Obstructed wireless networks with COOJA extended

Manasses Ferreira Neto

Wireless Informational Sensing Embedded systems Models Algorithms and Protocols,
Computer Science Department DCC, Minas Gerais Federal University

UFMG

Introduction

The model is based on a grid structure of one-dimensional street segments and two-dimensional street intersections. This structure provides a realistic representation of a variety of network scenarios with obstacles and, at the same time, allows a simple enough analysis.

Related Work

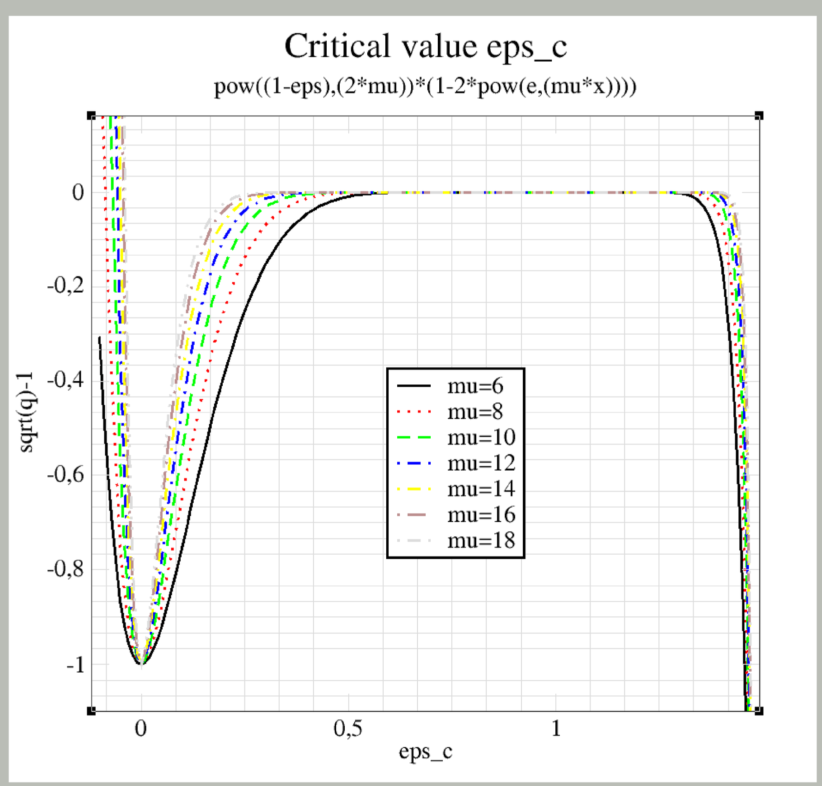
- Model and Analytical CTR: [Almiron et al. 2013]

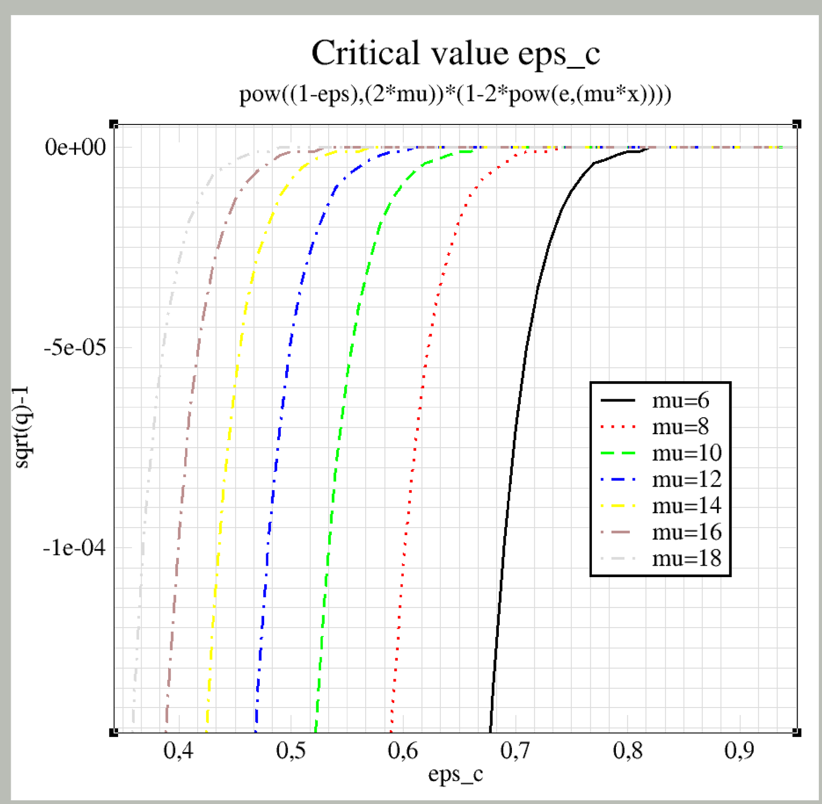
$$r_c = \frac{ln(g) + ln(\mu - 1)}{\mu}, \epsilon \geq \epsilon_c$$

