Teaching Several Software and Tools for Bachelor Students of Chemical Engineering: Simulation and Optimization

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INTRODUCTION

Over the last decade, the industry sector has increasingly relied on modelling, simulation, and optimization methods to address challenges and enhance efficiency in manufacturing [1-3]. These methods aid in reducing production costs, optimizing time management, and improving customer service [4]. Simulation and optimization teaching must be updated and re-designed for future engineers, training students on mathematical modeling and optimization tools, as well as simulation techniques applicable to chemical and production systems, combining different methods and tools compatible with new engineering trends.

PURPOSE

The purpose of this course was the re-design of the current program in the Simulation and Optimization subject of the Chemical Engineering Degree at the Universidade de Santiago de Compostela (USC). The objective was to train students with the mathematical modeling, optimization and simulation skills, in an effective way accordingly with the new developments in the engineering context.

METHODOLOGY

The course included a combination of theoretical instruction and hands-on projects to facilitate learning. Students were introduced to a range of simulation and optimization methods and software tools relevant to manufacturing processes. Seven group projects provided opportunities for students to apply their knowledge to real-world scenarios, fostering practical problem-solving skills and facilitating a deeper understanding of mathematical modeling, simulation techniques and optimization methods.

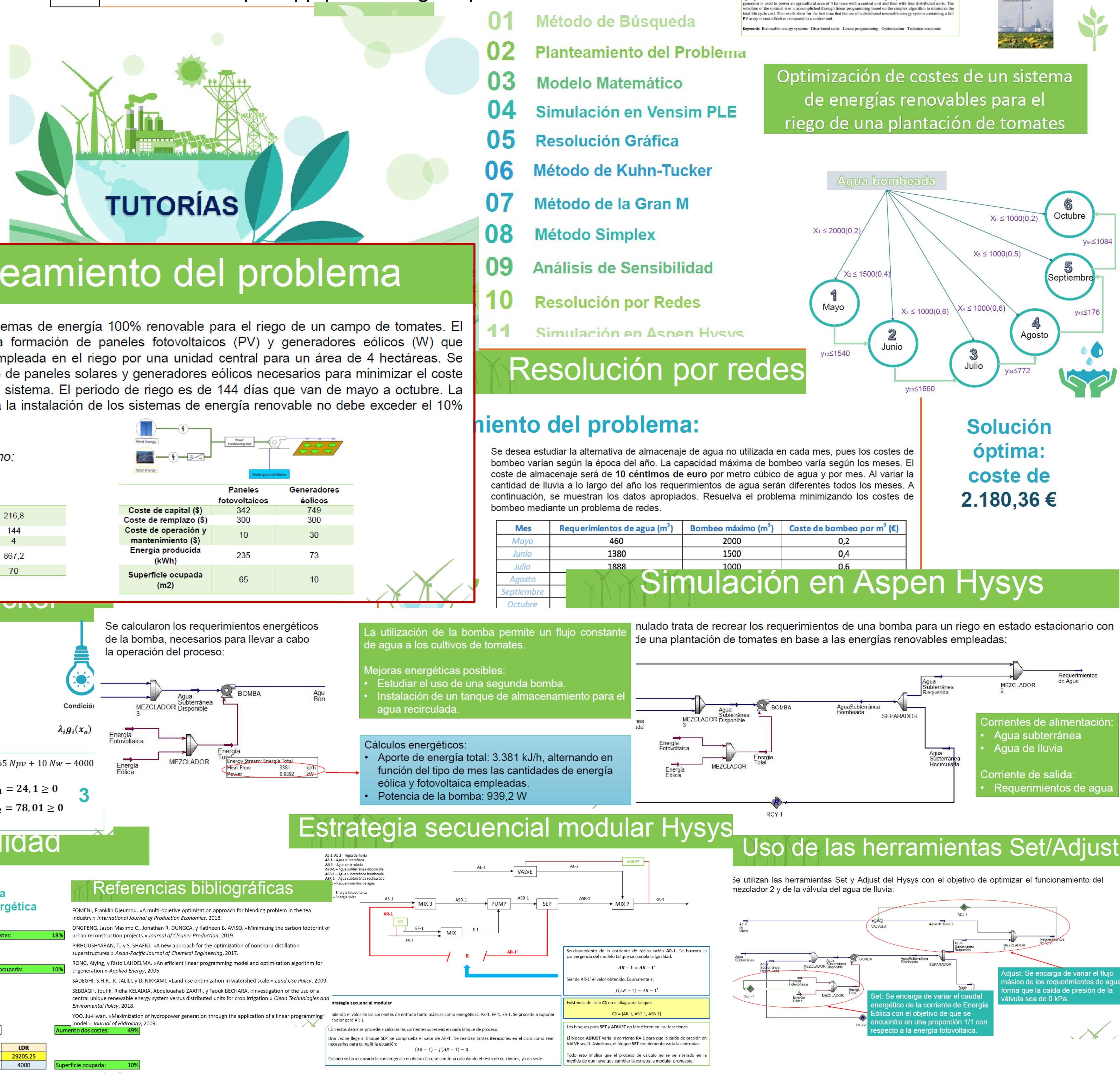
MODELS
- PRINCIPLES OF MODELING (Vensim)

