Using Teams of Quadcopters to Aid in Search and Rescue Missions

Ryan Whitell and Dr. Ronald Lessard

Department of Electrical and Computer Engineering, Norwich University, Northfield, VT

Introduction

Currently, most SAR missions are done either by foot or by helicopter. These methods are slow, dangerous and one dimensional. Quadcopters could conduct quicker and more efficient SAR missions. The deployment of drones is starting to become more common in aiding SAR teams by taking overhead snapshots of disaster areas. These snapshots are helpful but don't come close to the potential quadcopters have for aiding in SAR missions. This research aims to improve the functionality of drone systems in one key area: formation-flying. A flying formation of quadcopter drones can sweep a larger area than one alone and could pinpoint any signals coming off of devices, such as a cellphones, and converge upon the target.
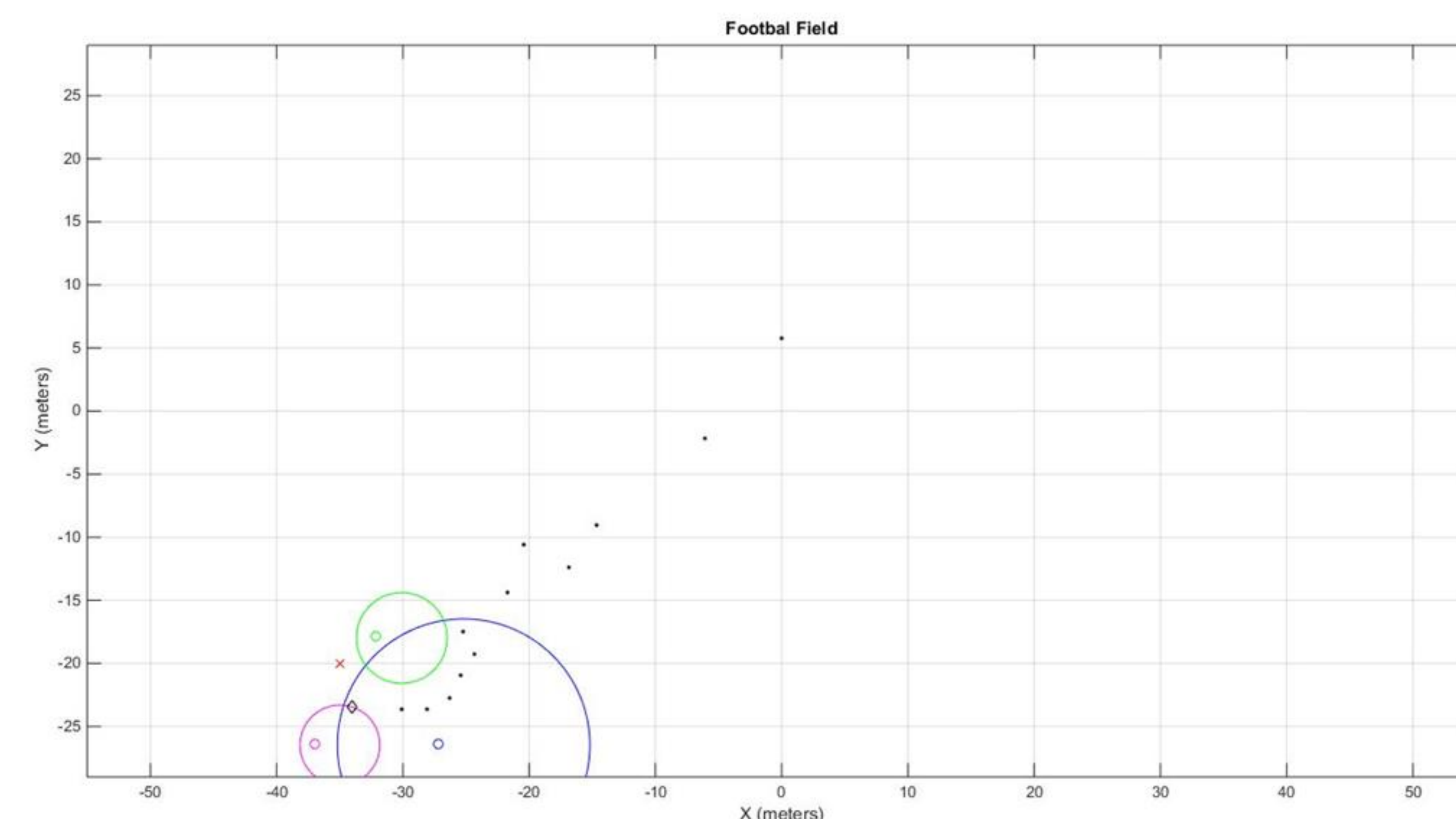
Methods

