



CoCo Seminar Series Fall 2024

Inferring Local Interactions from Global Response in Condensed Active Matter: Complex Emergence in the Mechanics of Fire Ant Rafts

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**Wednesday September 25, 2024 12:00-1:00pm EDT
Hybrid (EB-T1 & Zoom; meeting link available on
<http://coco.binghamton.edu/>)**



Condensed living systems often exhibit adaptive morphologies and mechanical properties that enable functions such as growth and localized strengthening. One such class of living materials is fire ant aggregations. These transient networks form when ants reversibly link together into buoyant raft structures to survive floods. We find that, when left alone, these rafts change shape ceaselessly over the span of several hours, often growing and resorbing tether-like protrusions that colonies can use as land-bridges to escape water. In contrast, we find that externally loaded ant rafts resist flow even at relatively slow strain rates, which may prolong colony unification in response to environmental conditions such as waves or water currents. In both cases, these collective behaviors emerge from the local interaction and bond properties between ants comprising the network. However, experimentally isolating and interrogating the properties of individual ant-to-ant interactions under native conditions is intractable. Therefore, we instead employ a combination of agent-based modeling and computational network mechanics that let us hypothesize and test local-to-global property relations. These models not only elucidate possible causes for the cooperative behaviors observed in ant rafts, but also extrapolate principles that could potentially guide engineered material and swarm robotics design in the future.

Rob Wagner received his BS in mechanical engineering from Union College (Schenectady, N.Y.) in 2013. From 2013-17, he worked as an application engineer at GE Oil & Gas (Houston, Texas). In 2022, Rob earned his PhD in material science and engineering from the University of Colorado Boulder as part of the Vernerey Soft Matter Mechanics Group. From 2022-23, he worked as a Postdoctoral Researcher at Cornell University in the Silberstein Mechanics for Material Design Lab. In January 2024, Rob joined the Mechanical Engineering Department at Binghamton University as an assistant professor. Presently, Rob's research focuses on the mechanical properties of polymeric materials and living systems. Specifically, he investigates how the combination of structural arrangement, dynamic bonding, and constituent-driven mechanical work mediate the emergence of desirable mechanical properties in soft materials.

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