



International Congress on Industrial and Applied Mathematics in Valencia

Mathematics for modeling Biological processes

- **Carlos Conca, guest speaker, explains the process that the human body experiments from receiving a smell to the electric current which arrives to the brain.**
- **Tomas Chacón, president of the Organizing Committee: "We can translate into mathematical language, how joints, dental implants and blood circulation work".**
- **Leah Edelstein-Keshet, guest speaker: "With mathematics we can understand how normal cells become pathological".**

Valencia, July 16th of 2019. How does the scent of a flower travel, from the moment we perceive it, from our nose to our brain? Which is the optimal way to place a dental implant? Why does a cell become pathological alone? All these answers can be answered, theoretical and rigorously, thanks to mathematics. This is the area of Mathematical Biology, which studies biological processes using mathematical tools and techniques, such as differential equations, statistics or numerical modelling.

"Mathematics achieves a much more detailed understanding of the phenomena that we observe, in an experimental way, in nature and in life itself. That's why they change the traditional paradigm of science and give rigor to what is only empirical", considers **Carlos Conca**, mathematician from the University of Chile and guest speaker at the International Congress on Industrial and Applied Mathematics (ICIAM), which is being held this week in Valencia until July 15th.

During his talk, "Modeling Our Sense of Smell", he explained that thanks to mathematics, the process that the human body experiments from the moment it receives an scent, which is a chemical stimulus, to the electric current that reaches the brain and is translated into the olfactory sense can be seen. "The mathematical model can deliver information that

experiments can't, and it allows for a much finer observation of the microstructure of tissues and the mechanism of smell," says Conca. This mathematical problem is called inverse problem, and it can be extrapolated in order to investigate the functioning of the rest of the senses.

The challenge of understanding how the brain works

Understanding these processes can also be helpful to illuminate how the brain translates these stimuli and, in general, how the brain works – something we know very little about. "Brain-body interaction is perhaps one of today's great mysteries of which we practically know nothing, and I am convinced that mathematics will play a very important role in the great questions of neuroscience", says Conca.

Tomas Chacón, president of the ICIAM2019 Organising Committee and researcher at the University of Seville, explains that, "although an individual neuron can be modelled, the big problem is to achieve it with all the neurons that compound our brain, and this is a very complex challenge". The president of the Scientific Committee of ICIAM2019, **Alfio Quarteroni**, adds that "simulating neuronal processes is a great challenge which, if resolved, would help to understand diseases such as Alzheimer's and Parkinson's".

Protein behavior, surgery and medicine

However, applied mathematics is more advanced in other biological processes: "We can translate how a lot of things function into mathematical language - dental implants and blood circulation for example, in order to decide the optimal positioning of a bypass; hip implants, in order to optimize their surgery; in pharmacokinetics, we can decide which treatments and therapies should be applied to each patient," says Chacón.

Leah Edelstein-Keshet, from the University of British Columbia (Canada), will also speak on biological processes on Friday 19th, during her lecture "Pattern formation inside living cells" at ICIAM2019. Born to a mathematical father and mother who was a Biologist, she investigates "problems in cell biology using differential equations to understand the distribution of signalling proteins within cells". Edelstein-Keshet explains that protein interactions in cells are "really important for understanding how normal cells can become pathological".

On Thursday 18th July, from 19:45 to 20:45 hours, **Víctor M. Pérez-García** will speak about mathematics in relation to cancer. He will give an informative lecture; open to the public, at the Palau de les Arts (City of Arts and Sciences) in Valencia. Pérez-García is director of the Mathematical Oncology Laboratory (MôLAB) at the Institute of Mathematics Applied to Science and Engineering of the University of Castilla-La Mancha, where they use mathematical modelling to describe, understand and cure cancer, both in order to improve existing treatments and to create new ones.

Tomorrow, Wednesday 17th, Industry Day

Tomorrow, ICIAM2019 will be dedicated to the transfer of mathematical technology in the industry in order to "show the great innovative potential" of mathematical tools such as

statistics, big data and the techniques of modeling, simulation and optimization for the industrial sector, explain the organizers.

The speakers will present the success stories of their companies, many of them based on the application of artificial intelligence or advances in modeling and big data techniques. Ferrosolar, for example, will explain how it relies on mathematics to obtain higher purity silicon; Banco Santander will discuss the applications of data analysis in banking; and the Reganosa company will present a tool, developed by Spanish researchers, which improves the management of natural gas networks.

The celebration of the **International Congress of Industrial and Applied Mathematics 2019** is the biggest conference on this topic in the world, it takes place every four years and this is the first time the event is being held in Spain. These days, more than 4,000 mathematic from all over the world are discussing mathematics of the future. This celebration is possible thanks to the sponsorship of many institutions, amongst them The Ministry of Science, Innovation and Universities; the Foundation of the Valencian Community for the Promotion of Higher Studies (FFES); the Diputació de València; the City Council of Valencia; the University of Valencia; and Banco Santander.

For more information:

<https://iciam2019.org/>

Press:

Divulga

Ignacio Fernández Bayo

ibayo@divulga.es

610 908 224

Laura Torrado

lauratorrado@telefonica.net

607 283 282

Patricia Ruiz Guevara

patricia.ruizguevara3@gmail.com

608 763 628