A Coverage Curve from the Drone Model

by Dave Perkins

The Centre for Search Research
Ashington, Northumberland

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Synopsis

This brief paper is a follow-up to the preliminary report on the drone model.[1] It is presented as a separate document because there is more work to do on the model itself and some of its outcomes might change as a result. Nevertheless, this paper can be read as proposing the current best estimate for a drone coverage curve.

Background

In the preliminary report [2] there is a description of the effects on some of the model outcomes of varying the four variables whose values are set by the user. These variables are the obstacle density, obstacle height, drone height and the angular field of view of the drone camera lens. The outcomes investigated were the target detections made by the drone, expressed as the number of targets detected as a percentage of the targets available for detection, the Effective Sweep Width and the Probability of Detection. This last value (the PoD) was found by calculating the coverage and then referring to an existing coverage curve. As explained in the report, the coverage curve used was the Inverse Cube curve.

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[1] Perkins, D., (2021), *A Preliminary Report on a Computer Model to Simulate Searching for a Missing Person using a Drone, with some early results*, The Centre for Search Research, available from: drone-paper.pdf (tcsr.org.uk)

[2] Ibid, page 6

At the time, the Inverse Cube curve seemed a good choice. It was devised to give PoDs for aircraft searching for ships, and at first sight it seemed that the idea of an airborne drone searching for a missing person on the ground described a similar situation. Further reflection, however, suggested that this was not the case. The Inverse Cube model depends on a human observer positioned in the aircraft. With a drone, the human observer appears much later in the chain of events and is not positioned at the same place as the drone. The detecting done by the drone is an electronic process with no human involvement and therefore without any of the associated deficiencies. The Inverse Cube model depends on a moving ship leaving a detectable wake as it moves across the sea. At a rough estimate, perhaps only a quarter of missing persons are moving when located, and in general it is the person who is seen by searchers rather than any clues that they might have left. In addition, any clues left by a moving person are likely to be several orders of magnitude removed from the wake of a moving warship.

This would seem to suggest that the Inverse Cube curve is not suitable for giving PoDs for this application.

Constructing a coverage curve from the model

By selecting a suitable set of values for the four user-controlled variables, a range of values of coverage and the percentage of targets detected was produced. The model provided sufficient detection opportunities for the percentage of targets detected to be taken to be the Probability of Detection. When these were plotted the graph shown in fig. 1 was produced. This is the proposed coverage curve for searching by means of a drone.

It is important to appreciate that this does not pretend to give the overall PoD but relates to only the first stage of the process, namely the performance of the drone camera. The information from this first stage then has to be transmitted to the drone operator, displayed on a screen and viewed by an observer or group of observers. The comment in the drone model paper on the Three Step approach explains this in slightly more detail.

