# ABSTRACTS OF ICCCC2020 PAPERS

**CERCETARE DEZVOLTARE AGORA/ AGORA UNIVERSITY OF ORADEA/ ROMANIA**

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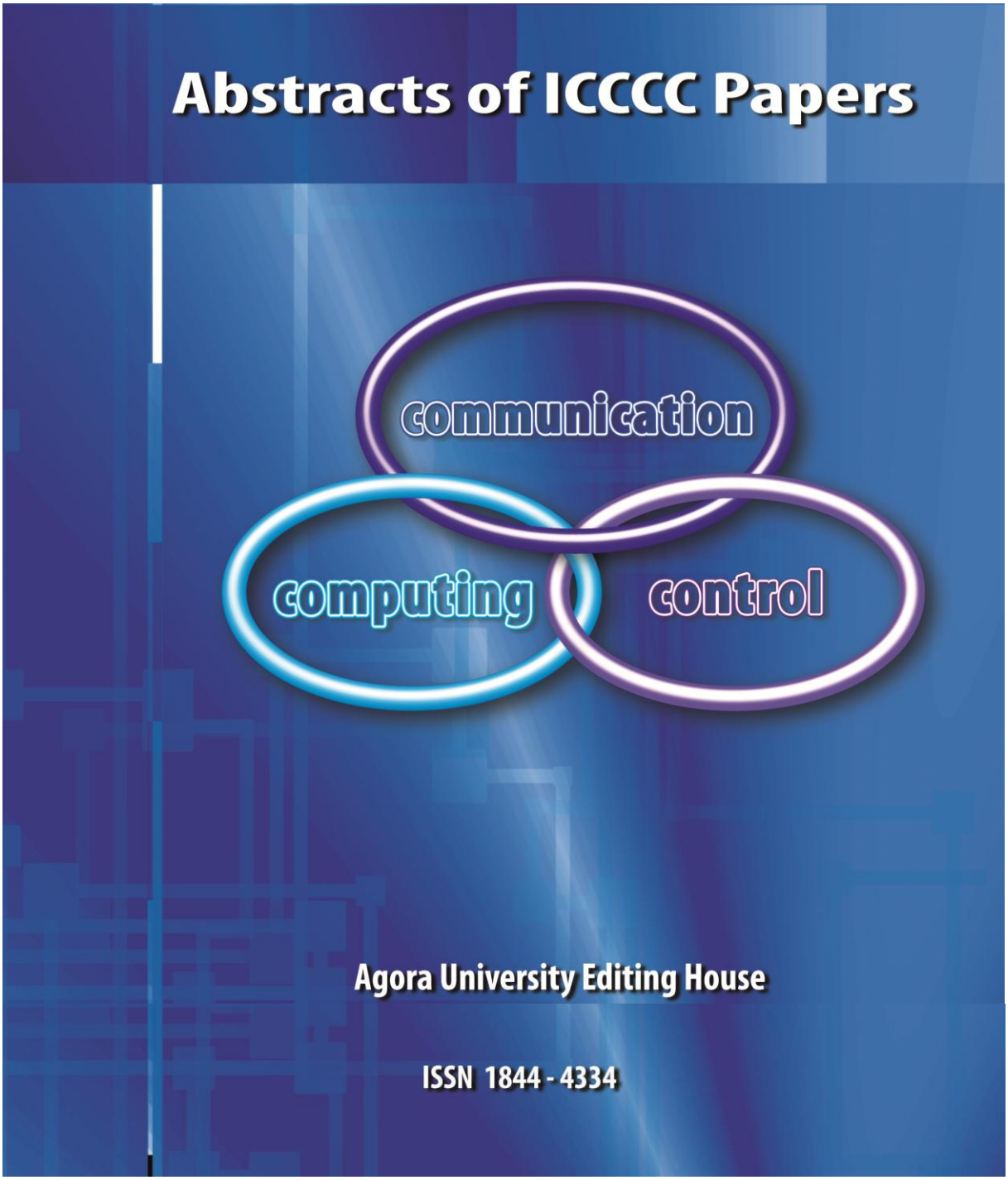
## ICCCC2020

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2020 8th International Conference on Computers Communications and Control (ICCCC)

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**On site event canceled due to coronavirus COVID - 19**
**ICCCC2020 will be held online via Zoom Pro instead of in person**

**Keynote speakers (in alphabetical order):**

1. Prof. Razvan ANDONIE (Ellensburg, USA),
2. Prof. Valeriu BEIU (Arad, Romania),
3. Prof. Alfred BRUCKSTEIN (Haifa, Israel),
4. Prof. Felisa CORDOVA (Santiago, Chile),
5. Prof. Yezid DONOSO (Bogota, Colombia),
6. Acad. Gintautas DZEMYDA (Vilnius, Lithuania),
7. Acad. Florin Gheorghe FILIP (Bucharest, Romania),
8. Prof. Enrique HERERRA-VIEDMA (Granada, Spain),
9. Acad. Janusz KACPRZYK (Warsaw, Poland).

**Chairs of ICCCC2020**

1. Ioan DZITAC (General Chair)
2. Florin Gheorghe FILIP (PC Chair)
3. Misu-Jan MANOLESCU (OC Chair)
4. Simona DZITAC (OC Chair)
5. Horea OROS (Proceedings Chair)
6. Domnica DZITAC (Virtual Chair)

