



Soft Living Active and Adaptive Matter



Bioinspired flow networks: Excitability, self-sustained oscillations and a fluidic memristor

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Abstract:

Flow networks are essential for both living organisms and engineered systems. Very often they are successfully modeled as networks of linear resistors, however, in the animal and plant circulatory system, the resistance of each element can be highly nonlinear. In some cases, it can even present regions of negative differential resistance, where the flow decreases as the pressure difference increases. Inspired by these systems, we have proposed a mathematical model for nonlinear flow networks of any topology, it includes nonlinear resistors and allows for internal accumulation/depletion of volume. This model displays a wide variety of complex phenomena such as self-sustained oscillations, excitability and memory effects. We will describe this phenomenology and show how we are building such systems in the lab, where we exploit fluid-structure interactions to build tunable valves that can be arranged to create nonlinear flow networks. Finally, we will discuss preliminary experimental results where we have created what we have termed a fluidic memristor.

Date:
10/24/2022

Time:
9:00 AM-10:15 AM (PT)

About the speaker:

Dr. Miguel Ruiz-García is a Conex-Plus, Marie Curie independent researcher at Universidad Carlos III de Madrid (UC3M). Miguel has broad interests within soft matter physics and applied mathematics. He studies flow networks, theoretical machine learning and he also uses neural networks to tackle physical systems such as active matter or social relationships.



Before joining UC3M, Miguel was an Assistant Professor at Universidad Politécnica de Madrid (UPM). Previously, Miguel was a postdoctoral researcher in the Soft Matter Theory Group at the University of Pennsylvania, working with Andrea J Liu and Eleni Katifori.

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