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Thrust Vectoring for Precise Object Grasping by a Hybrid Unmanned Aerial Ground Vehicle (UAGV)

Background

Multicopters are being increasingly deployed for various tasks such as pick and place, and contaminant collection. To enable aerial grasping and manipulation, multicopters are equipped with rigid or soft graspers. However, aerial grasping and manipulation is a challenging task as it requires extremely precise real-time position control which is almost impossible due to ground effect. Especially in outdoor environments, extremely precise motion sensors are not available. Global positioning system (GPS) sensors, although inexpensive and provide localization in the world frame, are not accurate enough to perform critical tasks like aerial grasping and manipulation. Thus, a new approach is needed for multicopter systems to grasp items efficiently.

Invention Description

Researchers at Arizona State University have developed a hybrid unmanned aerial and ground vehicle (UAGV) equipped with passive wheels and acrylic plates which are used as deflectors for thrust vectoring. The acrylic plates are attached below every motor and serve to deflect the vertical thrust in order to produce horizontal thrust for translational motion on the ground.

The UAGV lands away from the object, travels towards it, and attempts grasping. A standard forward-facing global shutter monocular camera is integrated with a rigid grasper for object detection, tracking, and grasping. A nonlinear model predictive controller (NMPC) provides precise position control of ground motion. Multiple experiments with a range of initial conditions demonstrate the performance of the proposed UAGV and NMPC. The system is able to reliably reach and grasp the object when aligned with the object at distances between 1 m and 1.5 m.

Potential Applications

- Multicopters and hybrid unmanned aerial and ground vehicles (UAGVs)
- Near-surface grasping tasks
- Delivery and transportation
- Contaminant collection

Benefits and Advantages

- Provides higher grasping accuracy without requiring precise landing over the object
- Bypasses problematic ground effects common to aerial grasping tasks with multicopters
- Thrust vectoring method can be used for motion on various surfaces including water and ground

Related Publication: [Ground Trajectory Control of an Unmanned Aerial-Ground Vehicle using Thrust Vectoring for Precise Grasping](#)

[Research Homepage of Professor Wenlong Zhang](#)