**Springer volume: Advances in Intelligent Systems and Computing** (Series Editor: Janusz Kacprzyk)

# ABSTRACTS OF KEYNOTE LECTURES

| ID | Keynote speaker | Title & Abstract |
|---|---|---|
| 1 | **Razvan ANDONIE**<br>*Central Washington University,*<br>***USA*** | **Practical Hyperparameter Optimization for Deep Learning**<br><br>**Abstract.** While the training parameters of machine learning models are adapted during the training phase, the values of the hyperparameters (or meta-parameters) are specified before the learning phase. For a given dataset, we would like to find the optimal combination of hyperparameter values, in a reasonable amount of time. This is a challenging task because of its computational complexity. We present an integrated view of methods used in hyperparameter optimization of learning systems, with an emphasis on computational complexity aspects. Our thesis is that we should solve a hyperparameter optimization problem using a combination of techniques for: optimization, search space and training time reduction. Case studies from real-world applications illustrate the practical aspects. In previous work, we introduced the Weighted Random Search (WRS) method, a combination of Random Search and probabilistic greedy heuristic. This method outperforms many state-of-the-art hyperparameter optimization methods. We discuss practical applications of WRS in deep learning model optimization. |
| 2 | **Valeriu BEIU**<br>*Aurel Vlaicu University of Arad*<br>***Romania*** | **Land of the Giants … AI Chips**<br><br>**Abstract.** This presentation will start with a brief historic overview of Artificial Intelligence (AI), explaining the earlier AI waves. Afterwards, the focus of the second part will be on the rapid rise of AI, narrowing it down to Deep Learning, currently perceived as an ubiquitous solution for a wide range of applications. This trend has had, and continues to have, massive financial support and vast substantial implications, which will be mentioned alongside the current “Cambrian explosion” of AI start-ups. The third part will be targeting a sub-class of these AI start-ups, namely those working on designing and building AI chips. These will be classified—into cloud and edge AI hardware—analyzed, and put into context. The fast pace growing number of players in this deceptively esoteric research field will be identified, and their latest results will be surveyed. Finally, we will comment on forthcoming trends of AI hardware while pinpointing its growth potential in the wider context of *rebooting* and *quantum computing* seen through larger and larger investments (triggered by the expected demise of Moore’s law). |
| 3 | **Alfred M. BRUCKSTEIN**<br>*Technion*<br>***Israel*** | **Erratic Extremists Induce Dynamic Consensus: A New Model for Opinion Dynamics**<br><br>**Abstract.** A society of agents, with ideological positions, or "opinions" expressed as real values ranging from $-\infty$ (the "far left") to $+\infty$ (the "far right"), is considered. At fixed (unit) time intervals agents repeatedly reconsider and change their opinions if and only if they find themselves at the extremes of the range of |

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| | | ideological positions. Extremist agents are erratic: they become either more radical, and move away from the positions of other agents, with probability ε, or more moderate, and move towards the positions held by peers, with probability (1−ε). The change in the opinion of the extremists is one unit on the real line. We prove that the agent positions cluster in time, so that non-extremist agents are eventually located within a unit interval. However, the "consensus opinion" is dynamic. Due to the extremists' erratic behavior the clustered opinion set performs a sluggish random walk on the entire range of possible ideological positions (the real line). The inertia of the group, i.e. the reluctance of the society's agents to change their consensus opinion, increases with the size of the group. The extremists perform biased random walk excursions to the right and left and, in time, their actions succeed to move the society of agents in random directions. The "far left" agent effectively pushes the group consensus toward the right, while the "far right" agent counter-balances the push and causes the consensus to move toward the left. We believe that this model, and some of its variations, has the potential to explain the real world swings in societal ideologies that we see around us. (Joint work with Dmitry Rabinovich) |
| 4 | **Felisa CORDOVA**<br>*University Finis Terrae*<br>***Chile*** | **Trends and challenges of cyber-social-technological-cognitive approach in ecosystems**<br><br>**Abstract.** This lecture aims to provide an international forum to discuss the main ideas about cyber-social-technological-cognitive approach present in indifferent ecosystems. Nowadays, investments that promote disruptive technologies and digital transformation accompanied by advances in Industry 4.0 enable the development of intelligent and smart systems in different domains. The hyperspace allows the interconnection of multiple spaces of computers and networks which are interlinked with each other in cyber, social, technological and cognitive domains.<br>In the Cyber Domain many digital platforms in the hyperspace collaborate with Internet of the Things (IoT), Internet of Computers (IoC), Internet of the Services (IoS), allowing the integration, interconnection and interaction of people, computers and networks. e-crowd cloud and data bases facilitates the storage media and the interconnections among actors participating in the different interconnected networks. Especially holographic data, semantic sensors, intelligent supervisory control and cooperative actuators all play an important role in dynamic monitoring and decision systems.<br>In Social Domain it is perceived that many of the social management networks are used by citizens who wish to express their opinion or interact with other people participating in the network. Also, companies or public and private institutions are providing public service and supporting main activities, developing forums and crowd applications to share protocols, knowledge, regulations, ideas, procedures, among other things.<br>In this context legal, cultural, structural, and environmental factors are managed involving companies' goals and objectives, |

structure, standards, values for the community, culture and socialization of services.

In Technological Domain Industry 4.0 and digital transformation provides a set of technologies participating in the strategic, business and operational levels. At strategic and business level network technologies such as LAN, WAN, WLAN enable efficient communication and networking in the cyber space for companies and institutions linked. Artificial intelligence (AI) allows the community members display their capabilities, skills, expectations and knowledge, generating heuristics that are mapped in the cyber space as models, methods, techniques, tools and practices. In this way, community learning is shared in the ecosystem. Cybersecurity helps in the transactions, and in the protection of data and information. At operational level automation of physical processes allows real time control of events at operational level activities. Internet of things (IoT) can perceive and sensitize a physical object to be mapped later on the cyber space by technologies such as wireless sensors working at real time, physical data sensors, environmental sensors, equipment and mobile device sensors. Robotics and teleoperation allows acting on fixed and mobile equipment optimizing and making the operation of automated systems more flexible. Drones as aerial vehicles allow a close monitoring of any movements made in a site and its surroundings. Positioning technologies such as passive tags, RFID systems and GPS ensure traceability of products and services, also the transportation media used.

In Cognitive Domain the available knowledge provided by a person, a group, or a community of actors can be stored in the cyber space facilitating the classification and management of social, structural and intellectual capital of each organization participating in the ecosystem. Intellectual capital considers the knowledge of the progress of both intellectual and social capital of the community allowing planning the training needs for different actors.

In this context, we have the opportunity to analyse and discuss trends in some of the main conceptual models and architectures that integrate relevant attributes in hyperspace in different ecosystems, like green energy systems, smart cities, We-Media, among others. In particular, it is important to highlight the role of the Internet of Services (IoS) as it stands out as an ecosystem that takes over complex collaborative applications using interoperable resources across platforms and cloud storage. It also addresses advances in Artificial Intelligence (AI), neuroscience, and cognitive sciences that enable the development of Human Body Communication (HBC) and Human Information Processing (HIP) and thus open the door to multiple applications in the Internet of the People (IoP) domain.

