Lab 1: Mobility Models

CSE 4215/5431: Mobile Communications

January 14, 2011

Mobility models are necessary to understand the requirements for mobile communication architectures, as well as for evaluating the performance of different communication protocols for mobile networks. Several mobility models have been proposed and analyzed in the Computer Science and Engineering literature. Please refer to [1] for a survey of many of these models.

In this laboratory assignment, you will explore two simple mobility models, the *Random Waypoint* model and the *Random Direction* model. You will explore some characteristics and see some drawbacks of these models. Let us define the models precisely. Assume for simplicity that all nodes move in a rectangular field. In the Random Waypoint model, each node chooses a point p uniformly at random from within the rectangular field and starts moving towards it with a velocity v chosen uniformly from the interval $[0, v_{\max}]$. On reaching p it pauses for T_{pause} time steps. Then it repeats the same process. In the Random Direction model, in contrast, each node chooses a direction uniformly at random (from the set of directions that would keep it within the field) and follows it with a speed chosen uniformly at random from the interval $[v_{\min}, v_{\max}]$ until it reaches a boundary. Then, it pauses for T_{pause} time steps. It repeats the same process over and over.

This assignment is meant as much to stimulate your interest and curiosity as it is to teach you about mobility models. Please feel free to explore and report any ideas or questions that you may have. Extra credit may be given to good ideas or insights.

1 Questions to be addressed

Let us consider three simple criteria for evaluating mobility models. The first metric we will use is spatial node density. The second criteria is the variation of average node speed over time. The third criteria is the number of neighbours of a node, where, two nodes are neighbours if they are within radio range of each other.

You will record all three parameters over time and plot the density after 1000 time steps and the other two parameters as a function of time. For average node speeds you can plot the average of all nodes over time. For number of neighbours, pick a particular node and plot the number of its neighbours.

2 Details of your simulation

You can work in Java or C/C++, or you can use MatLab. The latter makes it easier to plot data. Assume a field of size 100×100 and $n = 10000$ nodes. Assume radio range $r = 10$. For the speeds, assume $v_{\min} = 0$, $v_{\max} = 6$. You can choose velocities to be real numbers. For recording node densities divide the space into 100 cells of equal size and record the density in each. Let the simulation run for 1000 time steps. If this is too time–consuming on your platform then you can use a smaller number.

Make a 3-d plot for the density after 1000 time steps over the field. Plot the other 2 criteria against time.

Repeat the experiments for when all nodes start at the center of the field and again for when all nodes are uniformly spaced (at fixed intervals), and for $T_{\text{pause}} = 0$ and $T_{\text{pause}} = 2$.

3 Report and code

Do not submit anything this week. We will wrap up this investigation next week and you will submit one report after that. In preparation for that report, write a brief (a few paragraphs) description of what you did, design choices or assumptions you made (if any) and what you could infer from your results. Also keep the plots ready for inclusion in that report. Document your code so that the grader can easily follow what you are doing.

References

[1] A Survey of Mobility Models, *Fan Bai and Ahmed Helmy*, Chapter 1 in Wireless Adhoc Networks, Kluwer Academic Publishers, Can be downloaded from `http://www.ece.ncsu.edu/netwis/mobility_model.php`