Multi-Rotor Aerial Vehicle with Full-Orientation Manipulation Capabilities

Efficient aerial system capable of stable, orientation-independent flight and environmental interaction without complex mechanisms or excessive power demands.

Technology

This invention introduces an aerial vehicle with eight fixed propellers, powered by brushless DC motors, and designed through an optimization algorithm that ensures decoupled orientation and position control. The optimized design ensures propeller placement avoids aerodynamic interference, distributes lift forces efficiently, and enables hovering in any orientation. The electronics box integrates classical sensors for stabilization, real-time computation of propeller speeds, and closed-loop control. The current prototype is capable of indoor localization and mapping, and real-time autonomous path planning.

Background

Conventional multi-rotor aerial vehicles face significant limitations due to the coupling between their orientation and ability to change position. Existing designs don't allow for stable hovering in arbitrary orientations, and very few integrate manipulation capabilities. Current solutions that attempt this either require complex actuated propellers, or demand impractically high lift-to-weight ratios. There is a critical gap of efficient aerial systems that can operate freely, maintain orientation-independent control, and interact with the environment.

Stage of Development

Technology ID

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Category

Engineering & Physical Sciences/Instrumentation

Sensors & Controls

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Prototype design completed with validated optimization framework and indoor autonomous flights.

Applications

- Infrastructure inspection and maintenance in difficult-to-reach positions and orientations.
- Delivery systems requiring accurate placement.
- Defense, search, and rescue missions requiring orientation-independent flight and difficult-to-maneuver environments.

Advantages

- Stable hovering in any orientation with efficient force distribution.
- Can be both battery-powered or tethered for maximum flexibility.
- Optimization-based design prevents propeller airflow interference.
- Capable of applying arbitrary forces and moments solely via propeller-induced thrust.
- Simpler and more practical than actuated-propeller alternatives.

Intellectual Property

A US provisional application has been filed.