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| 5 | **Yezid DONOSO**<br>*Universidad de los Andes*<br>***Colombia*** | **Methodologies for Solving Complex Multi-Objective Combinatorial Problems in Engineering: An Evolutionary Approach Applied to Computer Networks**<br><br>**Abstract**. In real problems in Engineering, solving a problem is not enough; the solution of the problem must be the best solution possible. In other words, it is necessary to find the optimal solution. The solution is the best possible solution because in the real world this problem may have certain constraints by which the solutions found may be feasible, that is, they can be implemented in practice and, unfeasible or that they cannot be implemented. Some of these problems in engineering can be MOP (Multi-Objective Optimization Problem). A general MOP includes a set of n parameters (decision variables), a set of k objective functions and a set of m restrictions. The objective and restriction functions are functions of the decision variables where is possible to obtain a set of optimal values.<br>Then the MOP can be expressed as:<br>Optimize y = f(x) = (f1(x), f2(x), ... , fk(x))<br>Subject to e(x) = (e1(x), e2(x), ... , em(x)) 0<br>Where x = (x1, x2, ... , xn) X<br>y = (y1, y2, ... , yk) Y<br>The method evolutionary algorithm (EA) refers to searching and optimization techniques based on the evolution model proposed by Charles Darwin. Genetic algorithms are used in several areas especially for searching and optimizations. In the real case the algorithm is implemented by choosing a coding for the possible solutions to the problem. The coding is done through chains of bits, numbers or characters that represent the chromosomes. The crossing and mutation operations are applied in a very simple way through functions of vector value manipulation. The EAs are interesting given the fact that at first glance they seem especially apt to deal with the difficulties presented by MOPs. The reason for this is that they can return an entire set of solutions after a simple run and they do not have any other of the limitations of traditional techniques. In addition, some researchers have suggested that the EAs would behave better than other blind searching techniques. |
| 6 | **Gintautas DZEMYDA**<br>*Vilnius University*<br>***Lithuania*** | **Recent advances in data dimensionality reduction using multidimensional scaling**<br><br>**Abstract.** Human participation plays an essential role in most decisions when analyzing data. The huge storage capacity and computational power of computers cannot replace the human flexibility, perceptual abilities, creativity, and general knowledge. A proper interaction between human and computer is essential. Moreover, such an interaction is one of the areas in computer science that has evolved a lot in recent years. Real data in technologies and sciences are often high-dimensional. So it is very difficult to understand these data and extract patterns. One way of such an understanding is to make a visual insight into the data set. Here, a hopeful view may be put on the visualization of multidimensional data. The goal of visualization methods is to |

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| | | represent the multidimensional data in a low-dimensional space so that certain properties (e.g. clusters, outliers) of the structure of the data set were preserved as faithfully as possible. The dimensionality reduction or visualization methods are recent techniques to discover knowledge hidden in multidimensional data sets.<br>Multidimensional scaling (MDS) is one of the most popular methods for a visual representation of multidimensional data. Low-dimensional visualization requires holding proximities between multidimensional points (observations) as much as possible. MDS requires estimating the coordinates of new points in a lower-dimensional space by minimizing some stress function. The stress function has many local minima often, and iterative algorithms are used for its minimization. Various attempts are made to the global minimum of the stress function still now. Classical approaches to minimize the stress reached their limits. New viewpoint to the problem is necessary, including its formulation and ways of solving. A novel geometric interpretation of the stress function and multidimensional scaling in general (Geometric MDS) has been proposed. Following this interpretation, the step size and direction forward the minimum of the stress function are found analytically for a separate point without reference to the analytical expression of the stress function, numerical evaluation of its derivatives and the linear search. It is proved theoretically that the direction coincides with the steepest descent direction, and the analytically found step size guarantees the decrease of stress in this direction. A strategy of application of the discovered option to minimize the stress function is presented and examined. It is compared with SMACOF version of MDS. The novel geometric approach will allow developing a new class of algorithms to minimize MDS stress, including global optimization and high-performance computing. |
| 7 | **Florin Gheorghe FILIP**<br>*Romanian Academy*<br>***Romania*** | **10th commemoration since Acad. M. Draganescu (1929-2010) passed away. Mihai Draganescu and The Birth of the Romanian ICT Sector**<br><br>**Abstract.** This year we commemorate 10 years since Prof Draganescu, a former president of the Romanian Academy (1990-1994), passed away. The present short paper is intended to highlight the decisive contribution of prof. Mihai Draganescu in designing and leading the creating a national, integrated, network-type, *information and communication* (ICT) sector in Romania and his subsequent contributions in the way towards a knowledge-based society.. The paper starts by reviewing several milestones and efforts made by eminent scientists and research and education schools that anticipated and set the stage for creating and deploying a national programme in the ICT domain. Then, it is exposed the design of a complex national ICT system that integrated in a coherent manner various subsystems such as: education, research, fabrication and usage of computers. Prof . Draganescu led the over 100 persons working in the virtual team that designed the national |

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| | | programme in 1967. He also led the deployment the programme and the paper reviews the first results. Besides being an engineers and scientific leader, prof. Draganescu was a philosopher and farseeing thinker who anticipated and described various development stages of the human society such as the information, knowledge-based, and consciousness ones which are eventually briefly described. More details and works of prof. Draganescu can be found in a dedicated sector of the Institute of AI and NLP of the Academy: http://www.racai.ro/about-us/dragam/ |
| 8 | **Enrique HERERRA-VIEDMA**<br>*University of Granada*<br>***Spain*** | **Consensus in Group Decision Making and Social Networks**<br><br>**Abstract.** The consensus reaching process is the most important step in a group decision making scenario. This step is most frequently identified as a process consisting of some discussion rounds in which several decision makers, which are involved in the problem, discuss their points of view with the purpose of obtaining the maximum agreement before making the decision. Consensus reaching processes have been well studied and a large number of consensus approaches have been developed. In recent years, the researchers in the field of decision making have shown their interest in social networks since they may be successfully used for modelling communication among decision makers. However, a social network presents some features differentiating it to the classical scenarios in which the consensus reaching processes have been applied. The objective of this talk is to investigate the main consensus methods proposed in social networks and bring out the new challenges that should be faced in this research field. |
| 9 | **Janusz KACPRZYK**<br>*Polish Academy of Sciences*<br>***Poland*** | **Decision aid, decision advice, decision support: when, why, for whom**<br><br>Abstract. We consider complex decision problems which concern difficult situations nd challenges that cannot be adequately represented by simple and traditional decision making models which are based on a straightforward utility maximization, preference analyses, etc. We assume that the complexity of the problem, for instance of strategic planning in a company, calls for an implicit or explicit participation of the humans in the process of conceptualizing, derivation and implementation of decisions which are meant to be not only technically effective and efficient but also to fulfill important more general goals, notably social. For this purpose we will use some solutions advocated in the broadly perceived human centric systems, human-in/on/ot-the loop, etc. Moreover, we will employ the concept of a decision making process that involves more factors and aspects like: the use of own and external knowledge, involvement of various „actors", aspects, etc., individual habitual domains, non-trivial rationality, different paradigms, etc. In general, we assume that we have a „client", who may be exemplified by a business owner or manager, and who needs a help in solving his or her problems from an „analyst" who can be a human domain specialist, |

