systems](#), [Predictive Control](#), [Intelligent Systems](#)

**Abstract:** The development, enhancement, and integration of intelligent functionalities aimed at automating vehicles are increasingly becoming a fundamental aspect of modern life. There is a growing emphasis on improving the everyday driving experience and reaping the benefits that these advanced cars offer. In light of these advancements, this study proposes a novel method for extracting trajectories, which serves as a valuable tool in implementing and evaluating complex algorithms and functionalities. Obtaining a real trajectory enables the observation of how a vehicle moves along a given road. Moreover, the extracted trajectory can also facilitate the development of additional functionalities such as lane keeping, velocity profile, and other advanced techniques. This multifaceted approach allows for the exploration and refinement of various intelligent systems, ultimately contributing to the overall improvement of autonomous driving capabilities. The proposed method of trajectory extraction opens up new possibilities for advancing the field, providing a solid foundation for implementing and evaluating intricate algorithms. Through the utilization of real trajectories, valuable insights into vehicle behavior can be gained, which can further enhance the performance of autonomous vehicles.

14:20-14:40, Paper ThB2.2

Add to My Program ☐

[Kernel Ridge Regression Based Modelling and Anomaly Detection for Temperature Control in Textile Dyeing Processes](#)

[Görgül, Ahmed Ümit](#)

Eliar

[Com, Mustafa](#)

Eliar Electronics Corp

[Sultanoglu, Mustafa Sencer](#)

Eliar Electronics Inc

**Keywords:** [Fault Diagnosis and Fault Tolerant Control](#), [Machine Learning](#), [Industrial Applications](#)

**Abstract:** This article proposes the use of Kernel Ridge Regression (KRR) for modeling and anomaly detection in the temperature control of textile dyeing processes. The anomaly being considered is the inability to heat or cool the dyeing machine temperature. It is concluded that anomaly detection results of the KRR model are satisfactory. The ultimate goal is to find problematic temperature controls rapidly and solve equipment failures of dyeing machines to increase right-first-time dyeing.

14:40-15:00, Paper ThB2.3

Add to My Program ☐

[Evaluation of a Time Efficient Medium Access Policy: GTDMA](#)

[Popovici, Alin](#)

Politehnica University Timisoara

[Stangaciu, Valentin](#)

Politehnica University Timisoara

**Keywords:** [Communication Systems](#), [Real Time Applications](#), [Internet of Things](#)

**Abstract:** Time-Division Multiple Access (TDMA) medium access policy is widely used in wireless sensor networks where predictability is mandatory in communication. Such a policy is ideal for real-time applications but has an inefficient use of the communication channel. A significant improvement is given by the Greedy TDMA (GTDMA) access policy. In this paper, we present a complex simulation platform built on a popular sensor network simulator. We present an accurate analysis over the benefits of the GTDMA policy over the classic TDMA after intense simulations in many scenarios.

15:00-15:20, Paper ThB2.4

Add to My Program ☐

[RISC-V Extension for Optimized PWM Control](#)

[Popovici, Cosmin-Andrei](#)

Technical University "Gheorghe Asachi" of Iasi, Faculty of  
Autom

[Stan, Andrei](#)

Gheorghe Asachi Technical University of Iasi

[Manta, Vasile](#)

Gheorghe Asachi Technical University of Iasi

**Keywords:** [Computer Architectures](#), [Embedded Systems](#), [Intelligent Systems](#)

**Abstract:** This paper proposes a RISC-V extension, named SigWavy, meant to optimize the PWM control for general purpose or application specific designs. The RISC-V extension named above is a PWM Control Unit with a dedicated ISA extension set designed for configuring and driving up to 32 PWM signals. The extension is integrated into RiscPwm, an updated version of our previous work, the RisCanFd SoC, for taking advantage of CAN-FD, a massively used protocol in the areas of automation and mobility. Being configured with the dedicated ISA extension or with parameters



directly extracted from CAN-FD commands, the proposed solution manages to configure/reconfigure PWM channels between 4.79x and 9.18x times faster than an ARM Cortex-M7 processor, although our SoC operates with a 6x lower frequency.

