Statistical physics of human mobility

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Abstract

In his talk we will present how mobility, networks and statistical mechanics may be bridged from a theoretical, experimental and technological perspective in various scales.

On the experimental side and at the mesoscale, we present recent results of an experiment on human mobility in an open environment with a spatial distribution of attraction points, where individuals' motion is tracked using GPS positioning transmitted from smartphones. We analyze the mobility patterns and find the statistical properties of flights and stops. We propose a simple stochastic dynamics model to reproduce the experimental results based on the existence of attractors and taking into account the effect of persistence in the direction of the motion.

On a purely theoretical side, we show how making use of entropy maximization techniques, one can propose a generic model for weighted network models generated by discrete, distinguishable events. This model is inspired by the need to isolate and analyse the causes beyond observed mobility data at the urban scale, which may be represented as a network formed by nodes that represent locations in the city and links are weighted according to the trips among them.

We will finally show a different application of network theory to understand a dynamical process, such as synchronization, emerging in a set of moving particles. In a simple model, we assume that oscillators behave as random walkers on a plane that interact according to some rules. We measure the synchronization time for the ensemble of oscillators to synchronize and provide some analytical insights for the behavior in two extreme situations, slow and fast motion, compared with the interaction time scale, reporting also a curious phenomena of resonance.