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| | | exemplified by an operations research expert, or an artificial, computer based system, exemplified by an advice giving system (recommender) or a decision support system. We assume that the client has a limited knowledge of formal and algorithmic tools and techniques, and needs an easy to use solution. On the one extreme, we assume that we can have a relatively effective and efficient model for solving it, for instance from a multiple criteria decision making class, and the client involved can provide us with some additional information or data so that we can use the paradigm of decision aid. On the other extreme, we assume two possible situations that, first, the model is practically unavailable but we have either domain knowledge, mostly tacit but maybe even to some extent explicit, or – second – we have enough data to pursue the so called data driven modeling. In both case we resort to the use of some non-model-driven decision suport systems. We also advocate that in some difficult situations in which specifics of a particular customer can be relevant, the paradigm of a decision advice can be employed using some new ideas from recommenders, notably their recent versions which can also provide reasons, rationale and explanations for a particular advice. |

# ABSTRACTS OF ACCEPTED PAPERS

## Chapter 1. Integrated solutions in computer-based control and communications

| ID | Authors | Title & Abstract |
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| 10 | **Corina Stefania Nanau**<br>*Transilvania University of Brasov*<br>***Romania*** | **Queuing Theory Application on DTN Buffer Management**<br><br>**Abstract.** This paper aims to draw a parallel between the component elements of a queuing system and the bu_er management used by the Delay Tolerant Network (DTN) nodes. Given that waiting in a queue is a widespread practice, many times it has been tried to optimize the time spent in such queues. The Introduction of the paper contains a brief description for some elements of bu_er management in DTN networks. The second section presents an initial information of queuing theory and several related works. The third section draws a parallel between buffer management in DTN and queuing systems by implementing a new drop policy as a part of bu_er management. The obtained results will be illustrated with the help of a practical network context, using the ONE simulator. |
| 12 | **David Cordero Vidal and Cristian Barria Huidobro**<br>*Universidad Mayor*<br>***Chile*** | **Proposal of a Multi-Standard Model for Measuring Maturity Business Levels with Reference to Information Security Standards and Controls**<br><br>**Abstract.** The continuous security risk organizations face in terms of information, forces them to constantly update their security protocols. This implies, among other aspects, to base their monitoring mainly on their own maturity status regarding cybersecurity in a SGSI (Information Security Management System). When a Chief Information Security Officer from an organization elaborates a protection plan of IT assets, a wide and varied range of threats must be considered. Now, these tasks are executed using conceptual models, which do not usually work in an integrated and systematic way. Thus, these models seek to increase maturity levels for protecting and safeguarding information security. Among the most common [1], we can find COBIT 5, CSE-CMM, NIST-CRST to which we add the security standards, such as OWASP, ISO 27000-1, SANS. From here, then, it is possible to see the lack of a multi-standard model that integrates systematically the individual actions with the expected results. The present project proposes that type of integrated model, one that links and blends, on the one hand, the security standards and, on the other hand, the measurements of the organization's maturity levels. By doing this, it will possible to count with a set of relevant actions, classified by evaluation categories, that provides us with conditions for crossing regulations with standardized controls, that allow us to explore how efficient these acquired measures were, and the possible corrections that should be introduced ahead. |
| 21 | **Catalin Ceaparu**<br>*Bucharest University of Economic Studies*<br>***Romania*** | **IT Solutions for Big Data Processing and Analysis in the Finance and Banking Sectors**<br><br>**Abstract.** This paper aims to give a general overview of the technologies used by two important trends in Business Intelligence nowadays, that continue to reshape the Data Architecture landscape worldwide. Bringing equally relevant value to businesses today, Fast Data and Big Data complete each other in order to enable both quick/short term as well as thorough/long term commercial strategies of companies, regardless of the industry they are |

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| | | part of. The body and conclusion of this paper will focus on the benefits of using the newest FinTech solutions for both aforementioned data processing models, while clearly stating the differences between the two. Both open source and proprietary type of solutions will be presented with the purpose to offer a thorough picture as to what the best architectural landscape of Big Data analytics should look like. |
| 35 | **Lucio Cañete Arratia*, Felisa Córdova** and Andrés Pérez de Arce*****<br>**Universidad de Santiago de Chile*<br>***Universidad Finis Terrae*<br>****Trade Plus S.A.*<br>***Chile*** | **Automatons immersed in ocean currents for transformation of biomass into fuel**<br><br>**Abstract.** When observing the Chilean sea from both biotic and mechanical perspective, oceanographers note that the Humboldt Current carries abundant biomass and that the movement of the water itself has the capacity to do work. Taking advantage of these two qualities of the ocean current, this article exposes the sketch of an automated device, the computational simulation when it was conceived and its mathematical model to make efficient the capture of biomass that will be processed, stored and dispatched as biodiesel. Said submerged automaton has a structural configuration that was outlined by cybernetic design resulting in a body that carries out the transformation process by itself, which starts on the side that faces the current with its content of biomass. This raw material is trapped thanks to an intelligent system that informs the reactor about the relative importance of the state variables that its body can control, stimulating those swimming organisms to move in the desired direction. The captured biomass begins its process until it becomes biodiesel by virtue of the mechanical energy provided by the same flow of seawater that affects the reactor. The rear part of the reactor releases both incident water and by-products into the sea without harmful environmental consequences. Some users of this new type of device are armies in time of conflict and merchant marines during algae bloom. |
| 38 | **Grigore Lupescu and Nicolae Tapus**<br>*University Politehnica of Bucharest*<br>***Romania*** | **Challenges porting blockchain library to OpenCL**<br><br>**Abstract.** This article discusses the complexities of porting a performance blockchain library, encompassing core cryptographic operations, to the OpenCL framework. We present the solution we developed as a general guideline and we highlight the limitations of the OpenCL framework. Given the potential use case of multiple platforms and devices, the effective portability of the library for end users is presented. Finally, a comparison with a CUDA variant of the library is discussed, both in terms of code complexity, runtime and performance. |
| 53 | **Arpad Gellert and Constantin-Bala Zamfirescu**<br>*Lucian Blaga University of Sibiu*<br>***Romania*** | **Using Two-Level Context-Based Predictors for Assembly Assistance in Smart Factories**<br><br>**Abstract.** The paper presents some preliminary results in engineering a context-aware assistive system for manual assembly tasks. It employs context-based predictors to suggest the next steps during the manufacturing process and is based on data collected from experiments with trainees in assembling a tablet. We were interested in finding correlations between the characteristics of the workers and the way they prefer to assemble the tablet. A certain predictor is then trained with correct assembly styles extracted from the collected data and assessed against the whole dataset. Thus, we found the predictor that best matches the assembly preferences. |

