How does mobility help distributed systems compute? supplemental material

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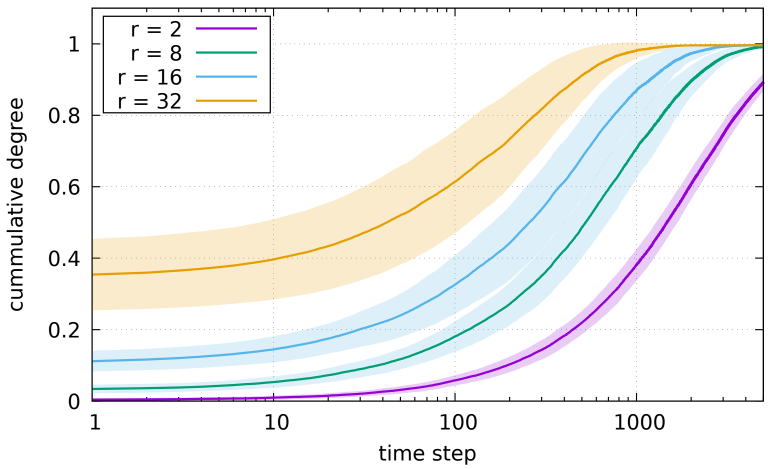

Figure 1: Average cumulative degree of agents moving with a correlated random walk ($\sigma = \pi/4$, $s = 1$, $N = 255$, $L = 80$). By moving straighter agents can achieve much the same effect as moving faster with an uncorrelated random walk.

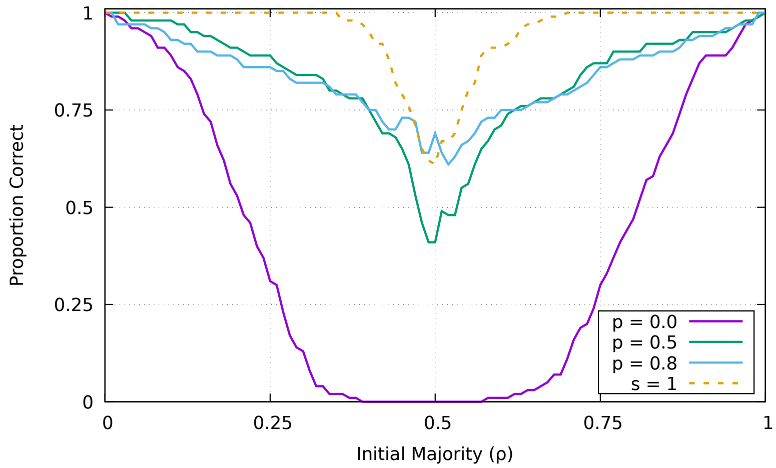

Figure 2: Performance of "small-world" random geometric graphs with no mobility. The solid curves show classification performance for a $N = 255$ agents with $r = 8$, $L = 80$ and $s = 0$ where every edge in the communication network has probability p of being replaced by a random edge (this is comparable the "rewiring" model for building a small world network from [1]). The dashed curve shows the performance of the same set of model parameters but with speed $s = 1$. Classification performance is considerably better with movement than with random long distance links for almost all initial conditions.

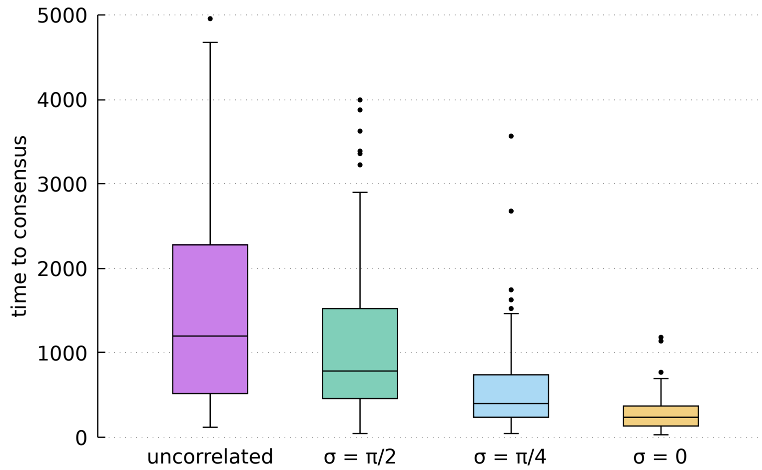

Figure 3: Time to reach consensus for a correlated random walk. At each time step agents select a new heading from a normal distribution with mean equal to their current heading and standard deviation σ. As agents walks become more correlated (lower σ) the average time to reach consensus decreases with a minimum reached when agents move under ballistic motion, only turning when they reflect off the arena boundaries.

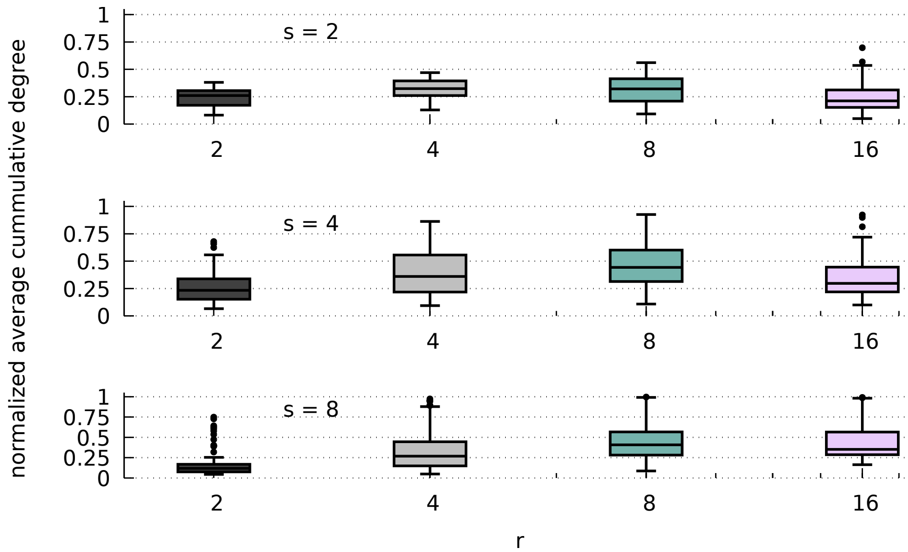

Figure 4: Median normalized cumulative degree for $N = 1023$ agents in an arena with size $L = 160$ at the time consensus is reached. Each box represents 100 random trials with the given r and s. Only those trials that reached consensus in $T = 5000$ time steps are included.

References

[1] D. J. Watts and S. H. Strogatz. Collective dynamics of “small world” networks. *Nature*, 393(6684), 1998.