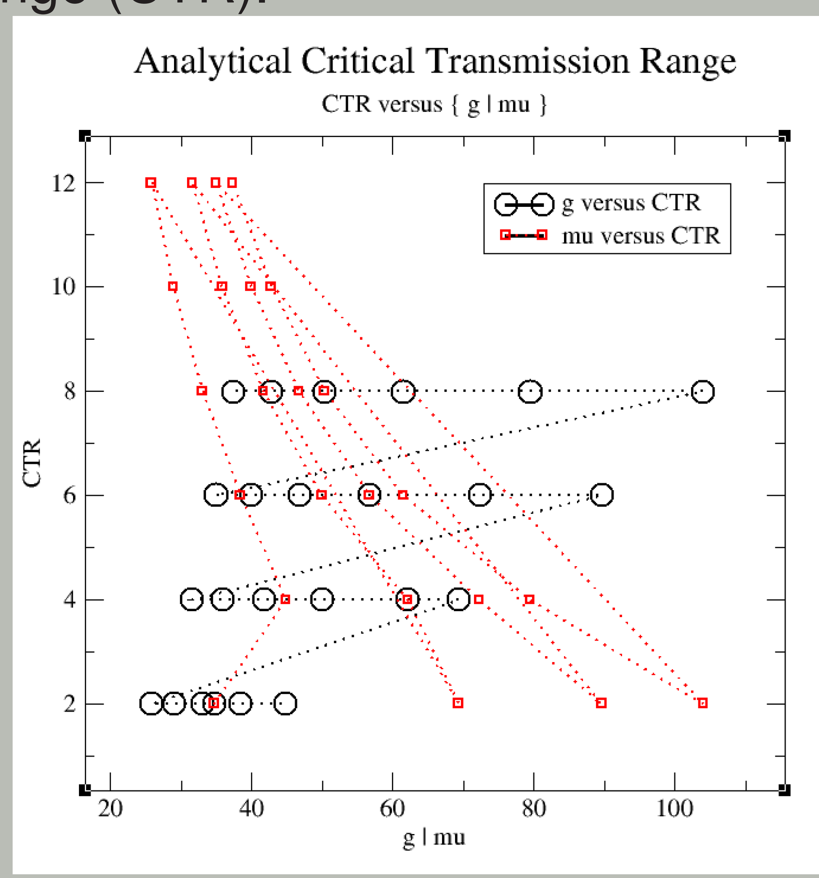
$$q = ((1 - 2\epsilon_c)^{2\mu}(1 - 2e^{\mu\epsilon_c}) + 1)^2$$