15:20-15:40, Paper ThB2.5

Add to My Program ☐

[Selective High-Latency Arithmetic Instruction Reuse in Multicore Processors](#)

[Buduleci, Claudiu-Raul](#)

Lucian Blaga University of Sibiu

[Gellert, Arpad](#)

Lucian Blaga University of Sibiu

[Florea, Adrian](#)

Lucian Blaga University of Sibiu

**Keywords:** [Computer Architectures](#), [Other Topics](#)

**Abstract:** In this work, we present an original contribution which augments the Intel Nehalem multicore architecture with a selective high-latency arithmetic set-associative reuse buffer. The architecture is simulated using Sniper, which we adapted to estimate the power consumption, area of integration and chip temperature, including latency modifications for the newly added unit. The implementation of a set-associative reuse buffer is a new approach, along with the applicability in a multicore microprocessor, applied to long-latency arithmetical instructions targeting dataflow bottleneck and increasing CPU performance. Additionally, we have performed a manual design space exploration for the enhanced microarchitecture, by varying the associativity and the size of the proposed reuse buffer unit and evaluating the impact on the interested metrics. Our simulations on the Splash 2 benchmarks, revealed an average reuse rate up to 33.27% allowing a maximum speedup of 6.56%. While the energy consumption remains stable, we see an average chip temperature reduction of 2.8°C along with the increase in associativity.

15:40-16:00, Paper ThB2.6

Add to My Program ☐

[An Overview of Different Topologies for CoAP Protocol Using Contiki Operating System](#)

[Krech, Florian-Aurelian](#)

Polytechnic University Timisoara

[Rota, Adriana Ioana](#)

Polytechnic University Timisoara

[Stangaciu, Cristina](#)

Politehnica University of Timisoara

**Keywords:** [Internet of Things](#), [Distributed Systems](#), [Communication Systems](#)

**Abstract:** The purpose of the Internet of Things is to gain momentum in all fields and to link devices equipped with sensors, processing power, software, and other technologies that can communicate and share data with other hardware through the Internet or other communications networks. This paper presents some different types of topologies used for CoAP protocol and analyzes their performance. The topologies we used for this paper are the following: box topology, linear topology, elliptical topology, and random topology. Our study shows differences of about 17% in power consumption concerning the topology chosen, which is not neglectable for the Internet of Things domain, where power consumption is a sensitive issue.

ThB3 Regular session, Disco Room

Add to My Program ☐

[Machine Learning](#)

Chair: [Vescan, Andreea](#)

Babes-Bolyai University

Co-Chair: [Gaceanu, Radu](#)

Babes-Bolyai University

14:00-14:20, Paper ThB3.1

Add to My Program ☐

[Learning the Dynamic Environment of an Original Game Using Hierarchical Reinforcement Learning Methods](#)

[Batalan, Vlad](#)

"Gheroghe Asachi" Technical University of Iasi

[Leon, Florin](#)

Gheorghe Asachi Technical University of Iasi

**Keywords:** [Machine Learning](#), [Agent - Based Systems](#)

**Abstract:** This paper compares the performance of two reinforcement learning algorithms, Q-Learning and MAXQ-0, in learning to play an original game. An extension of MAXQ-0 algorithm, MAXQ-P is introduced, which enhances the variety of the tree nodes with simple, ordered and repetitive nodes. The hierarchical approach provided by MAXQ-P finds the optimal solution faster than the flat Q-Learning approach but converges more slowly. Furthermore, the performance of the MAXQ-P algorithm decreases after a certain number of episodes due to representation error in the weights of the model. To address this issue, the model is periodically tested with an exploration value of 0, and if the model successfully finds the solution, it is stored for future use. This study provides insights into the benefits and drawbacks of using hierarchical reinforcement learning algorithms for complex tasks and highlights the importance of carefully designing and training such algorithms for optimal performance.

14:20-14:40, Paper ThB3.2

Add to My Program ☐

[Reproducibility in Deep Reinforcement Learning with Maximum Entropy](#)

[Paleu, Tudor-Andrei](#)

Gheorghe Asachi Technical University of Iasi

[Pascal, Carlos](#)

Gheorghe Asachi Technical University of Iasi

**Keywords:** [Machine Learning](#), [Intelligent Systems](#), [Agent - Based Systems](#)

**Abstract:** The latest work in the field of deep reinforcement learning speaks highly about the advanced exploration techniques which avoid the greedy decisions of agents. Usually, reinforcement learning works by finding the optimal policy for a Markov Decision Process. In off-policy algorithms the agent learns a value function for this optimal policy, separate of the action choice, an example being the deep Q-learning algorithm. Algorithms based on a maximum entropy framework, like soft Q-learning, overcome the greedy behavior of the agent, effectively combining exploration and exploitation by adding an entropy term to the Bellman equation. This method, applied to the Lunar Lander environment, was compared to the classic deep Q-learning, using the same set of different random seeds and averaging multiple runs. An implicit exploration strategy proves to compensate for disturbances caused by intrinsic sources of non-determinism, such as random seeds. This paper highlights the sensitivity to intrinsic and extrinsic influences for deep reinforcement learning, with respect to exploration and repeatability.