## Chapter 2. Computational intelligence methods

| ID | Authors | Title & Abstract |
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| 6 | **Martynas Sabaliauskas and Gintautas Dzemyda**<br>*Vilnius University*<br>***Lithuania*** | **Visual analysis of multidimensional scaling using GeoGebra**<br>**Abstract.** The paper deals with the multidimensional scaling (MDS) that depends on the class of nonlinear projection methods for a visual representation of multidimensional data. The performance of a new MDS-type method for multidimensional data dimensionality reduction and visualization (Geometric MDS) has been investigated visually using GeoGebra. Dynamic geometry program GeoGebra is a non-commercial and interactive software for the visual representation of algebra and geometry. We made specific GeoGebra scripts for the visual representation of the convergence process of Geometric MDS. This allows us to analyze visually the optimization of the stress function, describing the visualization quality and find the areas of attraction to the local minima. The results allow an easier comprehension of the MDS stress optimization by the anti-gradient search. Moreover, the results deepen the understanding of Geometric MDS, in general. |
| 11 | **Razvan Cristian Marales, Adela Bâra and Simona-Vasilica Oprea**<br>*Bucharest University of Economic Studies*<br>***Romania*** | **Edge Computing in Real-Time Electricity Consumption Optimization Algorithm for Smart Grids**<br>**Abstract.** Nowadays the electricity consumption optimization represents a big improvement point for the electricity supplier, but also for the consumers. Both sides can benefit from the progress of sensors and IT&C technologies and gain a lot if an automatically process is put in place. Hence, in this paper, we propose an algorithm which will monitor the electricity consumption and provide optimizations for each consumer, all in real time. For accurate monitoring outputs and better calculation, the algorithm will run into a smart grid context, where smart meters and appliances can be found and easily integrated. The proposed solution will be deployed in an edge computing environment. This architectural decision will make the final implementation more performant and less costly. |
| 54 | **Alexey Myachin and Andrei Akhremenko**<br>*National Research University Higher School of Economics*<br>***Russia*** | **The Study of Trajectories of the Development of State Capacity Using Ordinal-Invariant Pattern Clustering and Hierarchical Cluster Analysis**<br>**Abstract.** This work is devoted to the methodology for identifying structurally close objects of the type "country_year" based on a system of indicators character-izing the state capacity 1996-2015. A comparison of clustering methods (in-cluding hierarchical clustering) with methods of analyzing patterns based on a pairwise comparison of indicators: ordinal-fixed and ordinal-invariant pat-tern clustering is proposed. The possibility of sharing the methods of cluster-ing and pattern analysis to obtain interpretable results from the point of view of political science is demonstrated. Groups of countries with similar devel-opment paths by reference years on the basis of a dynamic analysis of pat-terns are identified. The dynamic change in state capacity (from the point of view of the selected indicator system) of 166 countries of the world is deter-mined. |

## Chapter 3. Fuzzy methods and soft computing

| ID | Authors | Title & Abstract |
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| 44 | **Alejandra Valencia*, Cecilia Montt Veas*, Astrid Oddershede** and Luis Quezada****<br>**Pontificia Universidad Catolica de Valparaiso*<br>***University of Santiago of Chile*<br>***Chile*** | **A Micro Simulation Approach for a Sustainable Reduction Traffic Jam**<br><br>**Abstract.** In developing countries, mainly in Latin America, urban traffic management has to deal with an appreciable percentage of public transport vehicle. Consequently, in Chile it is not exempt from that problem situation, mainly in the most populated cities. To visualize this scenario, a case that demonstrates this reality has been studied in a city in Chile. This case shows a serious conflict of public and private transport vehicles. These conflicts generate longer travel times between homes, work or study and higher operating costs of vehicles and even environmental impacts. The objective of the study is to propose measures that help reduce traffic jam or congestion and the conflicts generated through the VISSIM computational micro-simulation program. Through a software that simulates intersections where conflicts occur and also applies urban traffic management for a efficient use of roads. This computational micro-simulator uses a vehicle tracking model and lane change model plus other models that have been incorporated into this work. The movement of a vehicle whose driver wants to drive faster than the speed from the preceding vehicles is described, if the road has more than one lane, the vehicles will tend to overtake, which is modeled by a rule based on algorithms of lane change. For the collection of information, field data were obtained such as vehicular flows, traffic light programming, bus stopping at bus stops, bus and vehicle occupancy rates, speeds and measurement of queue lengths, according to the known data collection methodology. With the previous information, two models were simulated, where the best of them manages to mitigate the problem of congestion and suggests changing the traffic programming of the traffic light from 120sec to 90sec and propose the use of a type short bus tracks for public transport. This result positively influence in speeds and queues, at 14% 18% respectively, which also helps to improve congestion. |
| 50 | **Bogdana Stanojević* and Milan Stanojević****<br>**Mathematical Institute of the Serbian Academy of Sciences and Arts*<br>***Faculty of Organizational Sciences, University of Belgrade*<br>***Serbia*** | **Empirical versus analytical solutions to full fuzzy linear programming**<br><br>**Abstract.** We approach the full fuzzy linear programming by grounding the definition of the optimal solution in the extension principle framework. Employing a Monte-Carlo simulation, we compare an empirically derived solution to the solutions yielded by approaches proposed in the literature. We also propose a model able to numerically describe the membership function of the fuzzy set of feasible objective values. At the same time, the decreasing (increasing) side of this membership function represents the right (left) side of the membership function of the fuzzy set containing the maximal (minimal) objective values. Our aim is to provide decision-makers with relevant information on the extreme values that the objective function can reach under uncertain given constraints. |

