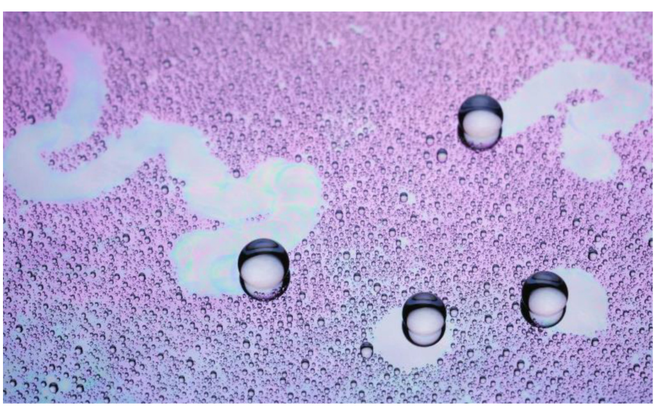
Editorial: Third Annual APS DSOFT Gallery of Soft Matter

Our world is made of soft matter–from slowly crawling glaciers to swirling flocks of birds, and from dancing raindrops to unfurling flower petals. The Third Annual Gallery of Soft Matter, showcased at the American Physical Society (APS) March Meeting 2024 in Minneapolis, organized by the APS Division of Soft Matter, highlights the aesthetic appeal and elegance of soft matter systems. Gallery submissions include stunning and thoughtfully crafted images and videos, paired with explanations of scientific phenomena, which we hope will captivate both scientists and the general public. Submissions were judged for their combination of striking visual qualities and scientific interest. All entries are accessible at https://engage.aps.org/dsoft/gallery/gallery/mm24-gallery. It is our pleasure to share the five winning entries in this Editorial, where the winners introduce hidden wonders of soft matter to be found in waltzing drops, tangled fibers, flowing suspensions, disordered structures, and morphing petals.

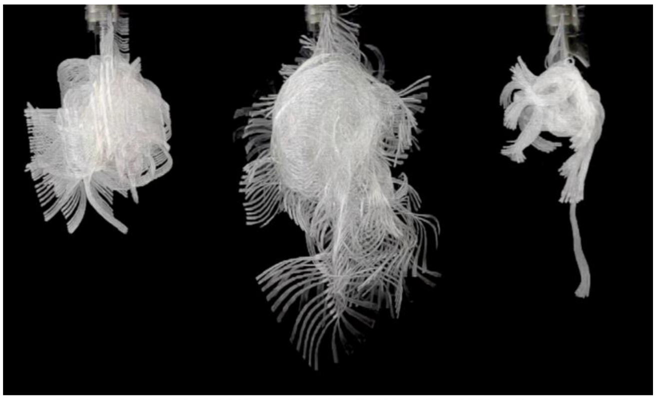
–Lebo Molefe, Irmgard Bischofberger, and Evelyn Tang



F. Wardani, M. Lin, D. Daniel, KAUST

The Waltz of Condensate Droplets on Lubricated Surfaces *(poster)* Infuse a nanostructured surface with a thin oil film, and you have prepared a dance floor for droplets to waltz on! We recently discovered that when droplets condense on lubricated surfaces, they spontaneously dance in a serpentine, self-avoiding fashion (leftmost drop), before switching to circling motions like whirling dervishes (drops at the bottom right). The driving force behind this dance is the Cheerios effect, which is due to the conversion of interfacial energy into kinetic energy. As larger droplets gobble up their smaller neighbors, they leave fresh areas for re-condensation and rebirth of new drops that start their own dance routines in a captivating ballet of renewal. These dancing droplets can revolutionize the way we capture water from the atmosphere, with potentially important heat-transfer applications.

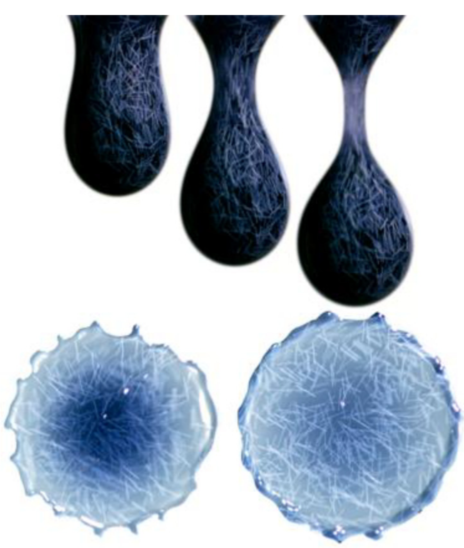
–Fauzia Wardani



I. Tiwari, V.P. Patil, S. Bansal, J. Dunkel, M. Saad Bhamla, Georgia Tech

How to Extract a Fiber from a Tangle? *(video)* Attempting to extract a single wire from a tangled mass often leads one to instinctively pull and shake the desired wire. Is there an optimal frequency for shaking the desired wire out when the tangle dangles under gravity? We conduct a controlled experiment with a tangled ball of fibers suspended from a vertically moving piston and discover an optimal frequency for this process. At relatively low frequencies (∼4 Hz, left), the fiber moves with the tangle, preventing its extraction. At moderate frequencies (∼17 Hz, middle), the tangle starts to jump chaotically, allowing the fiber to gradually come free. Interestingly, at high frequencies (>37 Hz, right), the piston's rapid movement induces damped oscillations in the tangle, which stops it from jumping and thus prevents the extraction process. Our experiments hint at resonance modes in a tangled ball of fibers.