14:40-15:00, Paper ThB3.3

Add to My Program ☐

[Standardized Transfer Learning Models Enhance Classification of Breast Ultrasound Data](#)

[Bota, Maria](#)

UTCN

[Ciobotaru, Alexandru](#)

UTCN

[Bota, Peter](#)

California University of Science and Medicine Colton

[Gota, Dan Ioan](#)

Technical University of Cluj Napoca

[Stefan, Julia](#)

Technical University of Cluj-Napoca

[Valean, Honoriu](#)

Technical University of Cluj-Napoca

[Miclea, Liviu](#)

Technical University of Cluj-Napoca

**Keywords:** [Biomedical Engineering](#), [Machine Learning](#), [Computer Vision](#)

**Abstract:** Ultrasound imaging is an often employed technique in diagnosing of breast cancer, although the prediction reliability depends on the specialist's experience. Computer Aided Diagnosis (CAD) systems have been introduced for the enhancement the quality and time invested in classifying breast ultrasound(BUS) images. Deep Convolutional Neural Networks based algorithms is considered one of the most successful strategy in breast ultrasound image analysis. Data limitation is one of the prioritizing issues at the current moment. This problem is referred by introducing transfer-learning-

based models and stratification as a data augmentation technique for achieving a better accuracy of the classification. The paper has demonstrated that the deep feature extraction and feature selection can properly categorized the breast ultrasound images using the pre-training methods. A dataset containing 1578 breast ultrasound images was used for model training and testing, and the optimal level of achievement was reached by InceptionResNetV2 and DenseNet121 with an accuracy of 83% and an "one over the rest" AUC score of 0.933 for DenseNet121, respectively 0.923 for InceptionResNetV2.

15:00-15:20, Paper ThB3.4

Add to My Program ☐

[Cross-Project Defect Prediction Using Supervised and Unsupervised Learning: A Replication Study](#)

[Vescan, Andreea](#)

Babes-Bolyai University

[Gaceanu, Radu](#)

Babes-Bolyai University

**Keywords:** [Software Engineering](#), [Machine Learning](#), [Other Topics](#)

**Abstract:** Successful software projects are now an important challenge, the main focus of the engineering community being to predict software failures based on the history of buggy classes. However, software defect prediction techniques are effective as long as there is enough data to train the prediction model. To mitigate this problem, cross-project defect prediction is used.

The purpose of this investigation is two-fold. First, replicate the experiments in the original articles and second, investigate other settings regarding defect prediction with the aim of bringing new insights and results on the best approach.

In this study, three supervised (Random Forest - RF, Logistic Model Tree - LMT, Naive Bayes - NB) and three unsupervised (Expectation Maximization - EM, DBSCAN, KMeans) approaches are investigated. The experiments used use preprocessed methods (normalization and feature selection). Two sets of experiments are performed considering all available features and using preselected features by Principal Component Analysis, each set of experiments being employed on both supervised and unsupervised methods.

The results of the replicated experiments confirm the original findings: when using supervised methods considering all features the best method is NB, followed by RF and LMT and similar to better results when considering fewer features (with PCA); when using unsupervised methods the results are not better than the original; however, when considering fewer features the results obtained with the newly considered methods (EM, DBSCAN, KMeans) are better than in the original paper.

