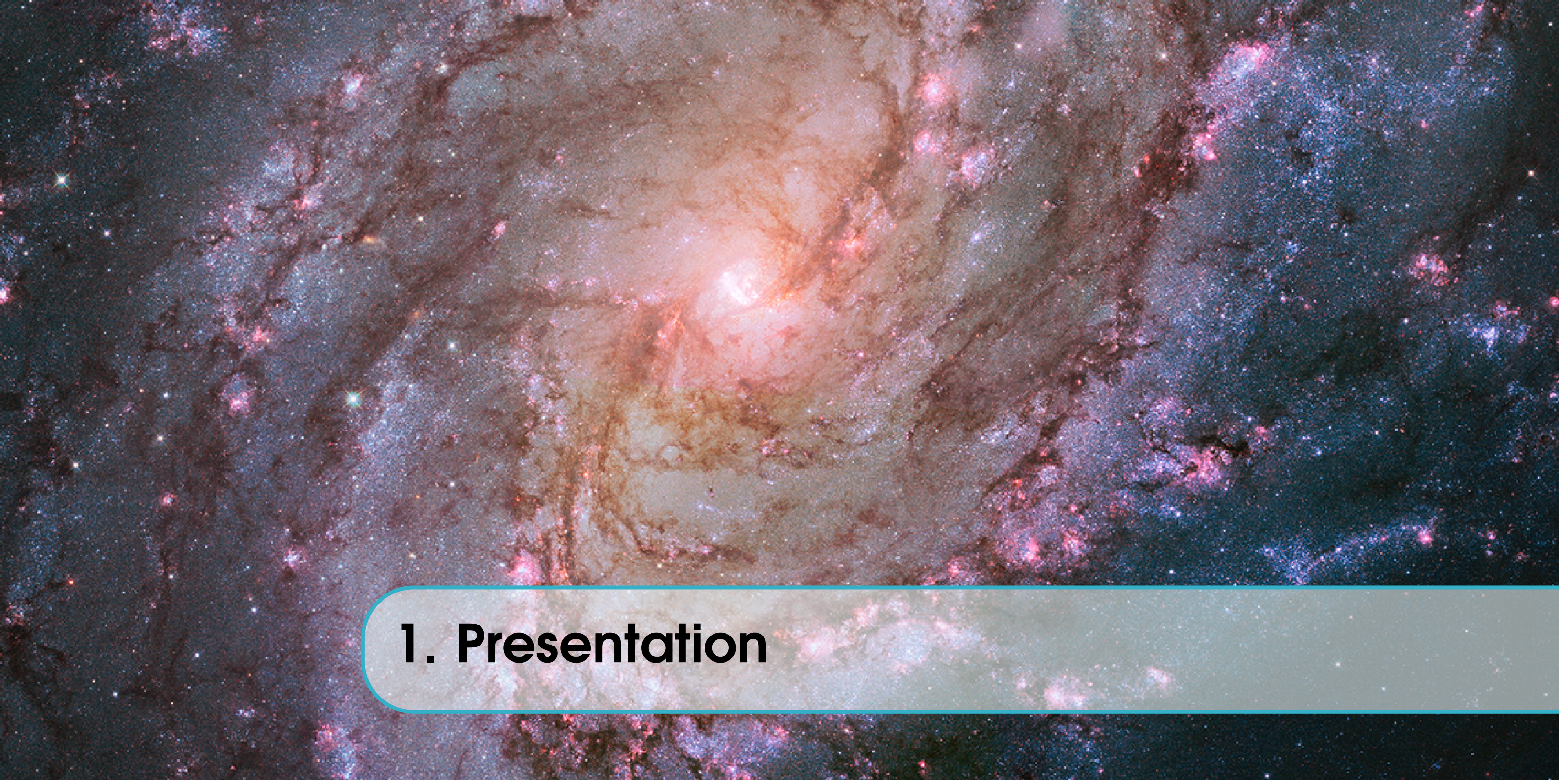

1. Presentation

After more than ten years of the beginning of the research group in smart grids, as well as the positioning of the brand of the group known as GIREI and in which several of its members have achieved their doctoral studies, noticed the need for knowledge transfer to the classroom of undergraduate, masters and doctoral degree from their academic experiences. It is why Esteban, Alexander, Diego, Wilson, and Manuel have come together to produce this work that contains source code, pseudocode, and results that can help different engineering applications.

This book is born within the first year of deploying Artificial Intelligence (ChatGPT, Poe, etc.), Educational Engineering, Education 5.0, and several advances in science and technology. The book proposes that the readers of the work can explore its applications and start with new research, as well as articulate results from different specialties.