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| 61 | **Victorita Radulescu**<br>*University Politehnica of Bucharest*<br>***Romania*** | **Application of Fuzzy Logic in Optimizing the Operation of Pumping Station**<br><br>**Abstract.** Nowadays, the optimization of the hydraulic installations functioning represents a complex problem requiring a large amount of calculation. This paper presents a multi-criteria method using the fuzzy logic to optimize the functioning of a pumping station, by minimizing the energy consumption and maximizing its efficiency. This includes the reduction of the maximum flow pumped, optimizing of time interval between starting and stopping, with effect on the energetic efficiency during the functioning. Numerical model of the performed calculations includes the flow rate consumption correlated with its optimum parameters, by planning the most efficient time functioning. It is introduced a new model non-deterministic, a fuzzy controller system associated with a new model of inference algorithm. This interference model is used to reduce the consumed flow rate by linear optimization and transition from a branched network, analyzed based on the neural networks, to an annular one. The branched neural network is structured on five input variables and 9 hidden lay-ers (seven as sub-input and two as output). It is presented the schematic struc-ture of the implemented neural network for obtaining the optimized functioning. The fuzzy numerical model is tested with the Matlab software, using a perma-nent function for the input and output variables. Some numerical results are also presented. Finally, some conclusions and references are mentioned. |
| 64 | **Mihaela Frigura-Iliasa*, Attila Simo*, Simona Dzitac**, Flaviu Mihai Frigura-Iliasa* and Felicia Ioana Baloi***<br>**Politehnica University Timisora*<br>***University of Oradea*<br>***Romania*** | **Fuzzy-Logic Based Diagnosis for High Voltage Equipment Predictive Maintenance**<br><br>**Abstract.** This paper presents a fuzzy-logic algorithm for predictive maintenance (Industry 4.0) and at the same time for future design improving, applicable for high voltage equipment (switches, surge-arresters, etc.). Starting from this algorithm a soft-ware tool can be developed tool for high voltage equipment maintenance. It is an example of implementing advanced mathematical and software solutions for the maintenance of operational high voltage switching equipment (and other high voltage devices, too). For testing and validating the algorithm experimental data (and also experimental setups) were operated from the industrial environment (manufacturers and users of that equipment) and used for conceiving a monitor-ing and diagnosing digital based procedure, both for a more efficient design of that equipment as well as for efficiently assess the technical state of their main HV contacts. The results obtained are encouraging and recommend the use of the algorithm on a larger scale. |

## Chapter 4. Decision making issues. Methods and support systems

| ID | Authors | Title & Abstract |
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| 18 | **Ramona Lacurezeanu and Vasile Paul Bresfelean**<br>*Babes-Bolyai University Cluj Napoca*<br>***Romania*** | **Making a multi-criteria analysis model for choosing an ERP for SMEs in a KM world**<br><br>**Abstract.** There has never been such a rich offer in terms of ERP solutions that cus-tomers can choose from because the problem of knowledge has never been emphasized in the past. An ERP system in line with the company's business is metamorphosed into a knowledge management tool that improves infor-mation transfer and generates "knowledge". On the other hand, major deci-sions are rarely simple, and the best alternative can befall only after careful deliberation. In the present research we endeavor to provide a model of mul-tiple-criteria decision-making (MCDM) in the selection of ERP applications. We illustrate and apply a MCDM technique, namely analytical hierarchy process (AHP) to assist SMEs to select the most appropriate ERP. We formu-late an AHP decision model and apply it to a hypothetical case study to demonstrate the feasibility of the choice to select the most appropriate ERP software for a specific SME. We believe that our work could become a di-dactic source of inspiration for teaching decision making techniques to young people and students. The application of the proposed model indicates that it can be applied to improve decision-making processes and condense the time interval needed for ERP selection. Our model can be considered good practice and identified with the know-what and know-who component of a KM model. |
| 36 | **Pablo Alberto Aliste*, Ivan Derpich** and Felisa Cordova*****<br>**School of accountants auditors of Santiago*<br>***University of Santiago of Chile*<br>****University of Finis Terrae*<br>***Chile*** | **Design of a multivariable model to reduce urban traffic congestion**<br><br>**Abstract.** Traffic jams are a major problem around the world, governments have been investing a lot of resources applying measures to solve this situation, and however, not much of them have had success. It is a very complex issue and countries have spent billions of dollars, but the problem continues and increases more and more. Some of the main impacts with regard to this issue decrease in quality of life, emission of more pollution, deteriorated products for being stuck in traffic, the business cost for not arriving on time, and extra-fuel consumption. Some smart cities have reduced significantly traffic congestion implementing congestion charge schemes. This paper proposes a multivariable model to estimate and reduce the urban congestion charge, it studies into of the main congested areas in Santiago centre of Chile collecting data from surveys about what price people are willing to pay to get into Santiago centre in vehicles. The multivariable model was tested to verify its validation to show in testing the overall significance of multiple regression in terms of F and $R^2$. These tests were validated and gave us the information that the model is statistically significant. Finally, this model and its methodology not only can be applied to Santiago city but also to any city worldwide. |

