Drone camera centering of moving target with delay

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by Ludvig Langebro and Baldomero Puche Moreno

This project successfully investigates how to control a drone in order to keep a moving target centered in a recorded video, even when there is a large time delay in receiving the video.

Drones are becoming more and more popular and their applications are endless from being used by firefighters to save people from burning houses to recreational use by catching stunning films of mountain biking. This work focuses on the latter, and how to keep a moving person centered in a video even when that video is hugely delayed from real time. The way this is achieved is by using an image recognition program that can detect people (even when they are on a bike or a pair of skis) and know their difference from rocks or trees. By using a model of how the drone and the targeted person move it is possible to predict what the video will show rather than having to wait for a delayed video, which is often older than a full second! After this is achieved a prediction algorithm is introduced that is able to estimate where the person will be heading in the nearest future by using old images recorded by the camera. The result of all these methods is the ability to autonomously get a drone to adjust its angle swiftly yet accurately and look at where the person actually is, based on old images, without the user having to touch anything. With these implementations the drone will simply work on its own. What this means is that even though the control software for the drone is, for instance, seeing a skier 5 meters behind the skier's real position, it can predict where the skier actually is and look there instead.

When performing this project it was important to identify a model of how the camera moves to know how to control it in an efficient way. This is also important for the prediction program since the image does not show the position of the camera nor the person it is following, but only their relative position. So for example, say we know the camera is currently at 30° (relative to the drone) and the person in the image is 10° above the centerline of the camera, then we know the person is at 40°. It is therefore of utmost importance to know the physics of how the camera moves in order to both have it move quickly and to predict the position of the person being followed. It is also important to measure how old the delayed video images are in order for the prediction algorithm to work well. Being wrong by just a tenth of a second can severely diminish performance. To put that into perspective, that is faster than a literal blink of the eye. But as long as the engineers do their job properly it is fully possible to do all this, and the users will be able to show all their friends how incredible they look on e.g., their longboards along the beaches of Santa Barbara or in the ski slopes of Kläppen.

*Available for download at http://www.control.lth.se/publications