American Physical Society
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College Park, MD 20740

March Meeting 2023 Featured Presentations
From Bach to Basketball: Physics in Unexpected Places

Study Quantifies How People Perceive the Structure of Bach's Music

March 6, 9:24 a.m. PST, Room 125

A celebrated pioneer of Baroque-style music, Johann Sebastian Bach wrote music that varied in structure, composition and medium. In this talk, Suman Kulkarni and colleagues will share a framework to better understand complicated patterns found within many of the artist's pieces. Based on principles of information theory, this study provides a comprehensive quantitative analysis of how networks formed by the notes (nodes) and transitions (edges) present in Bach's compositions are structured. Through sequences of notes, these compositions — represented as music networks — convey information to listeners. Using a model for human perception, the framework examines how that information is then perceived by listeners. Among the results is the finding that different compositional forms are distinguishable through their inherent and perceived information content. Furthermore, the musical networks communicate large amounts of information efficiently through motifs that are easier to infer accurately. The work provides a fresh look at how people interact with and experience this historic composer's creativity.

Tracking Memes to Understand How Information — and Misinformation — Travels Through Social Networks

March 7, 9:48 a.m. PST, Room 124

Past studies have investigated the spread of misinformation using hashtags and metadata, but the complex behavior of social information networks is difficult to characterize. Internet memes provide a natural source of data that traces the shapes of these networks. In this talk, Jedediah Kistner-Morris and Nathaniel Gabor will describe how they analyzed the way image-based internet memes spread and evolve through social networks, using machine learning image recognition techniques and analysis approaches inspired by condensed matter physics. Understanding how memes spread through social networks could offer insights into

how other types of information, and misinformation, spread and evolve through various networks.

Simulation Unravels the Mechanical Properties of Knit Fabrics
March 8, 10:48 a.m. PST, Room 130

Different knit fabrics have distinct mechanical properties depending on the stitch patterns and textiles that crafters use to make them. One example of these properties is the ability to store potential energy in materials with diverse fabric structures and geometries when experiencing mechanical strain, such as being stretched. Here, Xiaoxiao Ding and colleagues present a new, physically-validated yarn-level simulation which is able to yield more accurate insights about the strain energy and force responses in knit fabrics. Their talk will delve into how exploring the properties of knit materials is exploitable for designing wearable soft robotics.

A Physics-Based Approach for Analyzing the Quality of Basketball Player Positions
March 9, 9:36 a.m. PST, Room 206

Density functional theory (DFT), a modeling method for studying structures made up of many interacting particles, has recently been used to model a variety of social systems and situations. In this talk, Boris Barron and colleagues will explain how they used a DFT-inspired approach to analyze data of basketball player positions throughout games. The new method lets the researchers predict where a player is likely to be based on the positions of other players and the ball. It also lets researchers judge the quality of a player's position based on the probability of it leading to a good shot, providing a new data-driven method for quantifying a player's contributions to the team. The new approach could also be generalized to apply to a variety of other sports.

Chloroplasts in Plant Cells Show Glass-Like Behavior in Dim Light
March 10, 9 a.m. PST, Room 129

The chloroplasts in plant cells can move toward or away from light depending on the light intensity, organizing themselves into various configurations. In this talk, Maziyar Jalaal and colleagues will describe a study of the re-arrangements of chloroplasts in cells of a water plant often used in home aquariums. They found that when chloroplasts in a plant cell arrange themselves into a single layer to increase their light exposure in dim lighting conditions, their collective motions bear similarities to the behavior of glassy materials near the glass

transition — the point where glass shifts between solid and fluid states between solid and fluid states. The researchers suggest that being in a state close to this glass transition may let the chloroplasts quickly ball up into a clump to avoid damage when suddenly exposed to intense light.