1. Determine the relationship between RSSI and distance.
2. Build and test a algorithm for target locating.
3. Simulate in MATLAB.
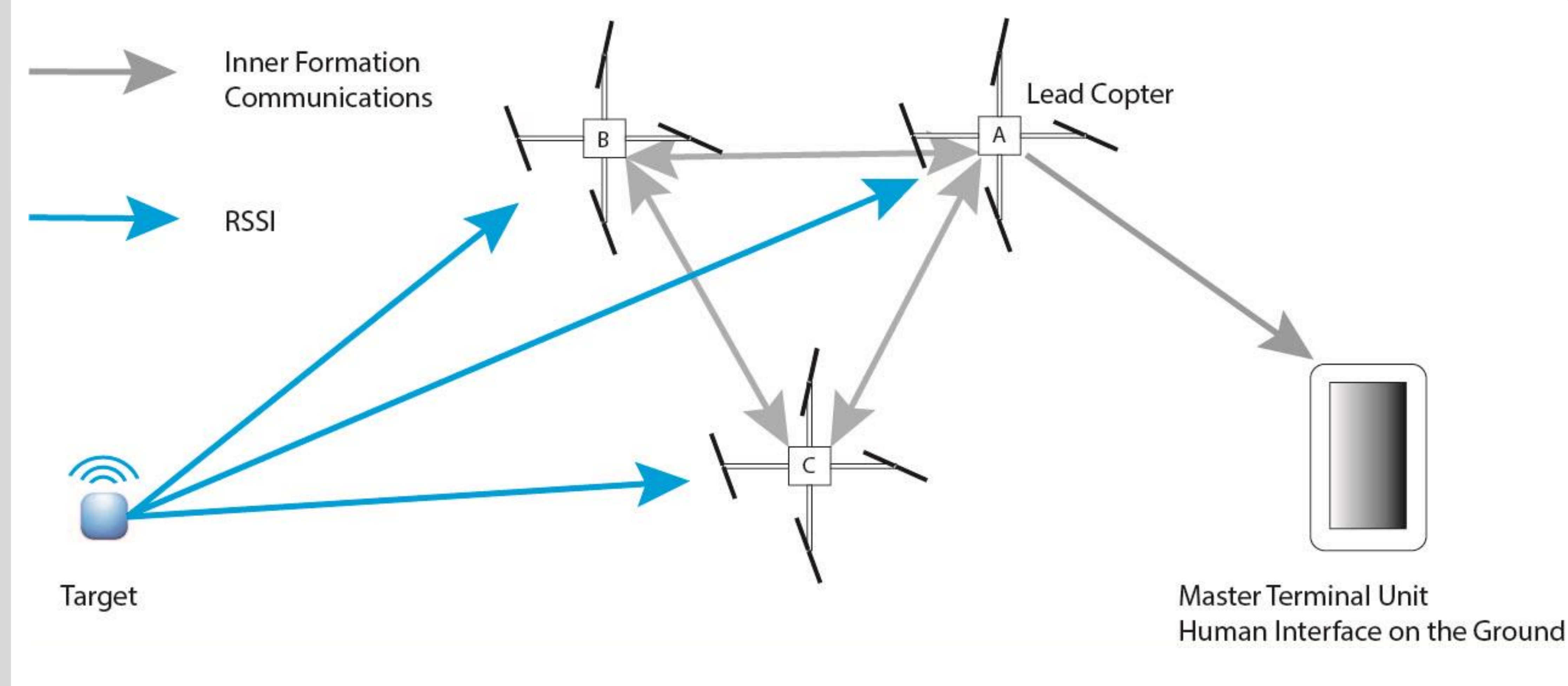4. Run a full scale test on the football field.

Full Scale Test

1. Formation at mid-field.   2. Target at 10 yards.   3. Final result.

MATLAB Simulation

The MATLAB simulation outputs the following figure. The circles around each drone are for visualizing the algorithm. The black diamond is the predicted location of the target. The red X is the target. A black dot at the center of the formation is plotted every step for visualizing the formation path.

Communication Structure

Inner Formation Communications

RSSI

Lead Copter

Target

Master Terminal Unit
Human Interface on the Ground

Conclusions

The full scale test a success. On first try, the formation tended towards the target very efficiently.

The full scale test was conducted in two dimensions, the formation and the target being on the same level. Real drones would fly much higher than the target and enter three dimensional space..