15:20-15:40, Paper ThB3.5

Add to My Program ☐

[TensorFlow vs. PyTorch in Classifying Medical Images – Preliminary Results](#)

[Stanescu, Liana](#)

University of Craiova

[Dinu, Gabriela-Loredana](#)

HELLA GmbH & Co. KGaA

**Keywords:** [Machine Learning](#)

**Abstract:** The paper presents a first series of results regarding the comparison of two deep neural networks designed, trained, and validated with the help of two deep learning frameworks, PyTorch and TensorFlow, in the classification of a large set of breast histopathology images. The original dataset consisted of 162 whole mount slide images of breast cancer specimens scanned at 40x. From that, 277,524 patches of size 50 x 50 were extracted (198,738 invasive ductal carcinoma negative and 78,786 positive). Invasive Ductal Carcinoma is the most common subtype of all breast cancers. The metrics compared in the training and validation phases were loss, accuracy, precision, recall and specificity. The architecture used for convolutional neural network has 8 layers: 3 convolution layers, 3 max-pooling layers, 1 linear layer and a sigmoid function. The number of epochs is considered a hyperparameter. It defines the number of times the entire data set must be worked through the learning algorithm. In our study we used 5 epochs. For the 8-layer network, PyTorch performed better in accuracy, precision, recall, and loss in both training and validation. In contrast, specificity is lower. Recall or sensitivity is around 73%, and specificity around 93%. Our estimates can be considered and continued since a diagnostic study must have both sensitivity and specificity of at least 70%. The results so far are promising, and we propose to continue the experiments in several directions.



## 2023 27th International Conference on System Theory, Control and Computing (ICSTCC)

October 11-13, 2023, Timisoara, Romania

[Program at a Glance](#) [Wednesday](#) [Thursday](#) [Friday](#) [Author Index](#) [Keyword Index](#) [My Program](#)

Last updated on September 6, 2023. This conference program is tentative and subject to change

### Technical Program for Friday October 13, 2023

To show or hide the keywords and abstract (text summary) of a paper (if available), click on the paper title.

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**FrRT1** Pop Rock + Blues + Jazz Room

[Add to My Program](#) ☐

#### [Round Table on Women in Engineering - Challenges and Solutions](#)

Chair: [Popescu, Elvira](#)

University of Craiova

Co-Chair: [Helerea, Elena](#)

Transilvania University of Brasov

**FrA1** Regular session, Pop Rock + Blues + Jazz Room

[Add to My Program](#) ☐

#### [System Identification and Modeling](#)

Chair: [Kießkalt, Julian](#)

Friedrich-Alexander-Universität Erlangen-Nürnberg

Co-Chair: [Caruntu, Constantin-Florin](#)

Gheorghe Asachi Technical University of Iasi

10:20-10:40, Paper FrA1.1

[Add to My Program](#) ☐

#### [Safe Data-Driven Reference Tracking with Prescribed Performance](#)

[Schmitz, Philipp](#)

Technische Universität Ilmenau

[Lanza, Lukas](#)

Technische Universität Ilmenau

[Worthmann, Karl](#)

Technische Universität Ilmenau

**Keywords:** [Adaptive Control](#), [Predictive Control](#), [System Identification and Modeling](#)

**Abstract:** We study output reference tracking for unknown continuous-time systems with arbitrary relative degree. The control objective is to keep the tracking error within predefined time-varying bounds while measurement data is only available at discrete sampling times. To achieve the control objective, we propose a two-component controller. One part is a recently developed sampled-data zero-order hold controller, which achieves reference tracking within prescribed error bounds. To further improve the control signal, we explore the system dynamics via input-output data, and include as the second component a data-driven MPC scheme based on Willems et al.'s fundamental lemma. This combination yields significantly improved input signals as illustrated by a numerical example.

10:40-11:00, Paper FrA1.2

[Add to My Program](#) ☐

#### [A Measurement Based Predictive Maintenance Algorithm for Rigid-Body Dynamical Systems Using Radial Basis Function Approximation and Information Theory](#)

[Ortmann, Jan](#)

University of Siegen

[Ortmann, Mathis](#)

Justus Liebig University of Giessen

**Keywords:** [System Identification and Modeling](#), [Signal Processing](#), [Robotics](#)

**Abstract:** This paper presents new viewpoints to solve predictive maintenance problems for arbitrarily rigid-body mechanical systems. Reliable predictions for changes in physical parameters are highly dependent on system model accuracy. Hence, costs for physical system modeling are expensive and time-consuming. To overcome this problem, we replaced the modeling process with a full measurement based procedure in conjunction with radial basis functions (RBF) approximation to create the system model. Subsequently, information theory is employed to generate a meaningful metric quantity that reports about the changes in physical parameters. A rigid-body mechanical system is used as an example to verify the presented theory.

