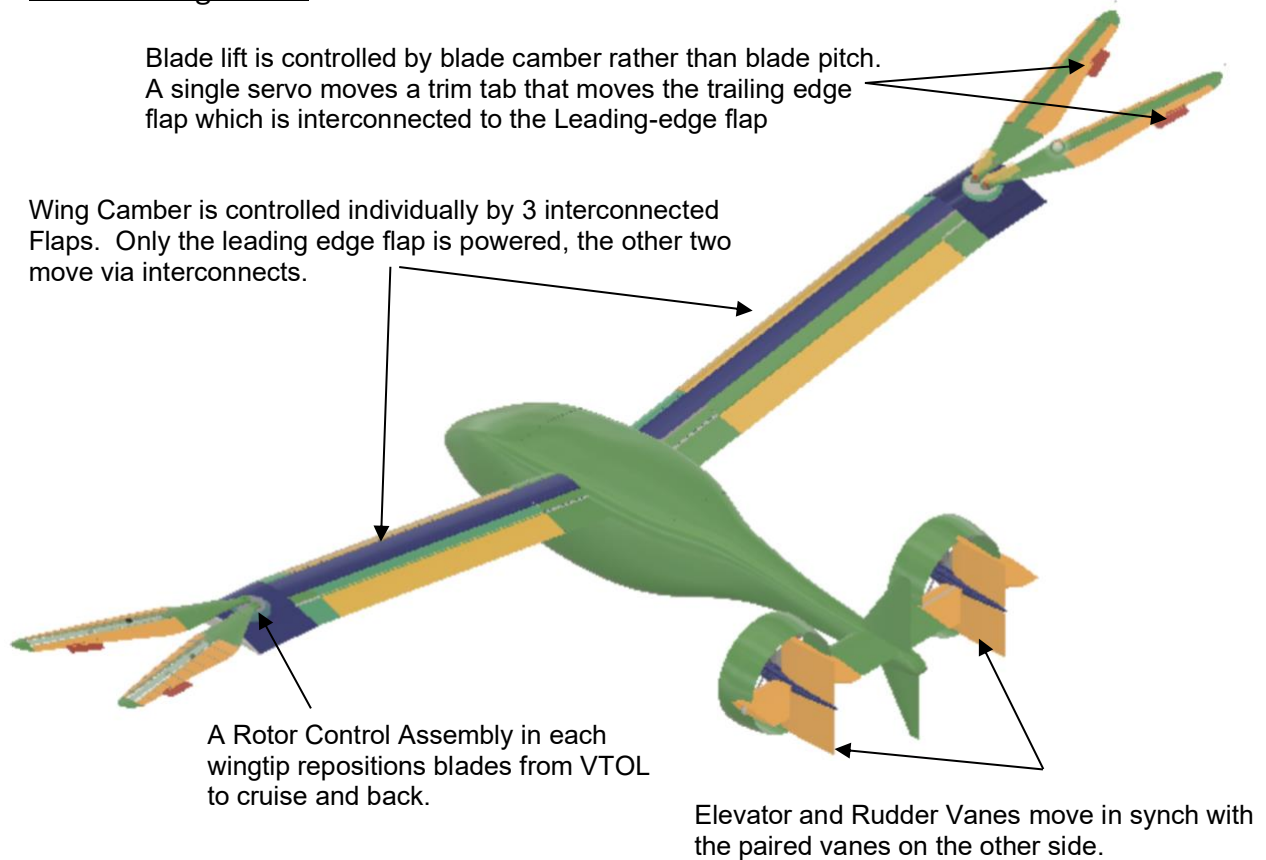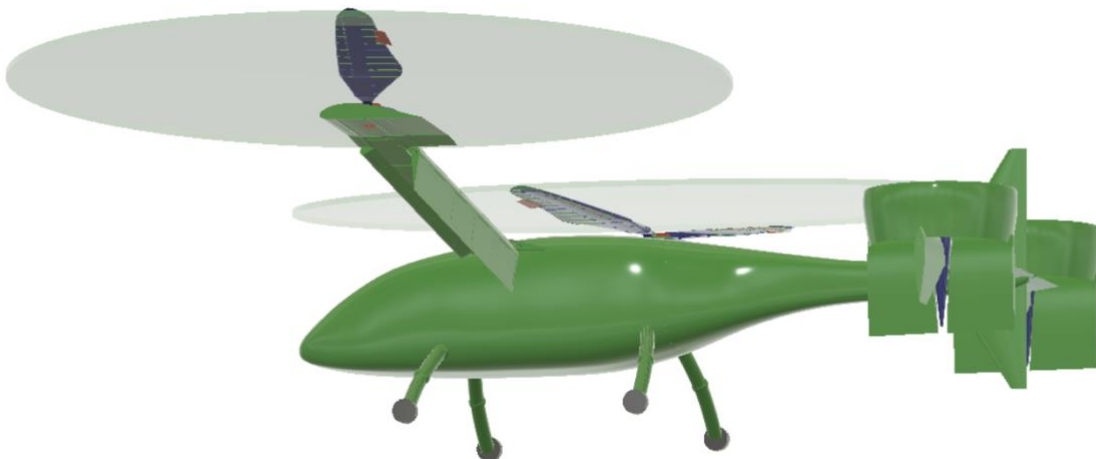# AV-1 Control Function Block Diagram

