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Journal of Dynamical Systems and Complexity An international journal of AMESDYC: The Relevance of Nonlinear Dynamical Systems and Complexity in Science and Technology

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Abstract

The Mexican Association of Dynamical Systems and Complexity (AMESDYC), has created the international Journal on Dynamical Systems and Complexity (JDSC), whose history is described in this first article. JDSC has the vision of ranking as one of the best internationally in the modern topics of dynamical systems and complexity, which also include applications to neurosciences, robotics, applied physics, artificial intelligence, machine learning, and those involving applied mathematics in general.

Keywords— Dynamical Systems, Complexity, Applied Mathematics, Multidisciplinary Physics, Robotics and Unmanned Systems, Computer and Information Systems, Artificial Intelligence and Cybersecurity.

1 Introduction

At the end of 2015, an event organized by Dr. Eric Campos Cantón, entitled "Workshop on Chaotic and Nonlinear Dynamics in Circuits and Systems", Chaos Fest for all the friends, brought together researchers and students from various universities, institutes, and research centers in Mexico. Representatives from those institutions included Dr. Esteban Tlelo Cuautle from the National Institute of Astrophysics, Optics, and Electronics; Dr. José Salomé Murguía from the Autonomous University of San Luis Potosí; Dr. Luis Gerardo de la Fraga from CINVESTAV Zacatenco; Dr. Jesús Manuel Muñoz Pacheco, from the Faculty of Electronic Sciences at BUAP; and Dr. Guillermo Huerta Cuéllar from the University of Guadalajara, among others, as can be seen in Figure 1.

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Figure 1: Participants in the Chaos Fest 2015.

Perhaps it was thought that the 2015 event might have been abandoned. However, in a working meeting between Dr. Eric Campos Cantón and Dr. Guillermo Huerta Cuellar, envisioned the idea of consolidating the event with an emphasis on the dissemination of scientific and technological topics. 2019 was the year to hold the 1st Meeting for the Dissemination and Research in the Study of Complex Systems and their Applications (Encuentro para la Divulgación e Investigación en el Estudio de Sistemas Complejos y sus Aplicaciones), with the acronym EDIESCA, by its meaning in Spanish. In this sense, EDIESCA was conceived in response to the need for coordinated academic bodies and research groups that can conduct research, drive technological developments, and disseminate their findings. The first goal of EDIESCA was to encourage academic participation in proposing the establishment of a scientific collaboration network for the study of complex systems and their applications, aiming to have a significant impact on the development of new projects. It also sought to disseminate the undergraduate and graduate education programs of the different participating Mexican institutions. The strength of this event and subsequent ones has been the long-standing support of Dr. Bahia Betzabet Cassal Quiroga, Dr. José Luis Echenausía Monrroy, and Dr. Héctor Gilardi Velázquez. EDIESCA 2019 was a success, with 24 speakers, including students and researchers, presenting posters and talks on their scientific results; some of the participants are featured in Figure 2.

The second edition of EDIESCA was expected to take place in 2020; however, the COVID-19 pandemic that affected the entire world somewhat prevented the event from continuing. However, in 2021, with activities carried out virtually, the decision was made to continue EDIESCA virtually, this time with the University of Guadalajara's Centro Universitario de los Lagos as its headquarters. Thus, in September 2021, the second edition of EDIESCA was held with the committee shown in Figure 2, being Dr. Esteban Tlelo Cuautle joined as the event organizer and gave it an international focus. The second edition of EDIESCA featured speakers from Greece, France, Turkey, India, and, of course, Mexico. On this occasion, EDIESCA 2021 received 26 original works, and as a result, in addition to the dissemination of the talks, the book "Complex Systems and their Applications: Second International Conference (EDIESCA 2021)" was published [1].

Figure 2: Participants of EDIESCA 2019.

Figure 3: Organizers of EDIESCA 2021.

