On the mean-field approximation and stability in an uplink cellular network

Taisia Morozova

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1 Abstract

We discuss an uplink cellular network model in the discrete time, where the users transmit signals to their tagged base stations (BSs) using the same channel. Transmissions occur simultaneously, and because of a shared frequency resource, there is interference caused both inside and outside the cell. In order to increase the reliability of the network, in our model we allow for *signal retransmissions* in case if a failure occurs. Such systems are called *automatic repeat request systems* (ARQ) and are used mainly in TCP protocols. We also use an additional tool to control level of interference, which comes in as a parameter of the attenuation function.

We introduce a mean-field approximation of interference and investigate its accuracy via stochastic simulation. We study network behaviour within the 'real' model and the approximated one and compare the results under different parameters. We discuss stability condition for the system with no interference control and apply it to our system. We also empirically analyze network performance measures such as utilization, coverage probability, average buffer size and empty buffer probability. We then again compare these metrics and make conclusions about the approximation's accuracy.

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