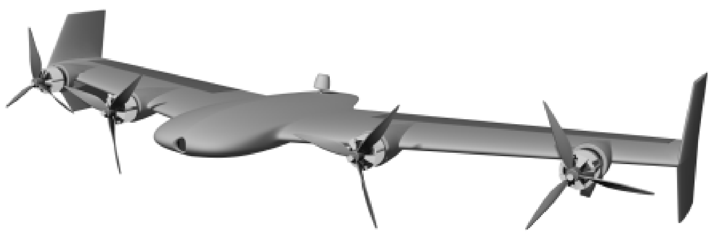
Drones are the future of flying with a wide range of applications. Most of the drones currently in use however, are quadcopters. These quadcopter struggle to reach high speeds due to their aerodynamic inefficiency. Through our DSE project, the Peregrine race drone, we aim to revolutionize high speed drones through a wing based racing drone design that utilizes its aerodynamics and propulsion capabilities to achieve ground breaking performance, with the aim to reach top speeds of 90 m/s and perform 25g turns at 60 m/s. We intend to verify these requirements and give racing pilots a real time experience of piloting and controlling Peregrine through a simulation which is based on a standardised drone racing track.

The mission statement for the Peregrine project is to design the fastest competitive racing drone on Earth at a unit price less than €2500. This was to be accomplished by a team of 10 aerospace engineering students from TU Delft within 10 weeks. Although the 10 week period has not concluded, the drone has experienced significant progress in its design, specifically in the 5 subsystems of Aerodynamics, Structures & Materials, Power & Propulsion, Control & Stability, and Performance & Simulation.



The Peregrine drone consists of a 69 cm swept wing, with a main pod to accommodate for storage of the electronics and battery at a suitable center of gravity. Double-sided winglets are present to allow for stable landing and takeoff in a tail-sitting configuration. To fulfill the mass budget, the structure of the drone is a composition of carbon-fiber reinforced polymer, which is used for load carrying surfaces and protection, and expanded polypropylene foam, which offers impact absorption and lightweight properties. The life cycle of all materials has been taken into account to ensure 80% recyclability by weight. Moreover, components of the drone are designed to be modular and replaceable.

The drone uses a total of 4 three-blade propellers which have been designed to optimise performance at high speeds. The 2 outboard propellers are vectored, enabling for a seamless transition from hover to cruise flight and assisting the elevons in pitch and roll control at low speeds. Large elevons spanning about 70% half-span and 40% chord have been integrated to fulfill the high maneuverability requirements. The drone is controlled similar to other racing drones, where attitude rates and throttle are the stick inputs. To achieve turns beyond 25g at higher speeds, the pilot must control roll followed by pitch. In addition, differential thrust of the propellers is used to stabilise yaw.

In order to verify the performance of the drone and implement the control system, a flight dynamics simulation has been created. The simulation intends to model the actual dynamics of the wing based drone on an actual race track with wind turbulence effects and noise disturbance. The simulation has been integrated with the control system in Simulink, which results in a simulation that is intuitively controllable for experienced drone pilots. The team aims to present a finished design along with the simulation at the DSE symposium.