TRANSPORT IN COMPLEX SYSTEMS

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Session Abstract:

Complex transport phenomena are among the most fundamental processes in natural, social and technological systems and across many length scales. A key challenge in understanding these processes is the development of theoretical tools that can not only address a given specific phenomenon at a given scale, but rather to understand the conceptual relationship between different processes and potentially different fields of sciences that address them. This trans-disciplinary approach has lead to considerable advances in understanding transport processes in particular, being able to identify common principles in phenomena as different as intra-cellular transport, and human mobility on a global scale.

The purpose of this session is to convey how fundamental aspects of transport processes at at work at a variety of natural, social, and technological systems on all scales, ranging from intracellular transport in living cells, to motility on single cell organisms, swarming and collective motion of animals to human mobility patterns and transportation on large scales. The idea is that although these systems are completely different, they share a number of common fundamental features. The session presents some of the key players in their respective fields and is designed to show how these very different processes and phenomena can be approached with related techniques and attitudes. Research on mobility and transport phenomena on all these scales is particularly exciting at present because of the massive increase of pervasive data available and techniques for obtaining it. A key goal of the session is to convey the success of trans-disciplinarity to engineers in order to potentially inspire designs across the board in the future.

The first speaker, Marta Gonzalez, will present her work on human mobility patterns, using massive data on cell-phone trajectories. The next speaker, Cristian Huepe, an expert on complex systems and collective motion, will discuss collective animal behavior and swarming and its applications to areas such as vehicular traffic and computer graphic swarm animations. Theoretical and experimental physicist Lars Hufnagel will then present his frontier research on image processing techniques using a multiview selective-plane illumination microscope. Finally, Stefan Klumpp will present his research on cooperative phenomena and patterns of cell motion.