Abstract 2: Large-Scale Networks: From Intelligent Robotics to Emergency Response

Large-scale graphs and networks have been studied extensively in recent decades and produced breakthrough results in a wide range of applications, including computer networks, the www, sensor networks, transportation networks, power systems, the IoT, biological networks, genetic networks, social networks, and many others. We overview the foundation of network theory going back to the pioneering work on Erdos-Renyi on random graphs and phase transitions, followed by small worlds, such as Barabasi-Albert, Strogatz-Watts, scale-free systems with Black Swan statistics, as well as Dragon Kings. The statistical properties and behavior of these networks are typically assumed to be essentially unpredictable, including natural disasters like earthquakes, solar flares, tornadoes and hurricanes, as well as man-made phenomena, like stock market crashes, epidemics, industrial disasters, and many others. New developments in large-scale networks theory involving critical behaviors provide the window to predict and statistically analyze these processes which were beyond theoretical understanding until recently. Various methods are being developed to control the corresponding network dynamics. This talk will describe applications in autonomous robot control, highly flexible and rapidly reconfigurable distributed sensor networks, and robust decision-making in emergency scenarios during natural or man-made disasters.