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Preface for the Special Issue of International Congress on Engineering and Complex Systems ICECS21

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Preface

Aristotle once said, the whole is more than the sum of its parts.

A quote that defines exactly what a complex system is.

Complex systems are systems where the collective behaviour of their parts entails emergence of properties that can hardly be inferred from properties of the parts. These systems appear in a wide variety of fields such as human science, economics, climate, modern energy, telecommunication infrastructures, transportation systems, embedded systems, mechanical industries, information systems Improving these systems minimizes the gap between science, policy, economy and society. Researchers in different fields should collaborate to enhance them. The value is created through the establishments of new connections between elements.

Complex systems are structures that import free energy and export entropy in order to enable them to self-organize their content and configuration. These systems are connected to an environment that contains other systems. These ones can be complementary, competitive, combative, predative or even available as prey.

In present time, companies and organizations absorb information from their environment and create stores of knowledge in the aim to take actions. Challenges in engineering, economics, management and logistics are growing in systems that are more and more complex adaptive ones. The features of complex systems modelling problems in different fields are incontrollable. We cite for example their nonlinearity, their emergence, their spontaneous order and their adaptation.

This special issue regroup ten contributions that address problems as complex systems in different fields. We name Optimization, Image and signal processing in healthcare systems, e-learning, mechatronics and control, energy and management and logistics. Thereafter, we present a brief review of these works. The authors demonstrated the impact of machine learning techniques or statistical analysis to present new studies in various topics.

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Optimizing health information technology to improve health system performance is a work in fast progress. In this aim, K. EL MOUTAOUAKIL et al. suggested a variety of optimal daily diets for people with diabetes in Morocco. They modelled the foods glycemic load in term of triangular fuzzy numbers and the problem of daily diet in term of fuzzy quadratic optimization programming. To solve the obtained model, they used the Particles Swarm Algorithm PSO. Image segmentation is a widely known process applied in the resolution of Healthcare issues. H. MOUSSAOUI et al presented a new method of skin cancer detection based on Otsus thresholding algorithm and marker-controlled watershed method. This hybridization process starts by segmenting the input image using fuzzy c-means algorithm. It then applies multi-Otsu thresholding algorithm that separates the pixels of an image into a variety of classes depending on the intensity of the gray levels. The next step of this proposed method is the marker-controlled watershed algorithm that divides the image into homogenous areas or regions by using edge-detection concepts including mathematical morphology. The proposed technique was experienced on skin cancer Kaggle datasets.

In mechanics and mechatronics field, S. MOUNTASSIR et al. successfully employed the Non-Uniform Rational B-spline to study the fracture mechanics as an alternative to Lagrange interpolation polynomials. The authors used the extended isogeometric analysis based on this function to evaluate the stress intensity factors in order to control the crack propagation. I. HARRADE et al. dealt with another common problem when controlling a planar robot. It is the singularity problem when computing its geometric or kinematic model. To overcome this problem, I. HARRADE et al. presented a new efficient method to calculate the position of the joints of the 3R robot using a metaheuristic algorithm employing the coordinates of four selected points in the object image to find the desired position. Authors performed simulations using several metaheuristic algorithms (MAs) with a population N = 400. The work of H. EL IDRISSI et al. aimed to assess the failure of an open-hole composite laminate subjected to tensile loading, using different progressive damage approaches. Authors proposed a user-defined material subroutine and implemented it, within Abaqus, by applying a combination of Pucks failure criterion and the gradual degradation model. They took into consideration the integrated model in Abaqus based on the Hashin failure criteria coupled with the continuous damage model.The unicycle robot is another interesting topic in this field because of its robustness. B. ELKINANY et al. modelled the inverted pendulum having two arms is using a mathematical representation based on the Lagrangian formulation which embodies the concept of the unicycle robot. They used then the fuzzy logic control algorithm to produce a high level of solidity for this system.

Energy systems should be studied as complex systems as well. They coordinate the operation with various distributed energy resources, energy storage systems and power grids to ensure its reliability, while reducing the operating costs and achieving the optimal economic benefits. A.A. BANGURA et al. modelled and simulated a hybrid solar-wind energy system. It contains photovoltaic cells and a wind turbine with an integrated Permanent Magnet Synchronous Generator (PMSG). The authors introduced the P and O algorithm in the MPPT (Maximum Power Point Tracking) regulator used in the PV energy subsystem. For the control of the machine side motor (MSC) and wind turbine with PMSG, the Direct Turque and Flux Control (DTFC) has been enforced. S. OUBENMOH studied the right use of floor heating systems with improved thermal performance in order to prove their efficiency under different African climates. It also aims to evaluate the usage of simplified geometric models of underfloor heating systems and to use them in transient simulations. Authors presented a valid analytical model and simulation to illustrate the effect of functional parameters of the heating system and witch mainly focuses on floor surface temperature to acquire the desired heat flux and the perfect supply water temperature. The study relied on the three heat transfer mechanisms: conduction, radiation, and convection. In A. ET-TALIBY et al. work, authors conducted a state of art study analysing and discussing machine-learning approaches used for photovoltaic faults detection or classification. Authors compared the existing approaches according to accuracy.

Concerning the economics complexity, various works in this issue studied companies and organizations as complex systems that consist of interacting individuals that change their actions and strategies in response to the outcome they mutually create. A. EL JOUAHRI et al. studied the aspects and impacts of the interrelationships between Industry 4.0 technology and Lean Supply Chain Management through a literature review of 79 studies between 2010 and 2021 available on scopus database.

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