11:00-11:20, Paper FrA1.3

[Add to My Program](#) ☐

#### [Simulation Chain for Sensorized Strain Wave Gears](#)

[Kießkalt, Julian](#)

Friedrich-Alexander-Universität Erlangen-Nürnberg

[Michalka, Andreas](#)

Friedrich-Alexander-Universität Erlangen-Nürnberg

[Strohmeier, Christoph](#)

Schaeffler Technologies AG & Co. KG

[Horn, Malte](#)

Schaeffler Technologies AG & Co. KG

[Graichen, Knut](#)

University Erlangen-Nürnberg (FAU)

**Keywords:** [System Identification and Modeling](#), [Modeling](#), [Simulation and CAD Tools](#), [Fault Diagnosis and Fault](#)

[Tolerant Control](#)

**Abstract:** Strain wave gears (SWG) are commonly used as speed reducers in robot joints. The output torque of these gears can be determined without external measurement equipment by evaluating the signals of strain gauge sensors mounted on the flex spline. This paper presents a simulation chain to compute these sensor signals with the intention to provide a model based approach to study faults in SWGs. It consists of a model describing the dynamic behavior of the gear, a space truss to compute the deformation of the flex spline, and a model for strain gauge sensors mounted on the flex spline. The comparison to experimental data shows the validity of the proposed approach. Moreover, selected faults are injected into the simulation chain and their impact is discussed.

11:20-11:40, Paper FrA1.4

[Add to My Program](#) ☐

#### [PI<sup>k</sup>D<sup>α</sup> Controller in the Human Machine Systems](#)

[Ivanescu, Mircea](#)

University of Craiova

[Nitulescu, Mircea](#)

University of Craiova

**Keywords:** [Control Systems Design](#), [Robotics](#), [System Identification and Modeling](#)

**Abstract:** his paper investigates the control of an electric vehicle by an human operator and the techniques needed to compensate for the operator's control deficiencies. Several classes of human operators, of various ages and health



conditions, are analyzed. It is shown that the human operator can be characterized by an integrator model with the fractional exponent  $\beta \in [0.8-1.6]$ . Particular attention is paid to people with Parkinson's disability for whom the exponent  $\beta$  tends to values of 1.5. The fractional model of the human machine system is determined. Control systems based on the use of observers for the estimation of human state components and hierarchical control systems are studied. The stability conditions are obtained by Lyapunov techniques. Experiments on a wheelchair driven by a person with Parkinson's disability confirm the correctness of the proposed solutions.

11:40-12:00, Paper FrA1.5

Add to My Program ☐

[A Spatially Distributed Boost Converter - Modeling and Simulation](#)

[Röbenack, Klaus](#)

TU Dresden

[Bärnklaus, Hans](#)

VEM Sachsenwerk GmbH

**Keywords:** [Modeling, Simulation and CAD Tools, Distributed Systems](#)

**Abstract:** Conventional power converters with lumped elements are widely used today. Distributed converter circuits have been known for a number of years, but are hardly used outside of radio frequency applications. These alternative converters may have qualitatively different properties. We model a distributed boost converter and compare its operation with a conventional boost converter.

FrA2 Regular session, Folk Room

Add to My Program ☐

[Software Engineering](#)

Chair: [Chirila, Ciprian-Bogdan](#)

Politehnica University of Timisoara

Co-Chair: [Nicola, Stelian](#)

University Politehnica Timisoara

10:20-10:40, Paper FrA2.1

Add to My Program ☐

[Enumerating Class Relations Weights to Assess Their Importance in a Graph Representation Model for Detecting Key Classes Using PageRank](#)

[Chirila, Ciprian-Bogdan](#)

Politehnica University of Timisoara

[Sora, Ioana](#)

University Politehnica Timisoara

**Keywords:** [Software Engineering, Theory of Algorithms, Other Topics](#)

**Abstract:** The most crucial classes in an object-oriented software system are known as key classes. They serve as the backbone of the software system and are typically documented in project documentation or executive summaries. Key classes play a vital role in software reengineering tasks, particularly when there is a lack of or inadequate documentation for the project. Therefore, the detection of key classes becomes a significant concern.

Various methods have been reported for detecting key classes, including static code analysis, dynamic code analysis, and machine learning. In a static code analysis approach, a weighted graph model is employed to represent the relationships between classes, such as inheritance, interface realization, field usage, and return type usage. By applying a link analysis algorithm on the weighted graph model, the classes are ranked based on their importance, enabling the identification of the top 20 most critical classes.