The chapters on georeferencing and network planning, multi-criteria analysis, power flow optimization, DC motor control, and power demand analysis have been generated from theory to practice based on the disciplinary knowledge of the authors, the pedagogical knowledge of several years of teaching and the technological expertise that characterizes them. Then it is time to enjoy its contents:

Chapter 2 presents a valuable process for working with geo-referenced scenarios in applications such as Electrical Engineering, Traffic Engineering, Road Networks, Water Pipelines, Underground Fiber Optics, Wireless Networks, Vehicular Networks, and Electromobility. Planning models do not always imply a simulation in a dimensionless or fictitious scenario. Studies and consultancies require testing in geo-referenced environments in urban, suburban, or rural areas. In this way, it is essential to validate the scalability and population growth of the variables that may intervene in the study. A bibliometric analysis that identifies the penetration of studies in various areas of knowledge but on geo-referenced scenarios is initially noticed for the survey. Thus, the Euclidean distance often used today is replaced by the haversine distance that includes the earth's curvature and with greater precision for specific scenarios. The substantial contribution of this work is the correction and incorporation of additional functions to those presented in MathWorks since all the study is done on Matlab, a licensed software but of great advantage for engineering research. Finally, routing work is presented as an example for wireless networks incorporating algorithms such as Dijkstra and where the connectivity matrix is evidenced when the problem is treated from the graph theory $G = (V, E)$.

Chapter 3 presents the multicriteria decision methodology as a practical approach to solving engineering problems that require an optimal joint solution. This method addresses the challenges posed by optimization problems with multiple variables and conflicting objectives or criteria. Multicriteria practices assist in identifying and evaluating a set of solutions, enabling decision-makers to select the best alternative among the contradictory criteria. The chapter describes the proposed multicriteria decision methodology for solving optimization problems in electric power distribution systems. Two practical issues are analyzed as examples: optimal reactive power compensation and optimal placement of reclosing devices. These problems involve analyzing multiple variables related to essential aspects of Electrical Engineering, such as efficiency, reliability, and power quality. The analysis includes power flow calculations and other engineering studies based on the proposed objectives. The method's effectiveness is demonstrated through its ability to handle the complexities and conflicts among the different variables. In summary, the multicriteria decision methodology is a valuable tool for solving engineering problems that require an optimal solution. Considering multiple variables and their potential conflicts, this method provides decision-makers with alternative solutions and helps them achieve the best balance among the conflicting criteria.

Chapter 4 presents an availability of interface processes between different software that allows a better study and analysis of electrical power systems, so an interface between Matlab and GAMS has been developed to solve the problem of optimal power flows, for which a generic methodology has been proposed. The designed interface allows for solving approximate (OPF-DC) and exact (OPF-AC) flows by obtaining the values of the different electrical parameters of the systems to be analyzed. The interface makes GAMS become a Matlab tool. The information processing time and the solution to the studies are less since there is only one software that executes the modeling and optimization, very similar to the processes of the specialized simulators, but with the difference that it allows increasing variables and restrictions for the solution of the optimal power flows.

Chapter 5 presents a comprehensive strategy for controlling a DC motor, employing three different control approaches: PID control, Model Predictive Control (MPC), and state feedback control using Ackerman and Bessel polynomial strategies. The study explores the performance of each control method and its suitability for different applications. The PID control offers a reliable and widely used approach, while the MPC provides advanced predictive capabilities. The state feedback control utilizing Ackerman and Bessel polynomials demonstrates an innovative approach for achieving optimal performance. The research highlights the strengths and limitations of each strategy, emphasizing the need for further testing and validation. Overall, this study offers valuable insights into enhancing DC motor control through diverse control techniques, opening new possibilities for optimizing motor performance in various industrial applications.

Chapter 6 begins by introducing the concept of time series analysis and its importance in forecasting the future values of a process. Then focuses on electricity consumption in Quito-Ecuador from 2004 to 2018 as a specific example of a time series data set and explains the challenges associated with modeling such data, also the importance of identifying seasonality and trend in the data is emphasized, which can significantly impact the accuracy of the model. Time series modeling is explained with MATLAB code to implement each step. Then SARIMA model is presented, a widely used method for modeling time series data with seasonal patterns. Additionally, autoregression, differencing, and moving average time series are analyzed. Also, time series models are validated with the residual sum of errors RSS and average error per sample to assess the model's performance. Finally, the work demonstrates using the SARIMA model to forecast future electricity consumption values. The text highlights the importance of continuous model refinement and updating as new data becomes available. This work provides a comprehensive guide to modeling time series data using SARIMA models. Its step-by-step instructions, MATLAB code, and practical examples make it a valuable resource for anyone interested in analyzing and forecasting time series data related to electricity consumption or other variables. By following the guidelines provided in this work, readers can gain a deeper understanding of time series analysis and make more accurate predictions for future values of their data.