

Propulsion Systems for e-VTOL Aircraft

Jordan Eriksen, Sam Grimshaw, James Taylor, Megan McEverley and Dave Fillingham

Quadcopters for Air Travel



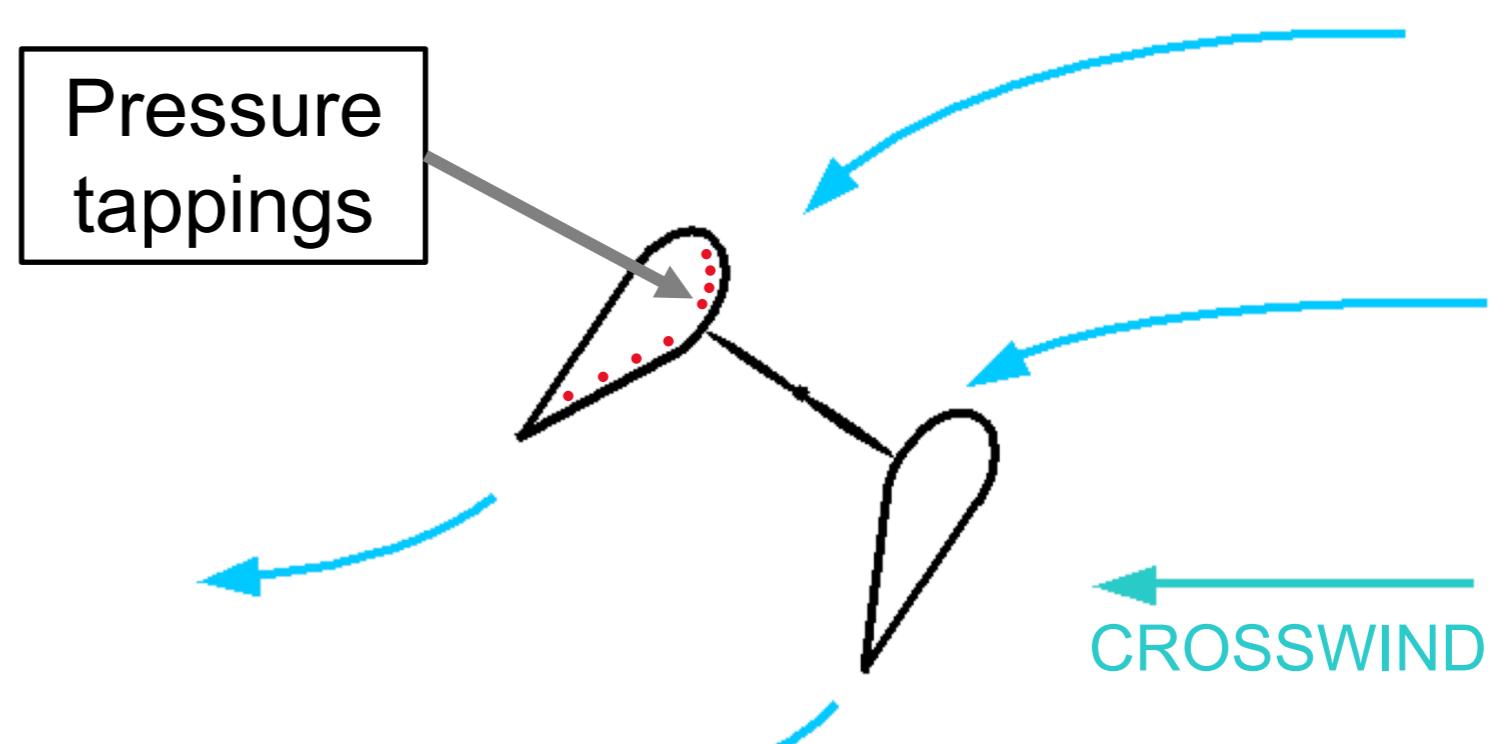
Quadcopter Global Market to treble in next 5 years reaching \$43.1bn by 2024 (droneii.com, March 2019)

Quadcopters are likely to be deployed first in the emerging e-VTOL personal transportation sector

Ducted fans have potential to be more efficient, safer and less noisy than equivalent open-rotor designs