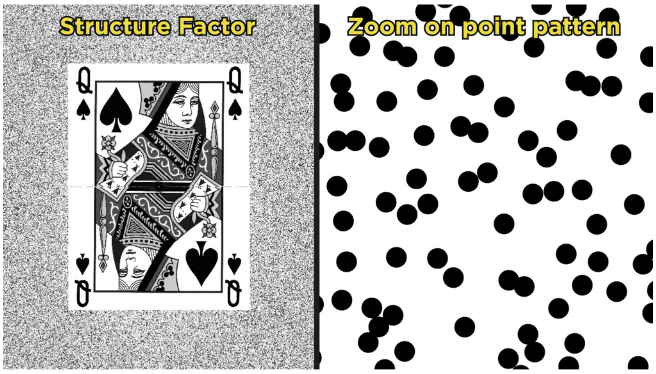
–Ishant Tiwari



S. Rajesh, A. Sauret, UC Santa Barbara

Capillary Flows of Fiber Suspensions *(poster)* The extrusion and spreading of droplets of fiber suspensions are relevant to industrial applications, including the 3D printing of fiber composite matrices. For applications such as additive manufacturing, it is important to control the droplet size, its thinning dynamics, and its spreading when impacting a substrate, as well as the final alignment of the fibers. To describe the capillary flows of fiber suspensions, we use high-speed imaging to capture the extrusion and spreading dynamics of suspensions prepared using micrometer-sized fibers that are 600–1000 μm in length and 50 μm in diameter. The droplets that are extruded have a diameter of around 4 mm at the time of pinch-off. Their size increases typically 2 to 3 times as they spread on a hydrophilic substrate. The final size of the suspension drop is closely related to the length and fraction of fibers in the suspension.

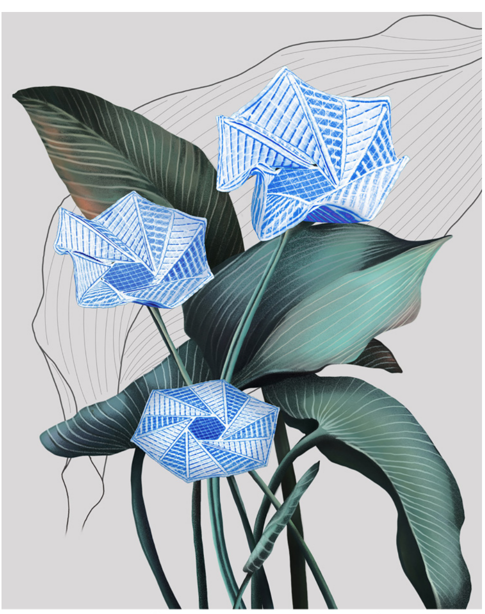
–Sreeram Rajesh



A. Shih, M. Casiulis, S. Martiniani, New York University

Painting Correlations in Fourier Space *(video)* From bird feathers to gemstones, many natural materials rely on periodicity to display vibrant colors and absorb or transmit light. However, systems that look disordered to the naked eye can achieve similar properties or even behaviors impossible to achieve in periodic structures. This is due to nontrivial long-range correlations between the positions of their microscopic components. Engineering disordered materials with target long-range correlations is challenging. Indeed, the number of far-away particles is much larger than that of nearby particles, so that there are many more constraints to satisfy to enforce long-range properties. We introduce FReSCo, an optimal algorithm for generating large correlated disordered structures, which lets us paint arbitrary patterns in the Fourier transform of sets of points, be they disks, spirals, playing cards, or … Steamboat Willie. Such fine control over pair correlations opens new possibilities to design disordered photonics, as well as high-precision Monte Carlo integration schemes.

–Mathias Casiulis



T. Gao, J. Bico, B. Roman, ESPCI-PSL/CNRS/CUB

Pneumatic Gaussian Cells (*poster*) Plant leaves and petals change their shape during morphogenesis by precise differential growth. Complete morphing of such surfaces typically involves manipulating both metric distortion and bending curvature simultaneously, known as Gaussian morphing. An example of a physical analogy is the pneumatic flower, where adjacent panels curl or unfurl in opposite directions, leading to closure or blossom, as shown at the center of the image. Each thin panel contains embedded inflatable cells, referred to as pneumatic Gaussian cells. Inspired by leaf bulliform cells, the cells are constructed with trapezoidal channels 3D printed on an airtight fabric layer, followed by heat-sealing another fabric layer on top. Upon inflation, both in-plane contraction and angular deflection can be programmed simultaneously through the cell's design. When connected to a single pressure source, actuation of the cells induces the transformation of the initially flat panels into complex shapes such as a synthetic flower.

–Tian Gao

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