Drone Detection using Audio Analysis

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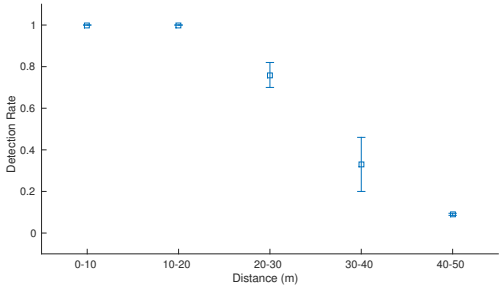
Drones are becoming cheaper and easier to use, and as more people have access to them new areas of use are invented. There have lately been reports of drones being used in illegal activities, for example to take aerial footage of secure facilities. To be able to detect approaching drones in time to take action we have implemented a drone detector.

Drones give of a distinct sound, and it should therefore be possible to use audio analysis as the detection mechanism to identify them. Linear predictive coding (LPC), a speech recognition method that is based on spikes in the frequency spectrum, which drones have as well, was chosen as the base for the detection. The purpose of LPC is that the sound at a point in time can be approximated from past samples. The coefficients calculated for this approximation are the LPC coefficients. It should be possible to build a database of coefficients from different throttle speeds to compare against, to take into account that a drone rarely has constant speed and that detection should be possible at all times. When the detector is optimized to find drones far away from the detector other sounds similar to the drones could also get detected. The slope of the frequency spectrum was researched as a complement for the detection to evaluate if it could decrease the number of false positives of the detector. To be an improvement the slope of the sounds LPC mistakenly considered to be a drone had to differ from the slope allowed.

A solution using LPC together with the slope gave good results, some of the other sounds previous found by LPC could be rejected with the slope addition. The results in the figure below show that the detector give satisfactory results for drones up to 30 meters when optimized for detection within 20 meters.



Detection rate when the detector is optimized for 20 meters.

It was concluded that drone detection using audio analysis is possible. Sounds originating from hardware similar to drones are difficult to distinguish from the drones and can give false positives, but further improvements could be made. An improvement could for example be to add source localization to the detector to be able to reject sounds below a certain angle. The implemented detector, with LPC and slope of the frequency spectrum, is hoped to become useful in the future.