Evolutionary dynamics and scaling laws in cancer: From mathematics to biomarkers and improved treatments.

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11:30 AM to 12:30 PM
https://purdue-edu.zoom.us/j/99822915094

Victor Perez-Garcia, PhD

Professor/Director

Institute of Applied Mathematics in Science and Engineering

University of Castilla-La Mancha (Spain)

Most physical and other natural systems are complex entities that are composed of a large number of interacting individual elements. It is a surprising fact that they often obey the so-called scaling laws that relate an observable quantity to a measure of the size of the system [1]. One of the most remarkable scaling laws in biology is the Kleiber law relating the size of an organism with its metabolic requirements [1,2].

In this talk I will describe the discovery of metabolic scaling laws in human cancers [3] and how they imply an explosive growth as the disease progresses. The observations can be understood using different types of biologically-inspired mathematical models. The most complex ones are discrete and recapitulate the variety of clonal populations emerging within neoplasms and their interactions [4]. The mathematical approaches allow for the definition of different biomarkers of the disease aggressiveness that have been validated using cancers imaging data [3,5].

I will discuss how the insight obtained from the mathematical models suggests ways to improve oncological treatments.
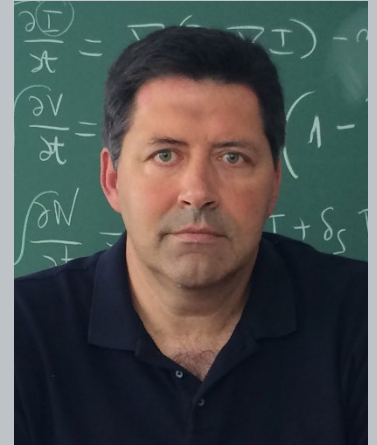
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[2] G. West, Life's universal scaling laws. Physics Today 57, 9, 36 (2004).
[3] V. M. Pérez-García et al, Universal scaling laws rule explosive growth in human cancers, Nature Physics 16, 1232-1237 (2020).
[4] J. Jiménez-Sánchez, A. Martínez-Rubio, A. Popov, J. Pérez-Beteta, Y. Azimzade, D. Molina-García, J. Belmonte-Beitia, G. F. Calvo, V. M. Pérez-García. A mesoscopic simulator to uncover heterogeneity and evolutionary dynamics in tumors. PLOS Computational Biology (2021).
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