Image: CityAirbus by Airbus

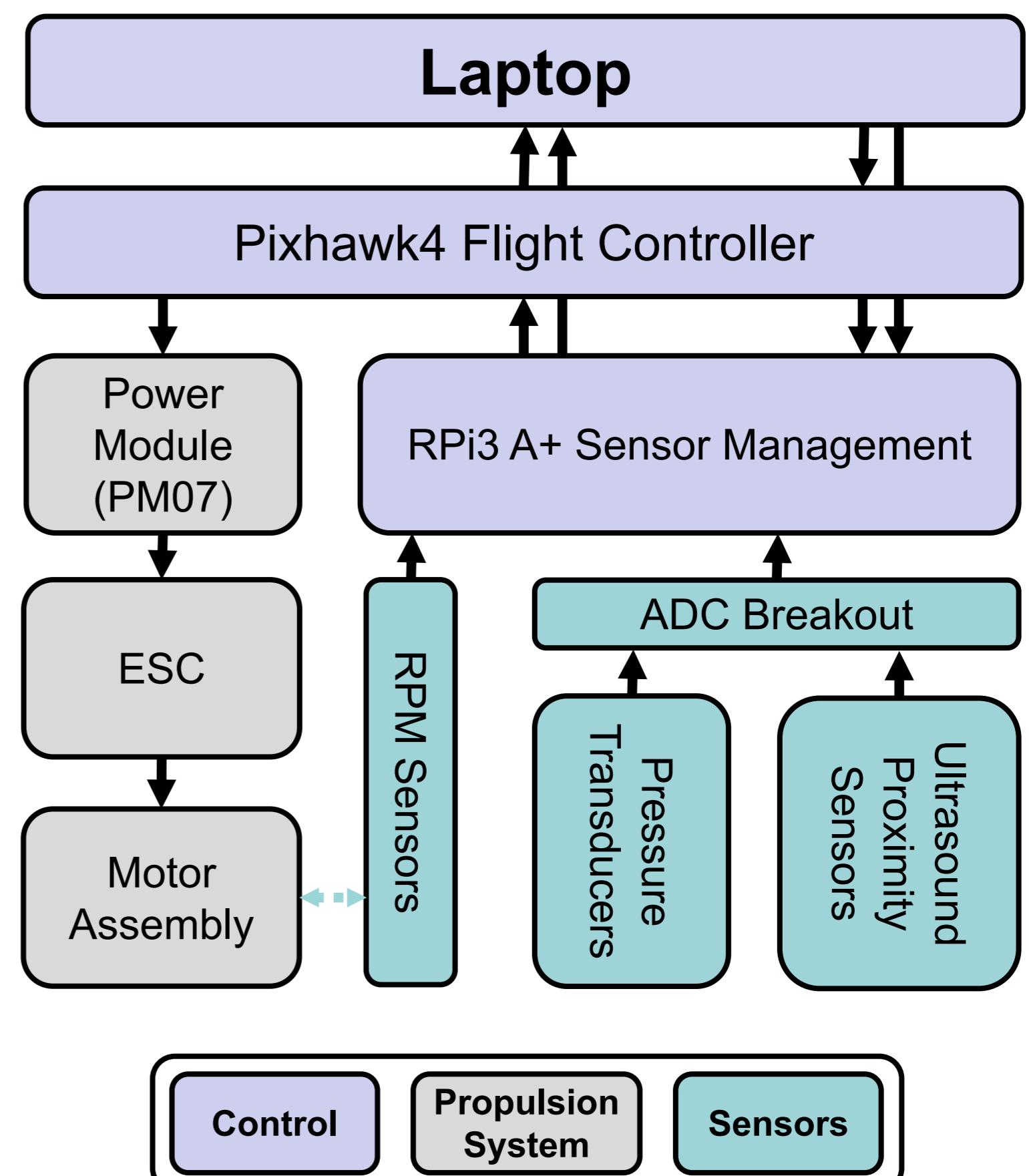
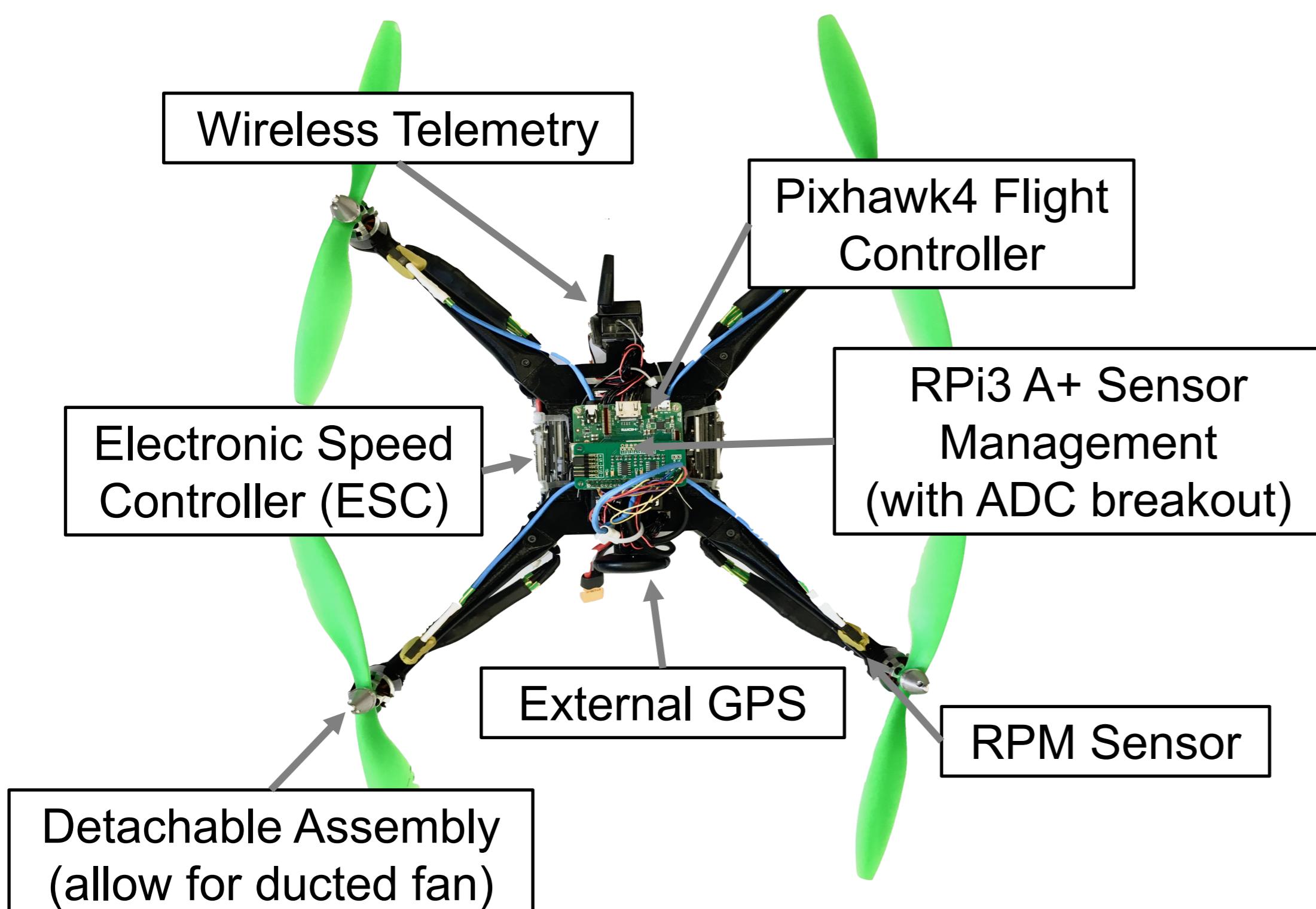
Effect of Intake Separation on Stability



Dynamic stability of ducted fan affected by presence of crosswinds and/or vehicle manoeuvres that can cause intake separation

Pressure tappings allow duct and fan performance to be measured in flight while manoeuvring

Measurements



Measurable quantities:

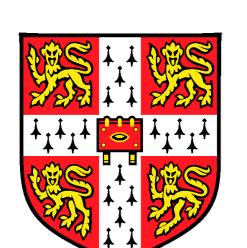
XYZ Acceleration
XYZ Velocity
3 DoF Rotation rate
Magnetometer (Compass)

Voltage and Current
Total Thrust (variable drone mass)
Motor RPM
Shaft Power (via RPM calibration)

Intake Pressure Coefficients
Pressure Rise across fan
Altitude (Ultrasound)
Horizontal Proximity (Ultrasound)

Figure of Merit can be determined for different propulsor designs using the onboard sensors.

$$M_f = \frac{T_T}{P} \sqrt{\frac{T_T}{2\rho A}}$$



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