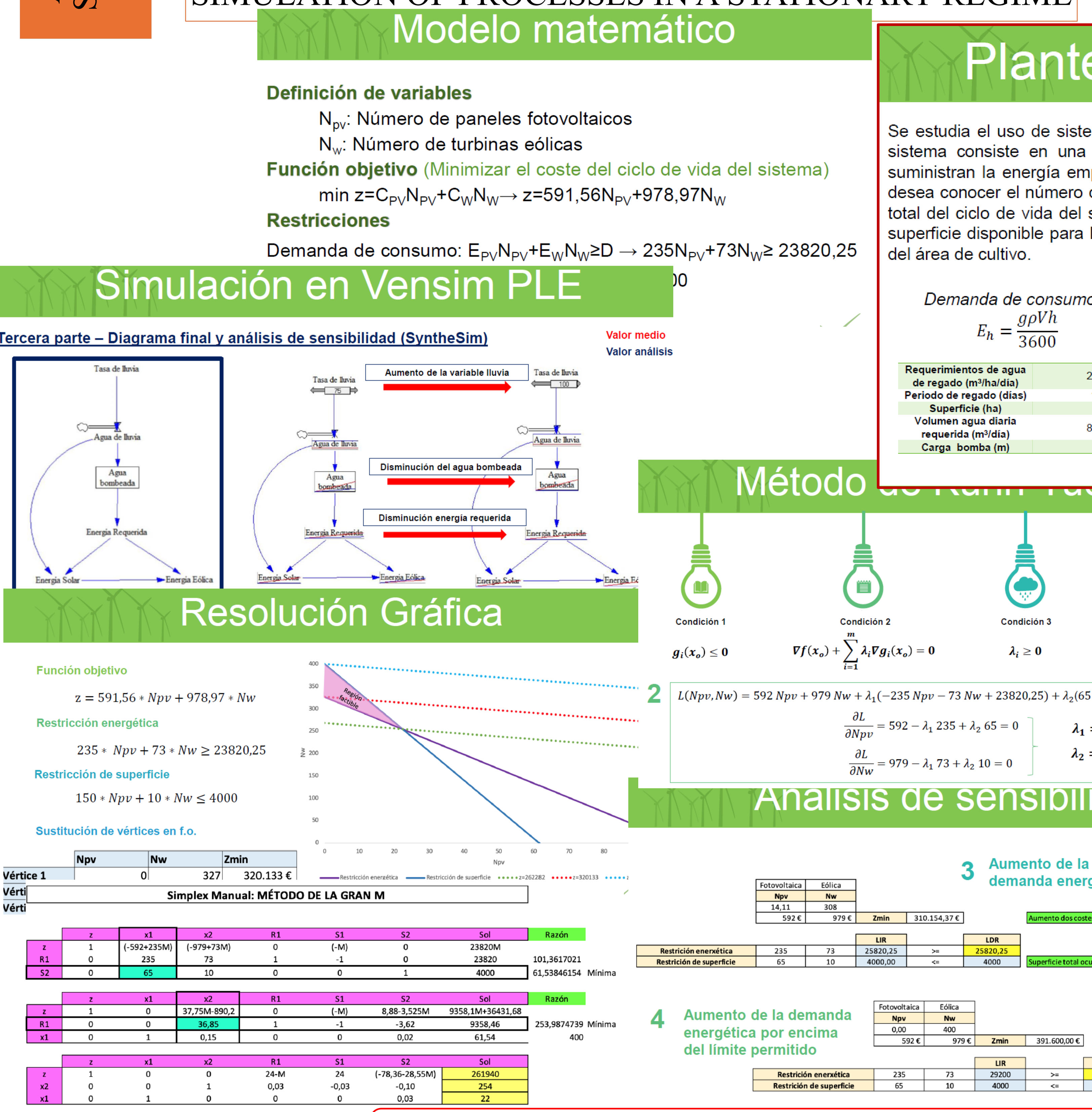
PROCESS OPTIMIZATION
- INTRODUCTION TO PROCESS OPTIMIZATION (Excel)
- OPTIMIZATION WITHOUT RESTRICTIONS (Solver)
- OPTIMIZATION WITH RESTRICTIONS (MATLAB)
- NETWORK ANALYSIS