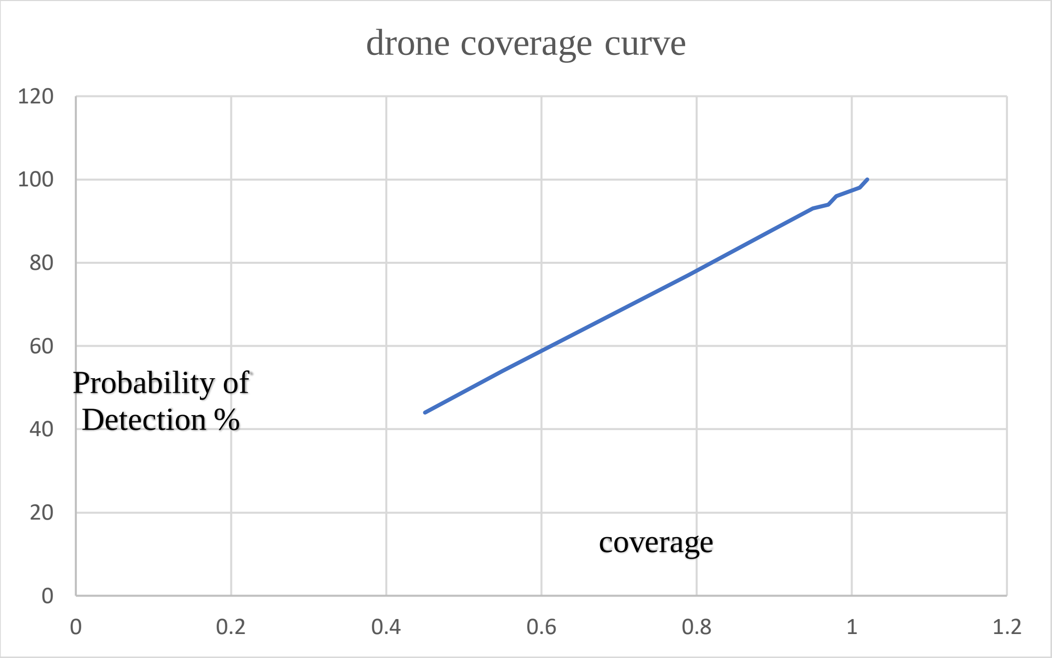

Fig.1. Drone coverage curve from the model

Comments

Fig. 2 shows how this curve compares with other coverage curves. For similar coverage values it gives values of PoD that are higher than those given for an Inverse Cube sensor. Bear in mind that the Inverse Cube curve was the one that was originally chosen [3] to provide PoD values for the drone in that it appeared to apply to a similar situation. The two curves are quite different, which underlines the earlier suggestion that the Inverse Cube curve was not a suitable choice.

Consider the Definite Range curve, which is also shown in fig. 2. The proposed drone curve is almost identical to this. How can this be? A Definite Range sensor will always detect a target within its operating range and will never detect one outside it. It describes an automatic process with no human involvement. That also seems to be a good description of target detection by the drone model.

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[3] Ibid, page 7

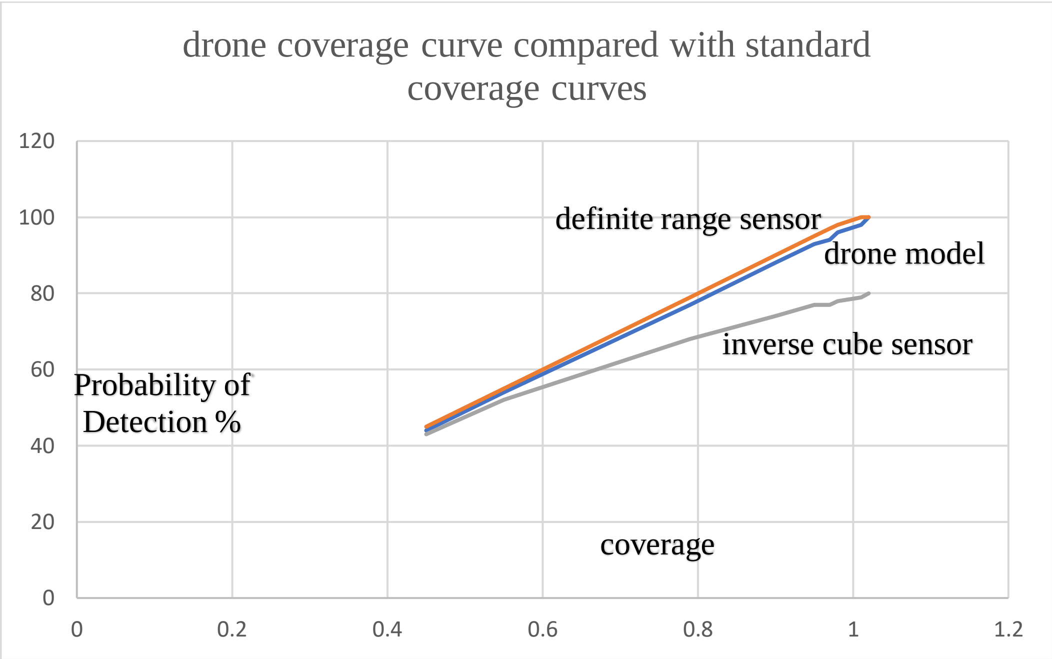

Fig.2. Drone coverage curve from the model with the curves for a definite range sensor and an inverse cube sensor for comparison

Conclusions

1. It can be argued that the Inverse Cube curve, while initially appearing to be suitable for drone detection, fails to satisfy for a number of reasons.
2. The graph of coverage and PoD coming out of the model is similar to the Definite Range curve. In addition, the initial process of searching by drone is similar to the assumptions on which the Definite Range curve is based.
3. It is recommended that, until proved otherwise, the curve produced by the model is used for the initial step in the process of searching by drone.