To evaluate the significance of class relations, we generate all possible combinations of weights for two pairs (1,2) and (1,5) for each class relation during the construction of the weighted graph. Our approach is tested on 14 analyzed systems of varying sizes, encompassing different domains like games, web servers, utilities, and more.

10:40-11:00, Paper FrA2.2

Add to My Program ☐

[Ecosystem-Centric Approach to Intelligent Product Development: Paving the Way for Scalable and Adaptive Solutions](#)

[Stanciu, Alexandru](#)

Microsoft

[Miclea, Liviu](#)

Technical University of Cluj-Napoca

**Keywords:** [Intelligent Systems, Cloud Computing](#)

**Abstract:** This paper explores the evolution from traditional to modern methodologies for the development of intelligent products. The traditional linear and sequential approach, often characterized by limited toolsets and hardware-centric programming, fails to address the complexities and dynamic requirements of today's digital ecosystems. To bridge this gap, we propose an ecosystem-centric approach to intelligent product development that emphasizes scalability, flexibility, and integration of advanced technologies. Our approach fosters the use of artificial intelligence, machine learning, and advanced data analytics techniques, providing a model for creating scalable and adaptive solutions. We also delve into the necessity of DevSecOps methodology, incorporating cloud-based solutions such as Integration PaaS services, and embracing IoT technologies. This paper contributes by highlighting the benefits of this approach, including improved functionality, reduced development lifecycle, enhanced supply strategy, and cost savings.

11:00-11:20, Paper FrA2.3

Add to My Program ☐

[A Practical Agile Route Optimisation Solution for Transport of Goods](#)

[Nitu, Alexandru](#)

Academia De Studii Economice Din Bucuresti

**Keywords:** [Optimization, Software Engineering, Intelligent Systems](#)

**Abstract:** The purpose of this study is to design and build an agile solution, able to adapt to as many practical situations as possible from the spectrum of optimizing distribution routes in the transport of goods. These optimizations are increasingly needed today, in the context of energy and climate crises. Making the use of electricity and fossil fuels more efficient means using a smaller amount of raw material to produce the same result. The study resumes the discussion of the classic problem of the traveler's commissary as the main starting point in optimizing the distribution routes, over which new functionalities are added to develop an agile algorithm, capable of adapting in as many practical scenarios as possible. Several types of algorithms, such as CVRP, VRPP, VRPPD, VRPTW, etc., are reviewed, explaining a graphical, easy-to-understand manner that clearly shows the difference in approach and the purpose for which they can be used. Reducing distances travelled by optimally grouping points of interest can bring substantial savings. As the study shows, the monthly costs for each vehicle in the fleet are significant, so a reduction in personnel entails a reduction in costs. The work focuses on defining many functionalities to achieve as many existing objectives as possible within any distribution company: minimizing the number of vehicles needed, minimizing transport costs, increasing customer satisfaction, and avoiding penalties. The structure of the paper includes the introduction, the current state of knowledge in the field, the methodology of the research with the presentation of the characteristics of the projected solution, the highlighting of the agile dimension of the proposed solution, the conclusions, and the most important research directions.

11:20-11:40, Paper FrA2.4

Add to My Program ☐

[Optimizing Precision in Cellular Clocks through Self-Regulated Accumulation of Molecules](#)

[Rezaee, Sayeh](#)

University of Delaware

[Nieto, Cesar](#)

University of Delaware

[Singh, Abhyudai](#)

University of Delaware

**Keywords:** [Biologically Inspired Systems, Biomedical Engineering, Optimization](#)

**Abstract:** The timing of cellular events is often determined by the instant when the level of a chemical species crosses a threshold from an initial value of zero. To attenuate the inherent random fluctuations in this first-passage time, the production rate can be a function of the current species level by implementing a feedback or self-regulation. In this study, we aim to identify the self-regulation strategy that minimizes timing noise around a specified mean first-passage time.