A real search and rescue system would encounter many problems not considered in this research. By using XBees, the radio signals were isolated in frequency and protocol. Picking up a lost hikers cell phone or wifi signal would require different hardware or protocols.

This research proved the concept that a team of drones can locate and converge upon a target. This project can be repeated through learning radio communication, algorithm development, feedback, and embedded systems.

Algorithm Flowchart
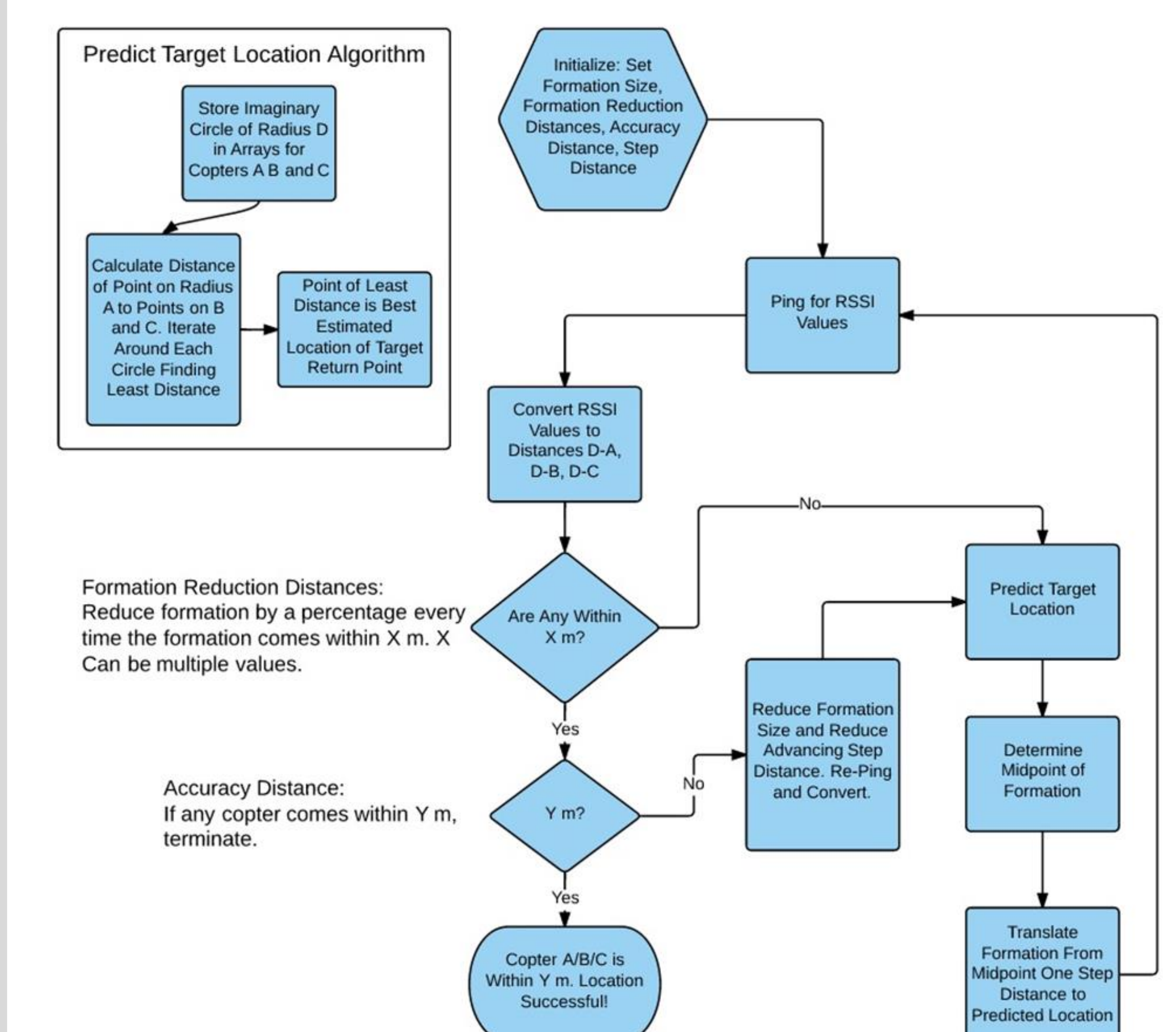
References and Acknowledgements

[1] B. Lee and W. Chung, 'Multitarget Three-Dimensional Indoor Navigation on a PDA in a Wireless Sensor Network', *IEEE Sensors Journal*, vol. 11, no. 3, pp. 799-807, 2011.
[2] P. Malmsten, "python-xbee Documentation", Release 2.1.0, 2013.