ANALYSIS AND SIMULATION OF PROCESSES
- SYSTEMS STRUCTURE (Aspen Plus, aspentech HYSYS)
- SEQUENTIAL MODULAR STRATEGY FOR THE SIMULATION OF PROCESSES IN STATIONARY REGIME
- EQUATION-ORIENTED STRATEGY FOR THE SIMULATION OF PROCESSES IN A STATIONARY REGIME

SKILLS

GENERAL	CG.3	Knowledge in basic and technological subjects enables them to learn new methods and theories and gives them the versatility to adapt to new situations
	CG.4	Ability to solve problems with initiative, decision-making, creativity, and critical reasoning to communicate and transmit knowledge, skills, and abilities in the field of industrial engineering
SPECIFIC	CQ.2.1	Ability to analyze and design processes and products
	CQ.2.2	Ability to simulate and optimize processes and products
	CQ.4.1	Ability to design, manage and operate chemical process simulation procedures
	CQ.4.2	Control and instrumentation of chemical processes
TRANSVERSE	CT.1	Capacity for analysis and synthesis
	CT.4	Skills for the use and development of computer applications
	CT.6	Problem-solving
	CT.8	Teamwork
	CT.13	Ability to apply knowledge in practice





CONCLUSION

This work underscores the significance of integrating simulation and optimization education to align with technological advancements, particularly in the industrial realm, while also preparing students for evolving job market demands and enhancing company performance. Specifically tailored for chemical engineers, the newly introduced course at the Universidade de Santiago de Compostela, emphasizes essential tools and software relevant to industrial applications. Faculty members, experienced in the field, emphasize the course's learning objectives, aimed at equipping students with skills to seamlessly transition into the workforce.

REFERENCES: Tripathi et al. Processes, vol. 10, no. 8, p. 1587, 2022; Rodič, Organizacija, vol. 50, no. 3, pp. 193–207, 2017; Winston and S. C. Albright, Practical management science, 5th ed. Boston: Cangage Learning, 2015; Garcia and F. You, "Supply Chain Design and Optimization: Challenges and opportunities," Computers & Chemical Engineering, vol. 81, pp. 153–170, 2015.