Question: Does the ArduPilot Program, running through a Pixhawk 6, have the capability and enough ports to control the control surfaces and motors as shown in the block diagram on the next page? And does the size of the Upper and Lower Rotor Blade motors matter? Does the ArduPilot program care if they are 3 kw or 8 kw motors?

Cruise configuration

Blade lift is controlled by blade camber rather than blade pitch. A single servo moves a trim tab that moves the trailing edge flap which is interconnected to the Leading-edge flap

Wing Camber is controlled individually by 3 interconnected Flaps. Only the leading edge flap is powered, the other two move via interconnects.

A Rotor Control Assembly in each wingtip repositions blades from VTOL to cruise and back.

Elevator and Rudder Vanes move in synch with the paired vanes on the other side.

VTOL takeoff configuration

Notes on the operation:
1. The upper and lower motors are stacked one above the other in the wingtip and operate synchronously during rotor-wing ops. Each wingtip motor is connected via vertical coaxial shafts to a rotor blade. In rotor-wing mode, the blades are 180º apart. To transition from rotor-wing ops to fixed-wing cruise, all four motors are simultaneously slowed to a stop in a position where the upper blades are extended out slightly (~15º) forward of the wingline; the coupler latches are signaled to decouple the motors (coupler latches are activated using a single signal sent to all four coupler actuators); the upper MOTOR LOCKS are activated to lock the upper motors and blades in place; the lower motors are started again to move their blades to a position slightly (~15º) aft of the wingline (cruise position); lower motors are stopped; couplers are spring-loaded to re-engage the coupler latches in pre-set cruise detents; the lower MOTOR LOCKS are engaged. The upper and lower motors remain off and locked in place during fixed-wing cruise, and the rotor blades are now wingtip ailerons in an extended V-Wing position. To transition from fixed-wing back to rotor-wing the same process is essentially done in reverse.
2. Flaperon motors are individually controlled.
3. Both Aft motors are oriented vertically during rotor-wing ops and provide ~20% vertical thrust. A separate signal is used for each tilt motor to provide opposite tilt to assist with yaw control in hover; in transition to fixed-wing, the aft motors tilt down to horizontal and provide 100% cruise thrust. Left and right Ducted Fan elevators and rudders operate in unison; one signal is used for DF Elevator servos on both sides; one signal for both DF Rudder servos on both sides.
4. A single signal can control both dorsal and ventral rudder servos which operate in synch.

Left Wing

motor lock	upper motor	ESC
		(2) coupler latch servos
motor lock	lower motor	ESC

(2) Rotor Blade Trim Tab Servos

(2) Flaperon Motors

Right Wing

ESC	upper motor	motor lock
(2) coupler latch servos		
ESC	lower motor	motor lock

(2) Rotor Blade Trim Tab Servos

(2) Flaperon Motors

Left Horiz Stabilizer

ESC — DF Motor — Ducted Fan Tilt Motor

DF Elevator Servo
DF Rudder Servo

Right Horiz Stabilizer

Ducted Fan Tilt Motor — DF Motor — ESC

DF Elevator Servo
DF Rudder Servo

Ventral Stabilizer Rudder Servo
Dorsal Stabilizer Rudder Servo