

Lab 3: Radio Range Models – part 1

CSE 4215/5431: Mobile Communications

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We have seen different radio propagation models in class. We will study some radio range models that have been used for simulations in mobile communications research in this assignment. Please refer to [1] for a survey of many of these models. For this exercise you are encouraged to read Section 4 of [1].

In this laboratory assignment, you will explore a simple radio range model, the Degree-of-Irregularity – *DoI* (or the binary DoI) model. This is sketched in Section 5.1 of [2]. It incorporates some of the non-idealities of real radio propagation. Simulate the model using Java or C/C++ or MatLab. MatLab makes it easier to plot data, and provides built in random number generators for many probability distributions.

1 Questions to be addressed

You will record the fraction of edges that are different for the same positions of nodes between the idealized circular radio range model and the less idealized (but still vastly simplified) DoI model. Specifically, record for each time instant the number of edges that fall in the following categories:

1. communication is possible in the idealized model but no communication is possible in the DoI model.
2. communication is possible in the idealized model but asymmetric (1-way) communication is possible in the DoI model.
3. communication is not possible in the idealized model but symmetric communication is possible in the DoI model.
4. communication is not possible in the idealized model but asymmetric (1-way) communication is possible in the DoI model.

Notice that for each edge and for each time step you will generate new random variables to simulate the radio range at that instant.

2 Details of your simulation

Assume a field of size 100×100 and $n = 10000$ nodes. Assume radio range $r = 10$ for the idealized model.

For the DoI parameters, assume that the inner circle is of radius 8. The outer is of radius 12. The DoI value defines the standard deviation of a Gaussian that is used to generate the instantaneous radio range. Use a Gaussian random variable with mean $\mu = 10$ and standard deviation $\sigma = DoI * \mu$. Each time you need a radio range, generate a new random value from this distributions.

Let the simulation run for 1000 time steps in each case. Let all nodes start from a uniformly distributed position and apply the random direction mobility model. Take measurements only in the last 100 time steps. Repeat your experiments for DoI = 0.001, 0.01, 0.05, 0.1.

3 Report and code

You will submit a report and all your code after the next lab. In preparation for that, record the metrics described before and 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.

Document your code so that the grader can easily follow what you are doing.

References

- [1] Models and solutions for radio irregularity in wireless sensor networks, *Gang Zhou, Tian He, Sudha Krishnamurthy, John A. Stankovic*, ACM Transactions on Sensor Networks 2(2): 221-262 (2006) Can be downloaded from <https://qosbox.cs.virginia.edu/wsn/docs/papers/tosn06-models.pdf> or <http://dl.acm.org/citation.cfm?id=1149287>
- [2] Range-free localization schemes for large scale sensor networks. *Tian He, Chengdu Huang, Brian M. Blum, John A. Stankovic, Tarek F. Abdelzaher*, MOBICOM 2003: 81-95. Can be downloaded from http://www.cs.virginia.edu/~th7c/paper/APIT_CS-2003-06.pdf