Design and Implementation of the Fish Gill Imitation Side-Window Regulator for Ducted Fan UAVs

Liu, Zihao (School: The High School Affiliated to Beijing Normal University)

Conventional unmanned aerial vehicles (UAVs) commonly suffer from under actuation, meaning they only have four control degrees of freedom (DOF) and lack two control channels in the horizontal direction. The traditional method to compensate for this issue is through control algorithms, but it does not resolve the problem of system coupling and cannot counteract adverse under actuation dynamics. This study aims to utilize the structural characteristics of a ducted fan UAV to design a simple structure that can provide two control channels in the horizontal direction, thereby solving the under actuation problem and enhancing stability and control accuracy. To address the issue, a side window regulator was installed on the sidewall of the ducted fan UAV by imitating the structure of fish gills. Wind tunnel and flight experiments validated that this design provides horizontal control force for the ducted fan UAV, supplements two horizontal control channels, and achieves a Fully actuated of six DOF. Additionally, the design of the side window generates a small and linear force, which produces a fine-tuned control and guarantees stable pitching and rolling of the UAV, thereby improving control accuracy. Installing the side window regulator renders novel and unique structuring and kinetic innovation, solving the under actuation problem and improving stability and control precision. This design improvement can enhance the ability of UAVs to navigate complex airspace with greater efficiency and effectiveness. Key words: Aircraft drive design, Fully actuated, Ducted fan UAV, Bionic Drive, Side window regulator

Awards Won:
Third Award of $1,000