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| 37 | **Constanta Zoie Radulescu*, Marius Radulescu**, Lidia Bajenaru* and Adriana Alexandru***<br>**National Institute for Research and **Development in Informatics*<br>*Institute of Mathematical Statistics and Applied Mathematics Gheorghe Mihoc - Caius Iacob*<br>***Romania*** | **A Multi-Objective Model for Devices Procurement with application in Health Care**<br><br>**Abstract.** Managers need to make informed choices about what to buy in order to meet priority needs and to avoid wasting limited resources. The procurement decision is a very difficult task since there exists a great variety of brands, vendors and equipment performances. In the present paper, we have developed a decision process for equipment procurement in which are used, in combination, a Multi-Criteria subjective weighting method SWARA (Step-wise Weight Assessment Ratio Analysis) for equipment evaluation weights, an adaptation of SAW (Simple Ad-ditive Weighting) for equipment performance and a new Multi-Objective optimization model for equipment procurement. The Multi-Objective model considers several types of equipment, their costs and their performances. The model aims to be an aiding in the decision process of equipment procurement.<br>Managers of health care systems need to find in their choices a compromise between the cost of procurement, brands' reputation, vendors' reputation and equipment performance. A numerical example for medical equipment procurement, based on sensors, is studied. |
| 42 | **Claudio Macuada, Astrid Oddershede, Luis Quezada and Pedro Palominos**<br>*Universidad de Santiago de Chile*<br>***Chile*** | **Methodological proposal to define the degree of automation in the sanitary industry in chile to adapt to climate change**<br><br>**Abstract.** This study proposes a methodology to support the decision making to improve the efficiency of the technological standard in the sanitary industry facilities considering the climate change effects. Nowadays, the population necessities in terms of environment, quality and continuity of service are constantly increasing. In this regard, the sanitary industry is adopting new technologies for its processes, with the purpose that be a factor for service improvement. At present time, the Chilean sanitary industry is concern about the degree of automation and the infrastructure requirements, since they are the main critical factors for future investment planning. Therefore, it is necessary to determine the current level of the telecontrol system facilities and generate actions to make improvements in those processes that show a poor quality of service. The research methodology is based on case study, integrating planning processes, data analysis, scoring method interacting with multicriteria approach. This paper emphasis on developing a decision model by the use of the Analytical Hierarchy Process (AHP), to identify the priority facilities that should improve their technological standard. A case study incorporating climate change factors is pursued in a metropolitan sanitary company in Chile, accomplishing the automation degree of a telecontrol system for the real case. These results give place to elaborate an inversion plan that can be converted into action plans for a sanitary company. |

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| 51 | **José Ricardo López-Robles*, Manuel Jesus Cobo Martin**, N.K. Gamboa-Rosales*** and Enrique Herrera-Viedma******<br>**University of the Basque Country/ Universidad del País Vasco*<br>***University of Cádiz*<br>****University of Zacatecas*<br>****University of Granada*<br>***(*)(**)(****)Spain***<br>******Mexico*** | **Mapping the intellectual structure of the International Journal of Computers Communications & Control: A content analysis from 2015 to 2019**<br><br>**Abstract.** International Journal of Computers Communications & Control (IJCCC) is an open access peer-reviewed journal publishing original research papers and it is considered by professionals, academics and researches as one of the main sources of knowledge in the integrated solutions in computer-based control and communications, computational intelligence methods and soft computing, and advanced decision support systems fields. With this in mind, this research conducts a bibliometric performance and intellectual structure analysis of the IJCCC from 2015 to 2019. It provides a framework to support computer, communication and control researchers and professionals in the development and direction of future researches identifying core, transversal, emerging and declining themes. For this purpose, the IJCCC's intellectual structure and thematic networks are analyzed according to the data retrieved from Web of Science Core Collection, putting the focus on the main research themes and its performance. Finally, this analysis has been developed using SciMAT, an open source (GPLv3) bibliometric software tool developed to perform a science mapping analysis under a longitudinal framework. |
| 62 | ***Rodrigo Barraza Alonso*, Juan Miguel Sepúlveda*, Juan Francisco Venegas Gutiérrez*, Vinka Monardes** and Ivan Derpich****<br>**Universidad Santiago de Chile*<br>***Universidad Antofagasta*<br>***Chile*** | **A Model for Solving Optimal Location of Hubs: A Case Study for Recovery of Tailings Dams**<br>**Abstract.** In this paper a method for optimal location of multi-hubs in a complex network with a large number of nodes is presented. The method is applied to the design of a logistics network composed of many tailings dams and mineral processing plants and combines two data mining techniques, K-Medoids and k-Means, with the multi-criteria decision making model PROMETHEE for the prioritization of nodes to be included into the clusters, based on certain technical and economic decision variables (such as the content of recoverable metals and the costs of transportation). The proposed method contributes to solve a large scale mathematical problem difficult to handle due to the number of variables and criteria. A case study for the recovery of abandoned deposits of mining waste is presented. The case study demonstrates the feasibility and usefulness of the proposed solution and lays the groundwork for further research and other applications of machine learning techniques for big data in support of sustainable production and a circular economy. |

