Epidemic models with local stochastic dynamics: from information spreading to neuronal avalanches

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Compartmental epidemic models like SI, SIR, or SIRS models have been studied widely in recent years. In such studies the nodes of the network are treated on equal footing as identical. However, in reality, each node has its individual characteristics and therefore interacts differently with a given contagion. In this work we introduce a local characteristic (fitness) into the network and define local stochastic transmission rules based on the local fitness of the individual nodes. We show that the simple SI model is capable of producing much of the important empirical evidence in information spreading in social networks, including: low prevalence, quasi-stationarity, and power-law statistics in users' activity. Furthermore, we also study the SIRS model under local stochastic dynamics as a simple model of neuronal activity in the cortex. Here, we also observe many features observed in empirical neuroscience and are able to reproduce scale-free behavior in brain oscillations and neuronal avalanches with exponents consistent with experiments. We end by arguing that stochastic local dynamics play a key role in general spreading phenomena.

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