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Editorial

Advances in Thermal Process Engineering and Simulation

Rosenberg J. Romero * and Jesús Cerezo *

Centro de Investigación en Ingeniería y Ciencias Aplicadas, Universidad Autónoma del Estado de Morelos, Cuernavaca 62209, Mexico
* Correspondence: rosenberg@uaem.mx (R.J.R.); jesus.cerezo@uaem.mx (J.C.)

The integration of theoretical insights and current findings in the articles included in this Special Issue holds the potential to bridge the gap between academic research and real-world challenges in enhancing physical–chemical processes. By aligning data-driven approaches with practical applications, these submissions contribute to a holistic understanding of the field.

The excessive generation of greenhouse and pollution gases worldwide has seriously affected the health of the Earth, affecting future living beings. The use of simulation tools and mathematical models is key to improving the performance of any kind of equipment and increasing its lifespan. This Special Issue presents studies related to numerical simulations that implement a mathematical model to understand and improve physical systems.

The first article [1] tries to solve various challenges related to the environmental and public health issues arising from the open burning of wheat straw residue. It also emphasizes the need to explore alternative uses for wheat straw to reduce waste and promote sustainability. Furthermore, the article discusses the low energy density and poor fuel properties of wheat straw, which hinder its potential as a renewable energy source. The main objective of the article is to tackle these challenges by investigating torrefaction process under different reaction atmospheres to enhance the fuel properties of wheat straw, making it a more viable and efficient fuel source.

The second article [2] analyzes the performance and energy efficiency of thermoelectric generators (TEGs) by investigating the impact of various factors such as segmentation, leg structures, and cooling nanofluids. By conducting a comprehensive analysis, the study aims to provide insights into optimizing TEG performance, which is crucial for enhancing the practical viability of thermoelectric energy generation technologies. The findings contribute to solving the challenge of maximizing energy recovery from thermal processes and advancing the development of renewable energy sources.

In the third article, the Guest Editor team apply artificial intelligence to solve a problem in the operation condition of a double-stage heat transformer (DSHT) [3]. The study presents three AI computer programs for calculating the conditions that result in the highest absorption temperature without compromising the performance of the DSHT. This optimization is crucial for improving the efficiency and performance of thermal energy recovery systems, contributing to the mitigation of CO_2 emissions and sustainable energy development.

In [4], the authors optimize the structural parameters of a multi-stage Tesla valve battery thermal management system using the neighborhood cultivation genetic algorithm (NCGA) and the Kriging approximation model to find the optimal values of the cooling plate by considering different design parameters.

The fifth study included in this Special Issue [5] proposes an accurate temperature prediction model for GaAs HBT devices used in the design of RF power amplifiers based on an extreme learning machine and atomic search algorithm. The predicted temperatures show a good agreement with the experiment results, demonstrating a superior performance of the proposed model in accurately predicting the temperature of GaAs HBT.

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Article [6] discusses the optimization of intake valve parameters for a piston-type expander based on load. An electro-pneumatic variable valve actuation system is proposed for the independent control of valve parameters. Trajectory planning for the intake valve is optimized to improve its mechanical properties. As a result, energy efficiency decreases with an increment in intake valve duration angle, while output power increases with a decrease in the amplitude of power growth. The optimum intake valve duration angle was determined using gray relation analysis.

In the next study [7], a computer data analysis is carried out to calculate the thermal efficiency of autoclaves during the vaporization of frozen wood prisms to produce wood veneers. The study analyzes energy consumption and thermal efficiency in different modes of operation of the autoclaves. The main finding is that dispatcher interventions increase both the duration and thermal efficiency of operating modes.

The next study in our collection proposes an alternative for reducing fossil fuel consumption with the use of an organic Rankine cycle to produce power and cooling [8]. Benzene, cyclohexane, methanol, and toluene are used as working fluids for the organic cycle and an ammonia–lithium nitrate mixture is employed for the absorption cooling cycle. Of these, benzene obtains the highest performance parameters.

This Special Issue reports a comparison of scenarios with data for the Mexican Electricity System preceding the COVID-19 pandemic. The baseline is the year 2000, and the goal is to reduce emissions by 50% by 2050. Several factors are considered, including fossil fuel reserves, technological efficiency, investment cost and price of each renewable energy source, and capacity projections. All of these are included in the model.

In the same vein, in the context of sustainability research into gas emissions, an air pollution-intensive industrial agglomeration in China is analyzed [9]. A novelty application of the spatial Durbin model (widely used in econometrics) is adapted for the emission of sulfur dioxide, technological innovation, green and non-green technologies, and industrial agglomeration.

Article [10] develops a simulation of a geothermal heat pump (GHP) to control the ambient temperature in a greenhouse located in an arid zone in Mexico during the year 2020. It is observed that the average deviation between the simulation and experimental data obtains very good precision.

For engineering applications, a comparison of numerical and analytical methods is developed to generate a solution to the three-dimensional heat diffusion equation [11]. The analytical solution is based on an infinite set of polynomials and an exponential-type function. The numerical solution is based on finite difference.

Finally, a numerical analysis of latent heat storage using a commercial plate heat exchanger for absorption system conditioning is presented by the Editor [12]. This article is a continuation of previous sustainability research in the field of thermal energy storage.

The Editors expect these papers will reach young researchers, encourage their involvement in the field of energy simulation analysis, and contribute to advances in thermal process engineering with the goal of reducing fossil fuel emissions.

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