Video: Landing a Drone with Pointing Gestures

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ABSTRACT

We demonstrate an intuitive gesture-based interface for manually guiding a drone to land on a precise spot. Using unobtrusive wearable sensors, an operator can quickly and accurately maneuver and land the drone after very little training; a preliminary user study on 5 subjects shows that the system compares favorably with a traditional joystick interface.

KEYWORDS

Pointing gestures; position control; live feedback

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DESCRIPTION

State-of-the-art quadrotors can perform many mission types (mapping, search, delivery) with full autonomy: however, landing in natural, populated, or uncontrolled environments is a delicate phase that still requires human supervision. For example, the operator must make sure that the drone lands sufficiently far from humans or animals, and on a surface that is flat, dry, and free of mud, leaves or long grass that may damage the propellers. In our scenario, the quadrotor returns from its autonomous mission and hovers in the vicinity of the operator, who takes control and guides the robot to land on a safe nearby spot: we implement this interaction using a novel hands-free pointing-based interface based on two Inertial Measurement Units (IMU) worn on the upper arm and forearm. We use the data from a single IMU to estimate pointed locations, however both IMUs are needed to detect the pointing event.

First, the operator moves to stand behind the drone and points at it; a 1-D Convolutional Neural Network [1] detects the pointing event, and the system localizes the operator with respect to the drone by using a predefined human shoulder hight and a pitch angle of the arm. The drone performs a "jump" move to signal the *selected* state: from now on, it will quickly maneuver so to follow the point indicated by the user on the ground, hovering above it. This provides to the user a live position feedback that mitigates errors in pointing target reconstruction and yields excellent position control accuracy (landing error < 0.10 m). When the indicated point does not move for a short while, the wearable device vibrates for three times at 1-second intervals: this acts as a countdown, after which the drone lands, unless the user moves his arm, resetting the timer.

Figure 1: User landing a drone on the box with the pointing gesture.

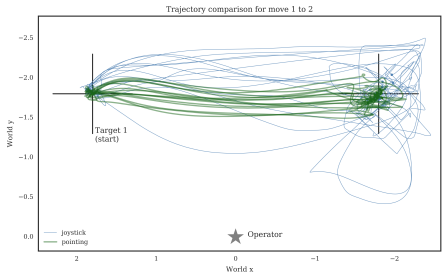

Figure 2: Comparison of resulting drone trajectories for joypad controller (green), and pointing interface (blue).

A preliminary user study on 5 subjects shows that the pointing interface yields shorter, faster and smoother trajectories than a standard joystick interface[1], even though few users reported to have prior experience with a joystick control of RC-cars and alike.

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REFERENCES

[1] Denis Broggini, Boris Gromov, Luca M. Gambardella, and Alessandro Giusti. 2018. Learning to detect pointing gestures from wearable IMUs. In *Proceedings of Thirty-Second AAAI Conference on Artificial Intelligence, February 2-7, 2018, New Orleans, Louisiana, USA.* AAAI Press.

[1] Datasets and the code are available at: http://people.idsia.ch/~gromov/hri-landing.

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