To follow EDIESCA meeting series, Dr. Everardo Inzunza González proposed holding EDIESCA 2022 in the city of Ensenada, Baja California, at the facilities of the Autonomous University of Baja California, some activities are highlighted in Figure 4. The event featured the participation of international researchers such as Professor Dr. Stefano Boccaletti, Dr. Sajad Jafari, Dr. Norbert Herencsar, Dr. Eva M. Navarro López, and Dr. Yaner Bar-Yam, as plenary speakers, and other researchers from countries such as India, France, Greece, Turkey, and Mexico in simultaneous sessions and posters. EDIESCA 2022, the number of talks grew again, reaching 54 presentations and 12 posters, allowing a selection of works to be published in special issues in journals such as Chaos, Theory and Applications, Integration VLSI, and Electronics. During the event, and in line with the growing number of Mexican researchers working with nonlinear dynamical systems and complexity, an agreement was reached with Dr. Cornelio Posadas Castillo on the location of the next event.

By 2023, EDIESCA would be held at the Faculty of Mechanical Engineering of the Autonomous University of Nuevo León, in Monterrey, Nuevo León. Dr. Posadas was in charge of organizing the event with Dr. Ernesto Zambrano Serrano. However, due to health issues and a medical complication,

Figure 4: Some activities in EDIESCA 2022.

Dr. Cornelio was unable to continue, and he passed a couple of months before the event. As a result, Dr. Miguel Ángel Platas Garza participated in the event alongside Dr. Zambrano. EDIESCA 2023 was very successful, some activities are shown in Figure 5, and as in previous events, the number of international and national participants continued to grow, reaching 80 talks and 21 posters. During EDIESCA 2023, the plenary talks of Professor Dr. Cesar Cruz Hernández, Professor Dr. Cristina Masoller, Professor Dr. Antoni Ivorra, and Professor Dr. Christos Volos were featured. Many of the presented works were selected and published in journals such as Integration VLSI, Chaos Theory and Applications, and the Mexican Journal of Biomedical Engineering, also published as book chapters in the book "Complex Systems and their Applications: Fourth International Conference (EDIESCA 2023)" [2]. EDIESCA 2023 was an event with excellent results thanks to and *in honor of Dr. Cornelio Posadas Castillo*.

Figure 5: Some activities in EDIESCA 2023.

The Universidad Panamericana campus Aguascalientes, in the city of Aguascalientes, provided

the opportunity to host EDIESCA 2024, thanks to the leadership of Dr. Héctor Gilardi Velázquez and the support of the university authorities. With a very detailed organization, it was possible to gather new participants and friends who attended EDIESCA since its early years, in addition to many new participants, some activities are shown in Figure 6. On this occasion, the event achieved the participation of more than 260 collaborators as co-authors distributed in 104 talks and 21 posters. This time, plenary talks by Professor Dr. Javier Martín Buldú, Dr. Jonathan Carlos Mayo Maldonado, and Dr. Christos Volos were also featured. There were also talks by researchers such as Dr. Monique Chyba from the USA, Dr. Nithin Nagaraj from India, and Dr. Akif AKGUL from Turkey, among other researchers from international and Mexican universities. Many of the papers presented at EDIESCA 2024 were published in the journals Integration VLSI and Chaos Theory and Applications, as well as in chapters of the book "Complex Systems and their Applications: Fifth International Conference (EDIESCA 2024)" to be published in August 2025 by Springer [3]. At the end of the event, on the Aguascalientes campus of the Panamericana University, a vote was held among different proposals for the next EDIESCA location, resulting in the selection of Universidad Michoacana de San Nicolás de Hidalgo.

Figure 6: Some activities in EDIESCA 2024.

During this year 2025, with Dr. Ulises Uriostegui Legorreta as the organizer of EDIESCA at Universidad Michoacana de San Nicolás de Hidalgo, in the city of Morelia, Michoacan, more papers are expected to be received than in the previous edition and the event format has been modified to have four days instead of the previous three. Figure 7 shows the advertising posters for the six editions of EDIESCA.