## Chapter 5. Theory for Computing, Control and Communication Systems

| ID | Authors | Title & Abstract |
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| 14 | **Dragoi Vlad-Florin*, Chouria Ali** and Jean-Gabriel Luque****<br>**Aurel Vlaicu University of Arad*<br>***LITIS*<br>****Romania***<br>*****France*** | **On recursively defined combinatorial classes and labelled trees**<br><br>**Abstract.** We define and prove isomorphisms between three combinatorial classes involving labeled trees. We also give an alternative proof by means of generating functions. |
| 15 | **Dragoi Vlad-Florin*, Bucerzan Dominic*, Hoara Sorin*, Pierre-Louis Cayrel** and Brice Colombier****<br>**Aurel Vlaicu University of Arad*<br>*** Université Jean Monnet*<br>****Romania***<br>***** France*** | **Soving a modified syndrome decoding problem using integer programming**<br><br>**Abstract.** In this article we model the well-known syndrome decoding problem, as a linear optimization problem. Most common algorithms used for solving optimization problems, e.g., the simplex algorithm, fail to find a valid solution for the syndrome decoding problem over a finite field. However, our simulations prove that a slightly modified version of the syndrome decoding problem can be solved by the simplex algorithm. More exactly, the algorithm returns a valid error vector when the syndrome vector is an integer vector, i.e., the matrix-vector multiplication is done over Z, instead of GF(q). |
| 16 | **Dragoi Vlad-Florin, Cowell Simon Robin and Beiu Valeriu**<br>*Aurel Vlaicu University of Arad*<br>***Romania*** | **Tight Bounds on the Coeficients of Consecutive k-out-of-n:F Systems**<br>**Abstract.** In this article we compute the coefficients of the reliability polynomial of a consecutive k-out-of-n:F system, in Bernstein basis, using the generalized Pascal coefficients. Based on well-known combinatorial properties of the generalized Pascal triangle we determine simple closed formulae for the reliability polynomial of a consecutive system for particular ranges of k. Moreover, for the remaining ranges of k (where we were not able to determine simple closed formulae), we establish easy to calculate sharp bounds for the reliability polynomial of a consecutive system. |
| 22 | **Simon Cowell, Mariana Nagy and Valeriu Beiu**<br>*Aurel Vlaicu University of Arad*<br>***Romania*** | **Reliability of Two-Terminal Networks Equivalent to Small Optimal Sorting Nets**<br><br>**Abstract.** Sorting networks are a special case of “oblivious” sorting algorithms that can be implemented directly in hardware. Their underlying non-plane connectivity graph representations can be mapped onto a certain class of minimal two-terminal networks, allowing us to associate a two-terminal reliability polynomial to any (optimal) sorting network connectivity graph. This class of networks is interesting in that it intersects the class of “matchstick minimal” two-terminal networks (which includes the planar Moore-Shannon hammocks), yet neither of these two classes contains the other. We compare the two-terminal reliability polynomials associated in this manner to small optimal sorting network connectivity graphs, with the reliability polynomials of Moore-Shannon hammock networks of equivalent dimensions. |

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| 28 | **Sorin Hoara, Roxana-Mariana Beiu and Valeriu Beiu**<br>*Aurel Vlaicu University of Arad*<br>***Romania*** | **Implementing Hammock Networks on IBM Q**<br><br>**Abstract.** IBM Q (https://www.ibm.com/quantum-computing/) represents a great opportunity offered by IBM to the quantum research community allowing running experiments, through a web interface, on several of their quantum systems on the cloud. One of the great technical challenges to making viable quantum computers is their qubit fidelity (quality/reliability) together with a plethora of error correction techniques—which, obviously, link to reliability theory. Hammock networks (a device-level alternative to gate-level reliability schemes) have shown outstanding reliability enhancements in the classical digital domain (e.g., about two-orders of magnitude better than gate-level von Neumann multiplexing). In spite of such performances, device-level reliability schemes in general, and hammock networks in particular, have never been assessed for quantum computations. A likely explanation is that device-level reliability seems much more akin to topological quantum computing concepts. That is why we have decided to test if and how much hammock networks might help in the quantum realm. Instead of theoretical analyses we have decided to perform simulations on IBM Q (unfortunately still gate-level constrained), and we report our preliminary findings in this paper. |
| 31 | **Simon Cowell, Sorin Hoara and Valeriu Beiu**<br>*Aurel Vlaicu University of Arad*<br>***Romania*** | **Experimenting with Beta Distributions for Approximating Hammocks' Reliability**<br><br>**Abstract.** It is a well-known fact that, in general, the combinatorial problem of finding the reliability polynomial of a two-terminal network belongs to the class of #P-complete problems. In particular, hammock (aka brick-wall) networks are particular two-terminal networks introduced by Moore and Shannon in 1956. Rather unexpectedly, hammock networks seem to be ubiquitous, spanning from biology (neural cytoskeleton) to quantum computing (layout of quantum gates). Because computing exactly the reliability of large hammock networks seems unlikely (even in the long term), the alternatives we are facing fall under approximation techniques using: (i) simpler 'equivalent' networks; (ii) lower and upper bounds; (iii) estimates of (some of) the coefficients; (iv) interpolation (e.g., Bézier, Hermite, Lagrange, splines, etc.); and (v) combinations of (some of) the approaches mentioned above. In this paper we shall advocate—for the first time ever—for an approximation based on an 'equivalent' statistical distribution. In particular, we shall argue that as counting (lattice paths) is at the heart of the problem of estimating reliability, the binomial distribution might be a (very) good starting point. As the number of alternatives (lattice paths) gets larger and larger, a continuous approximation like the normal distribution naturally comes to mind. Still, as the number of alternatives (lattice paths) becomes humongous very quickly, more accurate and flexible approximations might be needed. We put forward the beta distribution (as it can match the binomial distribution), and we use it in conjunction with a few exact coefficients (which help fitting the tails) to approximate the reliability of hammock networks. |

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| 52 | **Ahmad Hiasat**<br>*Princess Sumaya University for Technology*<br>***Jordan*** | **General Frameworks for Designing Arithmetic Components for Residue Number System**<br><br>**Abstract.** In many previous works, researchers have proposed Residue-based arithmetic components for the two classical moduli sets $(2^{p}, 2^p-1, 2^p+1)$, and $(2^{p}, 2^p-1, 2^{p-1}-1)$, where $p$ is a positive integer. These components included reverse converters, sign identifiers, and scalers. In this paper, we are widening the umbrella of these two sets to be $(2^{k}, 2^p-1, 2^p+1)$, and $(2^{k}, 2^p-1, 2^{p-1}-1)$, where $k$ is a positive integers such that $0<k\leq 2p $. The classical moduli sets are special cases of these expanded sets when $p=k$. This paper introduces multiplicative inverses for these expanded moduli sets. The introduced multiplicative inverses will ease the process of designing residue-based arithmetic components. This paper also proposes general frameworks for designing reverse converters, sign identifiers, comparators, and scalers. Additionally, this work expands the options available for a designer willing to design a RNS processor based on these enhanced moduli sets. |
| 57 | **Leonard Daus and Marilena Jianu**<br>*Technical University of Civil Engineering Bucharest*<br>***Romania*** | **The shape of the reliability polynomial of a hammock network**<br><br>**Abstract.** Motivated by the study of hammock (aka brick-wall) networks, we introduce in this paper the notion of X-path, which generates all possible connections through the network. The new concept of X-path, together with the Jordan Curve Theorem for piecewise smooth curves, allow us to provide a direct proof of duality properties for hammock networks. In the last part of the paper, we closely link the reliability polynomial of the hammock network having length l and width w to the reliability polynomial of the dual network (with length w and width l). An important consequence is a significant reduction of requested calculus for finding reliability polynomials of all hammock networks. |