

DEPARTMENT OF MATHEMATICS AND SIMCENTER
present

“Steel heat treating: mathematical modelling and numerical simulation of an industrial problem”

by

Dr. Francisco Ortegón Gallego

Director and Professor of Mathematics

Universidad de Cádiz, Spain

September 6th, 4 p.m., UTC SimCenter Auditorium*

Networking | Light Refreshments | Seminar | Q & A

Public Invited



Steel is an iron and carbon alloy. Steel used for industrial purposes has a carbon content of up to about 2% in weight. Other alloying elements may be present, such as Cr and V in tool steels, or Si, Mn, Ni and Cr in stainless steels. Most of structural components in mechanical engineering are made of steel. Some of these components, such as wheels teeth, bevel gears, pinions, etc., are committed to transmit certain types of movement (rotational or longitudinal). As a result, the contact surfaces of these workpieces are particularly stressed. The goal of steel heat treating is to obtain a satisfactory hardness. Before any heat treatment, steel is a soft and ductile material. Without any heating treatment, and because of surface stresses, the teeth of the gear will soon get damaged and they will not engage properly.

In this talk, we will be interested in the mathematical description and numerical simulation of the hardening procedure of a car steering rack. This particular situation is one of the main concerns in the automotive industry. In this case, the goal is to increase the hardness of the steel along the toothed line and keeping at the same time the rest of the piece soft and ductile to reduce fatigue.

In addition, we will describe a mathematical model for the heating-cooling step of a steel workpiece leading to the desired hardness. The resulting model consists of a strongly coupled nonlinear system of PDEs/ODEs. A simplified version of this model is used for the numerical simulation of the hardening industrial process of a car steering rack.

Prof. Francisco Ortegón Gallego obtained his PhD in Mathematics from the Universidad de Sevilla (Spain) in 1988 and a year later he obtained the same degree from the Université Pierre et Marie Curie, Paris 6 (France).

During the period 1987-1997 he worked at the Universidad de Sevilla, and since 1997 is working at the Universidad de Cádiz. Currently, he is a professor of Mathematical Analysis (chair) and holds the positions of head of department of Mathematics and coordinator of the PhD program in Mathematics at the Universidad de Cádiz.

The research topics that have most interested him deal with problems of mathematical physics and engineering governed by nonlinear systems of PDEs, from the theoretical aspects to the numerical simulation. In particular, the modeling of turbulence by techniques of the theory of homogenization, nonlinear elliptic and parabolic equations with singular coefficients, the thermistor problem, steel heat treating, etc.

This research have been developed within research projects, several of them as the main responsible. Professor F. Ortegón Gallego is the author of more than thirty articles in impact journals, he has participated in more than sixty international conferences, as an invited speaker on several occasions or as chair of the organization.

Currently, he is part of the ICIAM2019 organization that will take place in Valencia (SPAIN) from July 15 to 19.