The creation and consolidation of EDIESCA in its early years was an achievement of the initial group of Mexican researchers in their work to bring together those with common interests in the areas of nonlinear systems and complexity. One of the event's key features has been to provide researchers with the opportunity to participate in an internationally recognized event without having to pay a fee and with the opportunity to publish their work in a peer-reviewed indexed journal or as a book chapter. In addition to the above, to consolidate the group's participation in these activities, the Mexican Association of Dynamical Systems and Complexity (AMESDYC) was created on August 25, 2023. Its objectives are the same as those at the beginning of EDIESCA but with the vision of carrying out more activities to disseminate and promote science in the areas of nonlinear dynamical

Figure 7: Advertising posters for the six editions of EDIESCA.

systems and complexity. Among other activities, AMESDYC has proposed continuing EDIESCA and, as its next project, creating and consolidating the Journal of Dynamical Systems and Complexity (JDSC).

JDSC emerges at a pivotal time in the evolution of science and technology. As our understanding of nature and engineered systems deepens, nonlinear dynamical systems and complexity theory continue to reveal their profound significance across disciplines. From the organization of living systems and ecosystems to the control of autonomous machines and the evolution of intelligent algorithms, complexity is no longer a secondary feature—it is the essence of modern systems.

In the physical world, the behavior of many systems cannot be captured by linear models. Nonlinear dynamical systems provide the essential framework to understand phenomena such as turbulence, chaos, synchronization, and pattern formation. These phenomena are not merely mathematical curiosities but are central to the modeling of real-world systems in physics, biology,

chemistry, and engineering [4]. The study of complexity complements this by focusing on emergent behavior, robustness, and adaptability, which are foundational to understanding both natural and artificial systems [5]. Therefore, the Journal of Dynamical Systems and Complexity is committed to publishing high-quality research that lies at the intersection of theory and application, with a strong emphasis on interdisciplinary approaches.

1.1 The focus of the Journal of Dynamical Systems and Complexity spans several key areas:

Multidisciplinary Physics Complex systems in physics—such as those found in fluid dynamics, condensed matter, and plasma physics—are often governed by intricate nonlinear interactions. Examples include the modeling of climate systems, collective behavior in particle swarms, and phase transitions in disordered media [6]. These systems challenge traditional methods and require innovative mathematical tools and simulations for their analysis.

Applied Mathematics and Interdisciplinary Applications Applied mathematics serves as the language through which dynamical systems and complexity are formalized. Techniques such as bifurcation theory, chaos theory, and fractal geometry provide crucial insights into system stability, predictability, and control [7]. Applications range from epidemiology and ecological modeling to economics and neuroscience, highlighting the broad reach of nonlinear analysis.

Computer and Information Systems Information processing in dynamical environments—such as real-time systems, distributed computing, and networked infrastructures—often involves complex feedback loops and emergent computation. Modeling these systems requires both discrete and continuous approaches, integrating graph theory, cellular automata, and hybrid dynamical models [8]. The role of information theory in understanding complexity is also central to this field.

Artificial Intelligence and Cybersecurity Modern AI systems, including neural networks and reinforcement learning agents, exhibit complex adaptive behavior that can be analyzed through the lens of dynamical systems. Furthermore, the growing field of explainable AI is increasingly turning to nonlinear dynamics and complexity science for insights into interpretability and system behavior [9]. In cybersecurity, the detection and mitigation of threats in adaptive networks demand sophisticated models of system vulnerability and resilience.

Robotics and Unmanned Systems Autonomous systems must operate in unpredictable and often chaotic environments. The dynamics of locomotion, perception, and decision-making are inherently nonlinear and require models that account for real-time feedback, noise, and adaptation [10]. Swarm robotics, inspired by biological collectives, further highlights the intersection of complexity and

control theory.

1.2 The Role of Mexican Researchers in Advancing Complexity Science

The role of Mexican researchers in advancing complexity science has become increasingly prominent in recent decades, with notable contributions to both the theoretical and applied dimensions of dynamical systems and complexity. The Journal of Dynamical Systems and Complexity (JDSC) serves not only as an international platform for the dissemination of high-quality research but also as a dedicated venue to highlight and promote the impact of Mexican scientists in this evolving field. Through a wide spectrum of studies—ranging from nonlinear dynamics, chaos theory, and network science to interdisciplinary applications in biology, economics, and engineering—Mexican researchers have demonstrated a growing leadership and innovation capacity within global scientific communities.

