Biologically-inspired and Nano-scale Communication and Networking

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The turn to nature has brought us many unforeseen great concepts and solutions. This course seems to hold on for many research domains. In this tutorial, we study the applicability of biological mechanisms and techniques in the domain of communications. In particular, we investigate the behavior and the challenges in networked embedded systems with primary focus on wireless ad hoc and sensor networks, which are meant to self-organize in large groups of nodes. The existing bio-inspired networking and communication protocols and algorithms devised by looking at biology as a source of inspiration, and by mimicking the laws and dynamics governing these systems is presented along with open research issues for the bio-inspired networking. Furthermore, the domain of bio-inspired networking is linked to the forthcoming research domain of nanonetworks, which bring a set of unique challenges. The objective of this tutorial is to provide better understanding of the potentials for bio-inspired and nano-scale networking, and to motivate the research community to further explore this timely and exciting field. Based on selected challenges in wireless communication, we discuss potential bio-inspired solutions including insect colonies, ant colony optimization, firefly synchronization, activator-inhibitor systems, artificial immune system, homeostatic system, epidemic spreading, and cellular signaling networks.

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