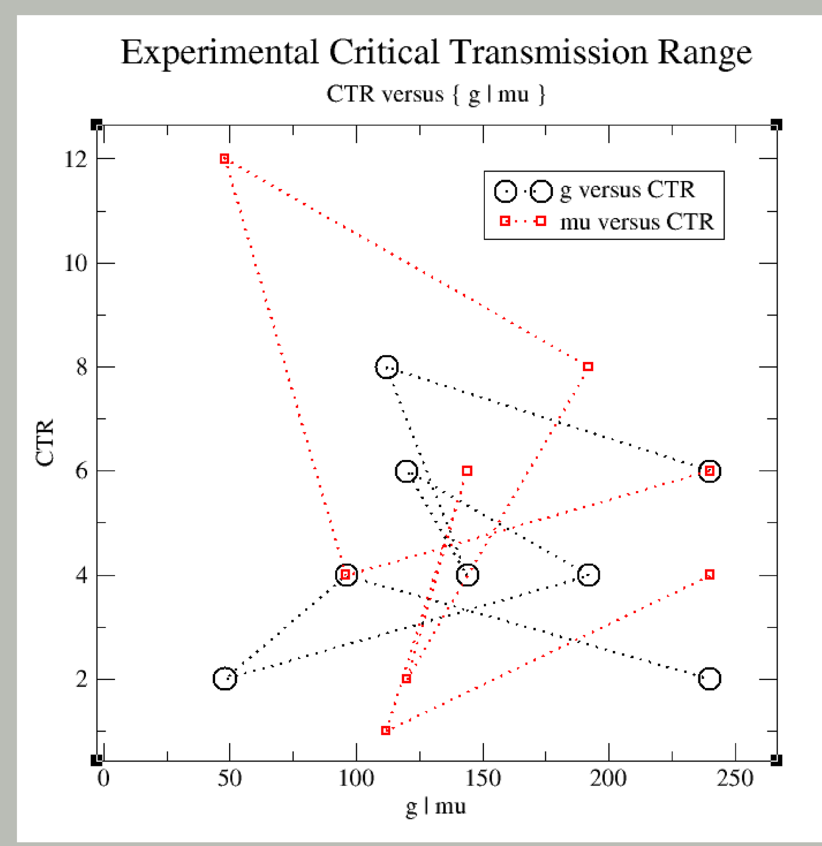
Results

We proposed a new class UDGO (Unit Disk Graph Obstructed) the simulator COOJA extended through to study obstructed wireless networks. Mainly, the behaviour of the Critical Transmission Range (CTR).









There is a promise future work on speed up the visibility calculations. We investigated (and started to code) the shifting-strategy with dynamic-programming described at [Erlebach et al. 2005].

Questions we made

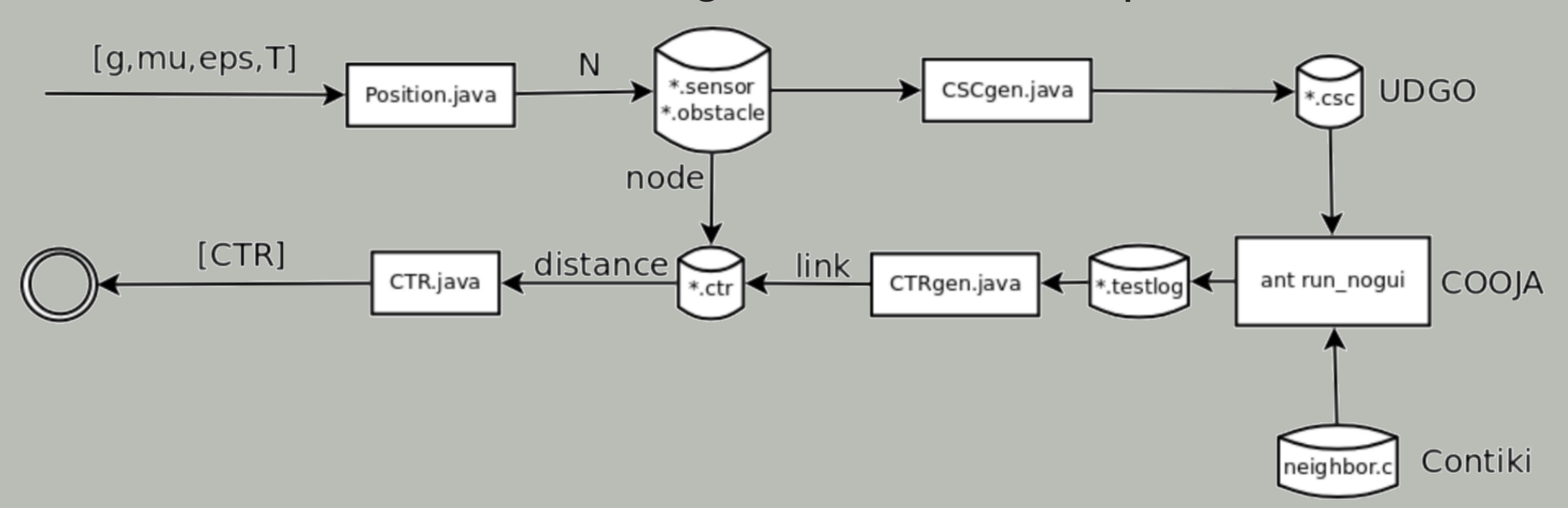
Analytical CTR will be greater than experimental?
Physical aspects of MRM could increase the visibility?
And the connectivity? What to expect when considering interference?
How can we feedback the model using the physical UDGO insights?