Previous results showed that no-feedback is the optimal strategy in the absence of molecule degradation. Based on this result, we study the case where the species may undergo degradation. First, we set the feedback to be a linear function of the number of molecules. We derive analytical formulas concluding that the optimal strategy involves positive feedback, whereby the production rate increases with the number of molecules. When feedback constraints are removed, our numerical methods suggest that a mixed self-regulation scheme is optimal. This strategy involves an initial positive feedback phase, followed by a sharp transition to a negative feedback scheme in proximity to the threshold. In summary, this research quantifies the fundamental limits of timing noise reduction, considering different strategies of self-regulation in situations where time-keeping species may be subjected to degradation.

11:40-12:00, Paper FrA2.5

Add to My Program ☐

[Innovation through Green-Energy Footwear and Piezoelectric Harvesting System](#)

[Panta, Robert Vasile](#)

Technical University of Cluj-Napoca

[Fanca, Alexandra](#)

Technical University of Cluj - Napoca

[Gota, Dan Ioan](#)

Technical University of Cluj Napoca

[Valean, Honoriu](#)

Technical University of Cluj-Napoca

[Puscasiu, Adela](#)

Technical University of Cluj-Napoca

[Stefan, Iulia](#)

Technical University of Cluj-Napoca

**Keywords:** [Internet of Things](#), [Embedded Systems](#), [Communication Systems](#)

**Abstract:** As renewable energy becomes more prevalent and the Internet of Things (IoT) industry assumes its rightful place in the global technology cycle, research interest in green energy and the possibility of embedded-technology-based wearable devices will increase. The current work focuses on kinetic energy harvesting using footwear mechanisms to generate renewable energy. Human motion is utilized as an innovative method for generating kinetic energy through piezoelectric sensors and recharging batteries for any purpose. The developed system will include a NodeMCU ESP32 (Node Microcontroller Control Unit) development board as a microcontroller to make energy harvesting manageable. The developed prototype will include a solar panel voltage source, making the microcontroller's dynamic charging possible. Furthermore, an IoT interface will monitor the embedded system, allowing the user to check the battery percentage of the piezoelectric-charged battery and the number of successful steps. The connection between the hardware and software components will be established using Bluetooth connectivity. The experimental study entangles multiple essential purposes, including research, health support, environmental protection, and the use of green energy generation techniques.

FrA3 Regular session, Disco Room

Add to My Program ☐

[Cyber-Security](#)

Chair: [Gușită, Bianca](#)

Politehnica University of Timisoara

Co-Chair: [Mocanu, Florin](#)

"georghe Asachi" Technical University of Iasi

10:20-10:40, Paper FrA3.1

Add to My Program ☐

[Applications of the MPSA Algorithm and CNN for Securing Medical X-Rays](#)

[Gușită, Bianca](#)

Politehnica University of Timisoara

[Găină, Lucian Ionel](#)

Politehnica University of Timisoara

[Stanescu, Daniela Natalia](#)

Politehnica University of Timisoara

[Chergulescu, Ioana](#)

Adaptemy

**Keywords:** [Cyber - Security](#), [Signal Processing](#), [Machine Learning](#)

**Abstract:** In the current context in which we live, after the health crisis caused by the Sars-CoV-2 virus, preserving data privacy is a sensitive topic and of major importance for everyone. Confidential information has become much more valuable than in the past and has practically become a currency of exchange. This paper proposes a solution for securing X-ray medical records based on an artificial intelligence algorithm that uses convolutional neural networks to transfer the style of a reference image and the MPSA steganographic algorithm to hide the digital X-ray. Furthermore, the paper presents the BeProtected desktop application and the results analysis in terms of imperceptibility and quality of the recovered message.

10:40-11:00, Paper FrA3.2

Add to My Program ☐

[Defense Method against Adversarial Attacks Using JPEG Compression and One-Pixel Attack for Improved Dataset Security](#)

[Cucu, Adelina-Valentina](#)

Université Paris-Saclay, Politehnica University of Timisoara

[Valenzise, Giuseppe](#)

Université Paris-Saclay

[Stanescu, Daniela Natalia](#)

Politehnica University of Timisoara

[Chergulescu, Ioana](#)

Adaptemy

[Găină, Lucian Ionel](#)

Politehnica University of Timisoara

[Gușită, Bianca](#)

