Aerospace Engineering Master's Defense

Longitudinal Static Stability of a Tethered Rotorcraft

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abstract

This thesis discusses the equilibrium conditions and static stability of a rotorcraft kite with a single main tether flying in steady wind conditions. A dynamic model with five degrees of freedom is derived using the Lagrange approach, which explicitly avoids any constraint force in the equations of motion. The longitudinal static stability of the steady flight under constant wind conditions is analyzed analytically from the equilibrium conditions. The rotorcraft kite orientation and tether angle are correlated through the equation $\Gamma=\delta-\vartheta$, a necessary condition for equilibrium. A rotorcraft kite design with 3kg mass and 1.25m rotor radius is found to be longitudinally statically stable at 25,000ft with Γ^*>⟦65⟧^0 for wind speeds above 19m/s.

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