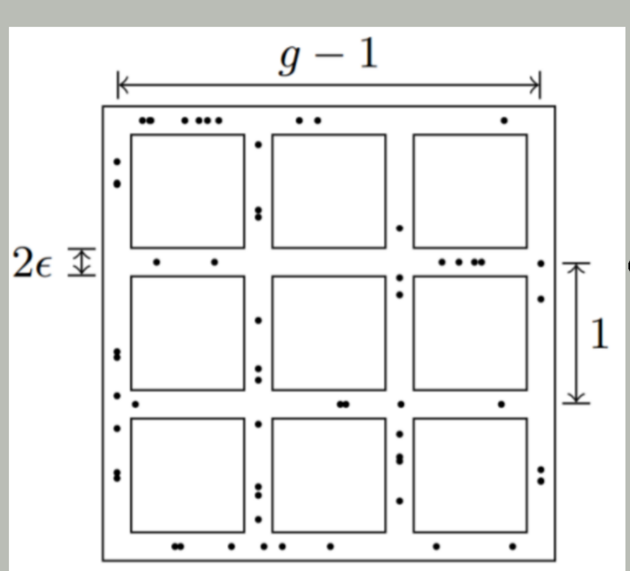
Answers we got

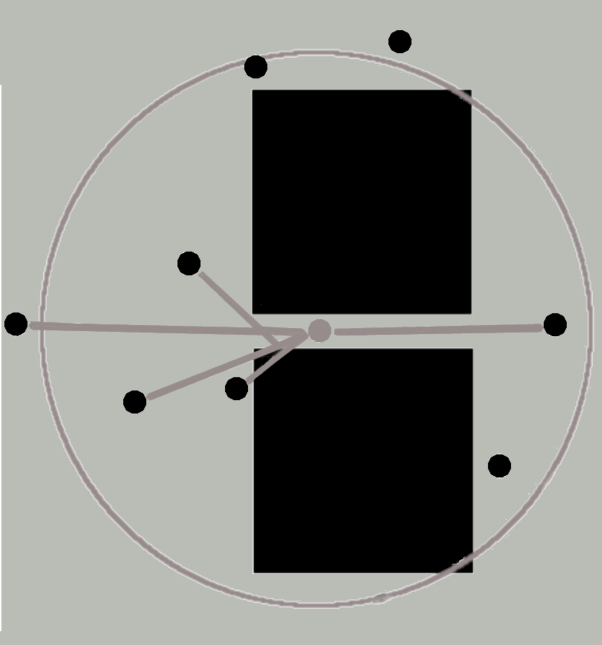
We discovered some insights with the introduced physical medium UDGO that could feedback the model. One thing that happens: the experimental CTR was higher than the analytical. Due the physical properties introduced with MRM that could make visibility increase.

POC1

On the first part of this work, we implemented an abstract medium at COOJA named UDGO gathering two pre-existing models UDGM and MRM. [Osterlind et al. 2006] UDGM inserts the Unit Disk Graph behaviour, being more simple. MRM leads with the physical aspect of the transmission, being much more complex.







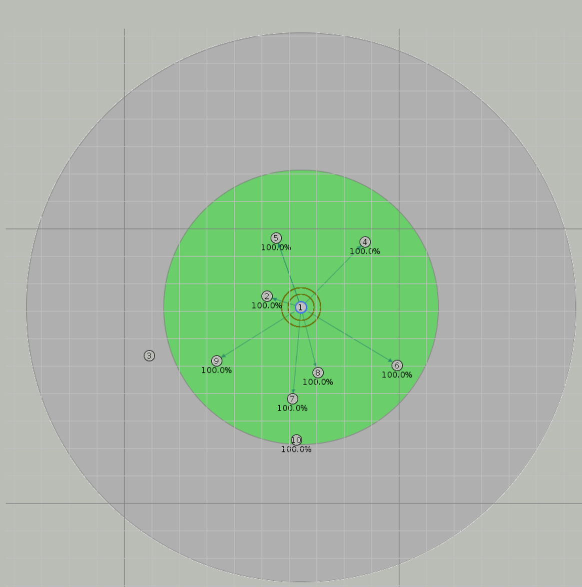
- Experimental: UDGO **https://github.com/mfer/udgo**
- Experimental: simulation in batch-mode
- Analytical: model and analytical CTR on obstructed networks

