Ghosts in radar surveillance

When hearing the word "radar", many people would probably immediately think of a detection system used mostly on airplanes or vessels. Maybe they could even guess that it is an acronym for "radio detection and ranging", and know that it needs an antenna sending out radio waves. Objects are only detected once they reflect these waves, but indoors these waves also scatter from walls and thus cause the user to think there are objects behind the wall - ghosts.

Because these ghosts appear due to the radio signal taking more than one route, this effect is termed *multipath*. A simple scenario is depicted in figure 1, where the ghost appears below the ground. If one knew where the radar was placed, it would be easy to simply ignore all the signals coming from below the ground. However, because radar surveillance systems are supposed to be installed quickly in all kinds of locations, such information is not easily available. This thesis therefore uses an approach to determine the surroundings by exploiting ghosts signals.

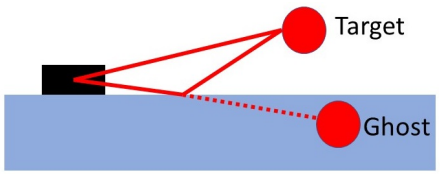

Figure 1: A radar (black box) detects both a target and its reflection in the ground (ghost target).

To do so, the strongest received signal is always assumed to be the main signal, and the second strongest signal the ghost signal. This holds as long as there is only one person walking in front of the radar. Radar systems determine the range, velocity, and angle of all objects in their view (including ghost objects), but it is actually enough to know the range and angle of the main and ghost targets to determine the position of a wall next to which the radar sensor was placed. All that is needed are three trigonometric functions: sine, cosine, and tangent.

Of course the algorithm sometimes gets it wrong if a signal is taken to be the ghost object when it really is not. But by measuring for a long enough time, these occasional mishaps can be weeded out. Interestingly enough, the wall is never determined accurately: its distance is consistently overestimated and it appears to recede diagonally. However, this does not really matter: if we had provided the system with the floor plan, it would probably have misclassified some real signals as ghost signals.

If this result is to be used for a commercial radar surveillance camera, it would still need a trained technician for installation. They would have to walk, without anyone else interfering, a few times in front of a freshly installed radar. This data would then be used by the radar to determine the room geometry and all following signals could be classified as real or ghost.

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