Prospectus:
Physical Networks –
Phys 5570   Spring 2024

A more detailed Syllabus will be available upon request and will be uploaded on the canvas course site in due time.

Instructor: Eleni Katifori

Physics, engineering, and biology are rife with examples of physical, or material, networks, such as mechanical networks, resistor networks, and flow networks. In these structures, the networks are geometrically embedded, and the physical limitation of space, the position of the nodes, is an important consideration. This course provides an introduction to such systems. The course will cover the basic mathematical tools for network theory, graph theory, and the physics of flow and mechanical networks. Specific systems of great relevance to physics, engineering, and biology, such as mechanical (spring) networks, force chains in jammed packings, the cytoskeleton and other intercellular structural networks, (biological) flow networks, resistor networks, and truss systems will be discussed, as well as dynamics and optimization as applied to these structures. Since these networks are typically complex, the second part of the course will cover a broad array of data analytic techniques to characterize and quantify these structures, such as topological data analysis (TDA) and machine learning.

1 Course Unit

The course will be offered only occasionally.

The course is primarily designed for advanced undergraduates with some programming experience and knowledge of linear algebra, beginning graduate students and advanced graduate students with interest to formalize their understanding of the field.

Class structure

MW 12-1:30pm ET

The course will be heavily computationally based and interactive. Students will be frequently expected to bring their laptop to class. The course grade will be determined based mostly on active class participation, and secondarily homework, computational projects and a midterm.

Reading
There is no required book that you will have to purchase. A reading list/notes will be provided.