MAE MECHANICAL AND AEROSPACE ENGINEERING

Matter Machines

Marc Miskin
Cornell University

Imagine the next generation of matter as reconfigurable at the command of computers. To meet a specific technological requirement, a computer algorithm designs the material's microstructure, and its own constituents, micron-sized robots, restructure themselves to take on an optimized state. My talk is a blueprint to realize this vision of active matter: I explain how to design materials with computer algorithms and how to build cell-sized machines. I will show how algorithms, created specifically for materials science, can design everything from the particle shape that minimizes the density of sand, to polymers that can be used to maximize the density of lithographic pattern features. To make matter that can reconfigure in the lab, instead of on the computer, I present a platform for building micron-sized robots that can function as the constituent elements of a material. I will show how an actuator made from graphene and glass enables cell-sized machines. Machines made through this actuator can change shape in fractions of a second while responding to environmental cues, carry electronics, and be fabricated en mass using standard semiconductor processing techniques. I discuss how, individually, materials design algorithms and nanorobots can reshape fields ranging from bio-electronic interfaces to optimal self-assembly. Yet viewed as two parts of the same platform, these ideas promise a new breed of matter that is adaptable, self-sensing, and precisely designed to fulfill the even most incredible technological demands.

Marc Miskin is a Kavli Institute Postdoctoral Fellow in Nanoscale Science at Cornell. His work centers on machines that can be used to control and design materials, both abstractly in the form of computer algorithms and literally in the form of robots. The former was the focus of his PhD at the University of Chicago, while the later has been his primary thrust since joining Cornell after graduation in 2014. His work has won several awards including a Springer Thesis Award and the Grainger Fellowship for excellence in experimental physics. Outside of research, he is actively involved in public science education, frequently appearing as a presenter at the local children's science museum and, with the BBC, is currently filming the pilot episode of a pop-science TV show.

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