

# Final report: Particle swarm network simulation

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<b>Course</b>	Modeling Abstractions for Embedded/Networked Systems (CSE5309)
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## Basic functionality

The goal is to simulate a discrete-time network wireless physical-level mesh network. The network has  $N$  particles in a swarm communicating over  $k$  channels.

This simulation is implemented using Python3, numpy, and PyGame<sup>1</sup>, the latter of which is used for rendering the simulation.

## Appendix A: Particle movement patterns

The  $N$  particles are spawned at random at radius  $\mathcal{N}(\mu = 100, \sigma = 10)$  and angle  $\mathcal{U}(2\pi)$  from center. The particles do not collide with one another and obey basic Newtonian physics.

The particles move according to a system of differential equations:

$$\frac{d\theta}{dt} = \frac{\pi}{r * 2}$$
$$\frac{dr}{dt} = \frac{(100 - x)^3}{100000}$$

## Appendix B: Table of notation

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$(r, \theta)$	Polar coordinates in (meters, radians)
$(x, y)$	Cartesian coordinates, in meters
$n \in N$	Node index
$k \in K$	Channel index

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<sup>1</sup><https://www.pygame.org/>

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$t$	Time in seconds
$\Delta t$	Simulation timestep

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The goal of this system is to simulate the physical layer of a wireless mesh network in order to measure its raw throughput. The network is composed of  $N$  nodes, operating as a swarm

This system simulates the motion of  $N$  massless particles, communicating over a wireless system with  $K$  channels