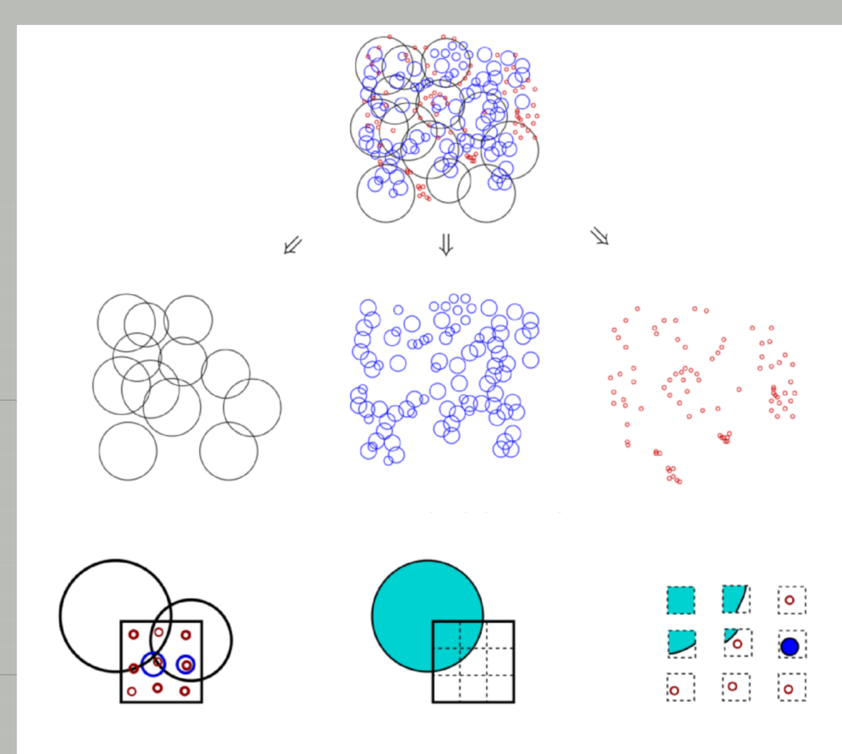
POC2

On the second part, we performed simulations to study the Critical Transmission Range for Connectivity CTR. Comparing the analytical provided by [Almiron et al. 2013] with the experimental that will be obtained by the authors using the extended COOJA.

`Number of Nodes: 2*g*(g-1)*mu`

8	224	448	672	896	1120	1344
6	120	240	360	480	600	720
4	48	96	144	192	240	288
2	8	16	24	32	40	48
g / mu	2	4	6	8	10	12





- Experimental: client-server approach to distribute the calculations
- Experimental: to simulate and to analyze
- Analytical: PTASGIG **https://github.com/mfer/ptasgig**

References

Almiron et al. 2013 Almiron, M. G., Goussevskaia, O., Loureiro, A. A., and Rolim, J. (2013). Connectivity in obstructed wireless networks: From geometry to percolation. In Proceedings of the ACM, MobiHoc, pages 157-166, New York, NY
Clark et al. 1990 Clark, B. N., Colbourn, C. J., and Johnson, D. S. (1990). Unit disk graphs. Discrete Mathematics, 86(1 - 3):165 - 177
Dunkels et al. 2004 Dunkels, A., Gronvall, B., and Voigt, T. (2004). Contiki - a lightweight and flexible operating system for tiny networked sensors. In Local Computer Networks, 2004. 29th Annual IEEE International Conference on, pages 455-462.
Erlebach et al. 2005 Erlebach, T., Jansen, K., and Seidel, E. (2005). Polynomial-time approximation schemes for geometric intersection graphs. SIAM J. Comput., 34(6):1302-1323.
Osterlind et al. 2006 Osterlind, F., Dunkels, A., Eriksson, J., Finne, N., and Voigt, T. (2006). Cross-level sensor network simulation with cooja. In Local Computer Networks, Proceedings 2006 31st IEEE Conference on, pages 641-648.

{mfer,olga}@dcc.ufmg.br