JDSC aims to capture this momentum by providing visibility to work originating in Mexico, encouraging scholarly dialogue and international collaborations. This includes the publication of original research articles, review papers, and special issues dedicated to emerging themes or national initiatives. The journal's editorial policy actively supports the inclusion of contributions that reflect the diversity of perspectives and challenges encountered in Latin America, while adhering to rigorous academic standards. In this context, JDSC becomes not only a repository of knowledge but a dynamic space for intellectual exchange and community building.

By drawing attention to the achievements of Mexican researchers—many of whom operate at the intersection of pure and applied science—JDSC contributes to the broader recognition of Latin America's role in shaping the future of complexity science. The journal also aligns with educational and institutional efforts to nurture the next generation of scientists in Mexico and beyond, reinforcing the country's strategic position in this critical area of research.

By the last, Esteban Tlelo Cuautle has contributed extensively to the design and implementation of chaotic electronic circuits and memristive systems, paving the way for new applications in secure communications, machine learning, the Internet of Things, and analog computing. Eric Campos Cantón has worked on multistability and hidden attractors in nonlinear systems, which are crucial to understanding phenomena with multiple coexisting states. Finally, Guillermo Huerta Cuéllar has led efforts in the study of complex systems from the perspective of nonlinear dynamics, particularly focusing on the experimental study, modeling, and analysis of chaotic systems as erbium-doped fiber lasers, synchronization, and the development of platforms for scientific dissemination in the field. In addition to these individuals, a growing network of Mexican researchers—based in public universities, private institutions, and national research centers—has made important strides in interdisciplinary fields such as bio-inspired robotics, complex networks, and artificial intelligence.

We are launching this new journal as a catalyst for cross-border collaborative research. We invite the international scientific community to contribute to this effort and to help shape the future of complexity science and its applications. Ultimately, JDSC envisions a more interconnected and representative scientific ecosystem, where contributions from traditionally underrepresented regions are essential to global progress.

2 Mexican Association of Dynamical Systems and Complexity (AMESDYC)

As mentioned before, during the early stages of EDIESCA, many researchers pointed out the need to create an association that would support the development of EDIESCA and allow us to carry out other academic activities together. Thus, the Mexican Association of Dynamical Systems and Complexity (AMESDYC) emerged as a result of the interaction and support among researchers in the area of dynamical systems, nonlinear dynamics, complexity, etc., as result AMESDYC was created on August 25, 2023.

2.1 The founding members of the AMESDYC

The success of EDIESCA is due to the ongoing participation of researchers from various higher education institutions and research institutes, whose goal has been to collaborate with peers and share a common interest in improving scientific development in the field of dynamical systems in Mexico. These same researchers have continued with a group project that resulted in the creation of AMESDYC, as mentioned above. The names of the founders and their institutions are listed in Table 1.

3 Conclusion

Based on what was mentioned throughout the document, we would like to express our joy at being able to mention the creation of the Journal of Dynamical Systems and Complexity, a result of collaboration among Mexican researchers. This short but fruitful history of cooperation among researchers who are now members of the Mexican Association of Dynamical Systems and Complexity, and they continue to work together to grow as a group by inviting more researchers, so that Mexico's name continues to shine in the science of dynamical systems and complexity.

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Esteban Tlelo Cuautle	Instituto Nacional de Astrofísica, Óptica y Electrónica, INAOE
Guillermo Huerta Cuéllar	Centro Universitario de los Lagos, Universidad de Guadalajara, UDG
Jesús Manuel Muñoz Pacheco	Benemérita Universidad Autónoma, de Puebla, BUAP
Juan Gonzalo Barajas Ramírez	Instituto Potosino de Investigación Científica y Tecnológica, IPICYT
Rider Jaimes Reátegui	Centro Universitario de los Lagos, Universidad de Guadalajara, UDG
Jorge Antonio López Rentería	Instituto Tecnológico de Tijuana, ITT
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