Subject: suggested processing schemes, pitot-static sensor and gust pod
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Pitot-static sensor

This is a short note to suggest a processing algorithm for the pitot-static sensor. The relevant variables are QCTF and PSTF, the respective dynamic and static pressure measurements. The pitot-static tube is located in a region of significant airflow distortion, so the measured "static" pressure is far from the ambient pressure. However, the sum of the two measurements is the total pressure, and this measurement is consistent with QCF+PSF with only very low error. The processing scheme therefore can be very simple:

$$\mathrm{QCTC} = \mathrm{QCTF} + \mathrm{PSTF} - < \mathrm{PSFC} >$$

where the angle brackets denote some type of smoothing. The reason for smoothing is that PSFC contains a large noise spectrum at high frequency that will contaminate QCTC unless it is removed. This removal is not necessary for low-rate processing, so smoothing is not needed in that case. However, for high-rate processing some smoothing is needed or a noise spectrum will appear in QCTC and the airspeed deduced from it. The best smoothing is a low-pass filter with a cutoff frequency of about 0.5 Hz, as was used in the extensive report on wind measurements in SOCRATES. However, a simple running average works almost as well, so at 25 Hz a running average of PSFC spanning 50 points or 2 s should eliminate most of the noise. QCTC can then be used in place of QCFC for the calculation of airspeed and then wind. When the airspeed is calculated from the Mach Number, again the smoothed version of PSFC should be used to find the Mach Number. No "PCor" correction is needed because that has already been applied to PSFC.[1]

Gust Pod

The gust-pod processing scheme proposed in the accompanying report is complex and the gust pod has not proven to provide good high-frequency measurements, so my suggestion is to omit this processing unless a need arises. In that event, the second-pass processor built into QAtools can be used to add the gust-pod wind measurements, or a separate R script can be developed from it that provides these measurements. The algorithm in QAtools involves complex coordinate transformations between the gust-pod and aircraft reference frames and requires the use of numerous fit terms that use separately the low-pass and high-pass measurements from the gust pod, so it doesn't seem worth routine processing, especially because the results have not been better than other measurements.

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[1]The same procedure can provide minor improvement to the longitudinal spectrum for TASX: Instead of using QCFC fo calculate the wind, use QCFA=QCF+PSF−<PSFC>, preferably with a time shift of 35 ms applied to advance PSF. The improvement is not enough to be worth using this.