THRUST ALLOCATION FOR AERIAL VEHICLE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/663,503, filed April 27, 2018, which is hereby incorporated by reference in its entirety. The present application is also related to a U.S. Application entitled, "Counter-Rotating Propellers for Aerial Vehicle," Attorney Docket Number XCOM-1-66313, filed on the same day as the present application.

TECHNICAL FIELD

[0002] This disclosure relates generally to aerial vehicles, and in particular but not exclusively, relates to control systems for vertical propulsion of aerial vehicles.

BACKGROUND INFORMATION

[0003] An unmanned vehicle, which may also be referred to as an autonomous vehicle, is a vehicle capable of travel without a physically-present human operator. An unmanned vehicle may operate in a remote-control mode, in an autonomous mode, or in a partially autonomous mode.

[0004] When an unmanned vehicle operates in a remote-control mode, a pilot or driver that is at a remote location can control the unmanned vehicle via commands that are sent to the unmanned vehicle via a wireless link. When the unmanned vehicle operates in autonomous mode, the unmanned vehicle typically moves based on pre-programmed navigation waypoints, dynamic automation systems, or a combination of these. Further, some unmanned vehicles can operate in both a remote-control mode and an autonomous mode, and in some instances may do so simultaneously. For instance, a remote pilot or driver may wish to leave navigation to an autonomous system while manually performing another task, such as operating a mechanical system for picking up objects, as an example.

[0005] Various types of unmanned vehicles exist for various different environments. For instance, unmanned vehicles exist for operation in the air, on the ground, underwater, and in space. Unmanned aerial vehicles (UAVs) or drones are becoming more popular in general. As their designs are refined and their capabilities expanded, their suitability for commercial use is expected to expand. Designs that improve the efficiency, stability, reliability, and/or endurance of UAVs will expand their

mission capabilities.

SUMMARY OF INVENTION

[0005a] According to a first aspect of the present invention, there is provided an aerial vehicle, comprising:

an airframe;

vertical propulsion units mounted to the airframe to provide vertical propulsion and physically organized into propulsion rings including at least an inner ring and an outer ring;

a flight controller including logic that when executed by flight controller causes the aerial vehicle to perform operations including:

determining whether an initial thrust command output vector results in a thrust command clipping of one of the vertical propulsion units;

transferring torque associated with the initial thrust command output vector from each the vertical propulsion units in the outer ring to the vertical propulsion units in the inner ring when the thrust command clipping of one of the vertical propulsion units in the outer ring occurs;

determining a revised thrust command output vector after transferring the torque; and

driving the vertical propulsion units according to the revised thrust command output vector.

[0005b] According to a second aspect of the present invention, there is provided a method of controlling vertical propulsion units of an aerial vehicle, the method comprising:

determining whether an initial thrust command output vector results in a thrust command clipping of one of the vertical propulsion units, wherein the vertical propulsion units are physically organized into propulsion rings including an inner ring and an outer ring;

transferring torque associated with the initial thrust command output vector from each the vertical propulsion units in the outer ring to the vertical propulsion units in the inner ring when the thrust command clipping of one of the vertical propulsion units in the outer ring occurs;

determining a revised thrust command output vector after transferring the torque; and

driving the vertical propulsion units according to the revised thrust command output vector.