Politehnica University of Timisoara

**Keywords:** [Machine Learning](#), [Computer Vision](#), [Cyber - Security](#)

**Abstract:** Machine Learning has gained widespread applications, especially in the domain of image recognition due to the high performance of algorithms and models. Nonetheless, the potential threat posed by adversarial samples has impeded their widespread adoption, especially in safety-critical applications. In such cases, the model's final performance is significantly compromised due to the presence of adversarial perturbations that are invisible to human perception. This paper introduces a novel pre-processing solution for protecting image datasets against adversarial attacks such as the Fast Sign Gradient Method or other similar attacks. The proposed method involves utilizing high JPEG compression for removing the adversarial perturbations of the dataset and applying a Targeted One Pixel Attack with the aim of recovering the true class of the images after the compression process. The proposed approach results in a highly secured and clean dataset maintaining a high classification accuracy. The approach was tested on CIFAR10 dataset. The results have shown that the misclassification rate after the FGSM attack was significantly reduced from 89.3% to 12.5% using this method for the compression quality of 20 on a subset of 1000 images.

11:00-11:20, Paper FrA3.3

Add to My Program ☐

[Challenges and Solutions in Designing a Network Architecture for Red and Blue Cybersecurity Competitions](#)

[Chindrus, Cristian](#)

Georghe Asachi Technical University of Iasi

[Caruntu, Constantin-Florin](#)

Georghe Asachi Technical University of Iasi

**Keywords:** [Cyber - Security](#), [Computer Science Education and Training](#)

**Abstract:** With the increasing importance of cybersecurity in our digital age, cybersecurity competitions have become a popular way to test the incident response abilities of participants. This paper proposes a network architecture to test the vulnerabilities that may appear in a Red and Blue cybersecurity competition. The network architecture is designed to simulate a real-world cyber-attack scenario and includes a router, a core system, and multiple subnets representing different teams. Each subnet contains vulnerable systems that must be protected by the teams, who must also launch attacks on the other teams to identify flags. The architecture presents several challenges, including the large number of rules required for router configuration, which prohibit direct access to opposing teams' virtual machines (VMs) and restrict/block access to specific phases of the competition. The VMs used in the competition include various vulnerabilities related to cryptocurrency wallet operation, medical clinics, chat services, X-ray clinics, SCADA communication protocols, and industrial power plants. Overall, the network architecture and VMs used in this competition provide a challenging and realistic scenario for participants to test their skills in identifying and mitigating cybersecurity threats.

[Enhanced Advanced Encryption Standard](#)[Scripcariu, Luminita](#)

"gheorghe Asachi" Technical University of Iasi

[Mocanu, Florin](#)

"gheorghe Asachi" Technical University of Iasi

**Keywords:** [Cyber - Security](#), [Communication Systems](#)

**Abstract:** The analysis of AES (Advanced Encryption Standard) including the byte substitution method, the permutation stage made by shifting the data matrix rows and the column mixing step, shows some of the weak points of this algorithm. We propose enhancing some features of AES by the mean of more powerful arrays and polynomials that make the algorithm more robust against various cryptographic attacks including the differential one. We analyze the algorithm over the Galois Field with 256 integer values, denoted as GF (256), and we propose to use Costas arrays for byte substitution and permutation, and a polynomial with primitive roots for mixing the columns of the data matrix, getting an enhanced version of the encryption algorithm, with better features and an increased degree of non-linearity.

[Implementation of a Security Operation Center - an Essential Cybersecurity Solution for Organizations](#)[Mocanu, Florin](#)

"gheorghe Asachi" Technical University of Iasi

[Scripcariu, Luminita](#)

"gheorghe Asachi" Technical University of Iasi

**Keywords:** [Cyber - Security](#)

**Abstract:** Cybersecurity is vital in our world that uses the public Internet to communicate in every field of activity. In this paper, we present a concise overview of a Security Operation Center (SOC) implementation that combines open source components and operates as a service (SOCaaS). The focus is on the case study of Security Onion, an open source security-monitoring platform, to highlight the effectiveness of this approach. The paper highlights the architecture, key features, and benefits of the SOCaaS model with open source components, emphasizing the integration of Security Onion's intrusion detection, network security monitoring, and log management capabilities. The case study demonstrates the practicality and scalability of Security Onion within the SOCaaS framework. It also addresses challenges and considerations, such as resource requirements, skill gaps, and data privacy. The paper offers insights into how organizations can leverage open source tools like Security Onion to enhance security operations while maintaining control and optimizing costs.

[Closing Ceremony](#)Chair: [Precup, Radu-Emil](#)

Politehnica University of Timisoara

Co-Chair: [Selisteanu, Dan](#)

University of Craiova

