

学术报告

报告题目： Evolutionary complexity and the imitation game of nature

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摘要： Complexity studies physical processes that are in general unpredictable, or difficult to predict, and depend on a multitude of interacting degrees of freedom. Examples include chaos, rare events, brain functions, natural mimicry and camouflage, swarms cooperative dynamics, intelligence, etc..

Despite that in some cases the evolution of these systems seems dictated by relatively simple interactions—such as predator-prey games in nature or neurons that send electric stimuli to their nearest neighbors—the effects arising are advanced and sophisticated, with a common denominator: extreme efficiency and sustainability.

A brain with 250 trillion connections and 100 billion neurons is contained in a cube of only 10 cm side, consuming less than 20W. Each neuron dissipates less than 1 nW: this power is one millionth the one dissipated by the most sophisticated transistor fabricated today. For example, rare events—like tsunamis, hurricanes—harness an exceptional amount of energy from environments in quite states; the equivalent power of such rare events is way higher than the most efficient plant available on earth. The camouflage of specific mollusks is more advanced than the most sophisticated nanomaterial engineered today; they can also dynamically change, contrary to man-made best structures. Ants explore a given terrain faster and on higher grounds than any current technology based on drones. Each ant requires also an infinitesimal amount of energy. Human babies develop spontaneous language abilities and cognitive thoughts, none of which happen in the most advanced technological platform currently available.

The goal of my research is to understand the physical origin of these behaviors and apply them towards sustainable technologies that tackle contemporary problem of global interest. In this presentation, I summarize some recent research in this field, discussing both fundamental and applied aspects. These range from energy harvesting to clean water production, design of smart materials via warped spaces, biomedical applications, information security, artificial intelligence, global warming, and optical neural networks.

简历： Andrea Fratalocchi is an Associate Professor (from July 2016) in the Computer, Electrical and Mathematical Sciences and Engineering Division at KAUST University. He joined KAUST in January 2011 as Assistant Professor. Prior to joining KAUST, Andrea Fratalocchi was a Research Fellow of Sapienza University of Rome under a KAUST Fellowship Award. From 2007 to 2009, Andrea Fratalocchi worked as a post-doctoral researcher at Sapienza University under a "New Talent" Award from the research center "Enrico Fermi." In 2012 he was appointed as Editor of Nature Scientific Report. In 2017, he won the middle east GCC enterprise Award as best electrical engineer of the year. As in March 2019, Andrea Fratalocchi authored more than 150 articles, one book, two book chapters and four patents.