Paper For Discussion: Motion Estimation and Hand Gesture Recognition-Based Human–UAV Interaction Approach in Real Time

Minjeong Yoo et al.

Presented by: Sofia Nelson (snelso24@nd.edu)

The primary objective of this paper is to design an efficient way to control unmanned aerial vehicles (UAVs). Traditional joysticks are useful but sometimes problematic, as it requires both hands occupied with the controller, and can be susceptible to human error, especially for inexperienced users. Thus, the authors investigate a hands-free approach that uses computer vision techniques to recognize hand signals corresponding to drone motion. More specifically, the paper aims to "propose a hybrid hand gesture system that combines an inertial measurement unit (IMU)-based motion capture system and a vision-based gesture system to increase real-time performance". [1]

A major challenge in gesture-based drone control is the translation from three-dimensional to two-dimensional spaces. Additional factors such as occlusion and lighting issues can contribute to the difficulty of implementing a solely motion-based drone control system. Thus, the authors propose a two-part hybrid control system. The first part consists of equipping the thumb with an inertial measurement unit (IMU) attachment that measures the rotation and tilt of the hand. These measurements are then mapped to the drone's directional controls, such as roll, pitch, and yaw, corresponding to standard joystick movements (left, right, forward, and backward). For increased robustness, the authors implemented a computer vision pipeline as well to detect static hand gestures for more general commands. These include *stop, take off/landing, arm/disarm,* and *return to home*.

The authors claim that this hybrid approach is much more effective than the individual implementation of IMU or vision-based gesture recognition. As their evidence, they tested their hybrid approach against vision-only gesture systems, as well as a traditional joystick controller. In their experimental steps, they tested metrics such as response time and accuracy. For statistical analysis, the authors examine the mean task completion time, and create confusion matrices to clearly present classification results. The findings indicate that the proposed hybrid system achieves quicker and smoother results than the other approaches, demonstrating its suitability for real-time human-drone interactions.

References

[1] Yoo M, Na Y, Song H, Kim G, Yun J, Kim S, Moon C, Jo K. Motion Estimation and Hand Gesture Recognition-Based Human-UAV Interaction Approach in Real Time. Sensors (Basel). 2022 Mar 25;22(7):2513. doi: 10.3390/s22072513. PMID: 35408128; PMCID: PMC9002368.