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# ***Interactive comment on “Calibrating airborne measurements of airspeed, pressure and temperature using a Doppler laser air-motion sensor” by W. A. Cooper et al.***

**Anonymous Referee #1**

Received and published: 16 April 2014

General Comments: This paper was an extremely interesting read. It was generally well structured, and showed good appreciation of the context of the work, and its potential applications. Most importantly, the measurement system developed and described as part of this work shows immense utility throughout the field of airborne research, and would be of great interest to numerous other airborne platforms around the world. In particular, this reviewer was impressed by the use of the technique described to independently test the validity of what is typically treated as a relatively straightforward SI-traceable measurement (temperature) using measurements of using different routes of traceability, in the highly complex environment experienced by an aircraft.

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## Specific Comments:

- 1) One difficulty with a paper discussing results an instrument that has itself been the subject of previous scientific publication, is how much explanation to give concerning the basic operating principle and the instrument itself. This reviewer might have wished to see a small section elucidating this, possibly with a picture, in order that readers don't have to immediately read prior literature to gain a very basic understanding of the technique/instrument.
- 2) Metrological terminology was at times used inconsistently. The International Vocabulary of Metrology JCGM200:2008 defines a quantity called 'standard measurement uncertainty, or more briefly 'standard uncertainty' which this reviewer assumes is equivalent to 'standard-error uncertainty' used in places throughout, starting at the end of the first bullet point in section 1. Consider changing. Error, accuracy and uncertainty are to some extent used interchangeably, the author's could revisit and possibly revise the use of these terms.
- 3) Section 2, p2590, line 28, should 'accuracy' be 'standard uncertainty'? Also change 'accuracy' later in paragraph? Is this directly comparable to the stated IRS 'uncertainty' on line 7?
- 4) Section 2, p2590, line 27, 'negligible error' - can this be quantified explicitly?
- 5) Section 2, p2591, line 3, 'algorythm that defines the peak' - are there details or a reference?
- 6) Temperature measurements: The final claim made in the abstract might be misleading, in that a measurement of temperature is required (eg eq 2) as part of the pressure-sensing system calibration, which is then in turn used in section 6 to derive temperature. Section 3.1 p2592 essentially states that the calibration of dynamic pressure is relatively insensitive to temperature errors, this may be true but it would be nice to understand how the relative contributions of each of the components in this

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uncertainty contribute, so this can be fully appreciated by the reader. P2594 Line 7 mentions the idea of iteratively measuring a correction by assuming a temperature and then verifying it by analysis, if the author were to include an example of this process it would confirm the 'tentative assumption' in line 7 on p 2594. Could, for example, the instrument be used to measure temperature where no other scientifically-maintained thermometry was employed on an aircraft, eg by use of a pre-existing avionics system, or atmospheric temperature predictions alone?

7) Section 3.3 p2595. This reviewer couldn't find reference to how the flow angle at the pitot tube was directly measured during the yaw manoeuvres in appendix B. Was this based on prior tests linking eg the IRS measurements with pitot flow angle?

8) Since alignment of the LAMS system was important, how was LAMS aligned with the aircraft IRS, or indeed its own IRS 'mounted on the same under-wing pylon' (section 3.3 p2595 line 13)? This reviewer can imagine that inflight differences between the LAMS IRS and the aircraft IRS could be examined, but the paper doesn't directly state this was the method used.

9) Section 3.5.1 p2599 line 9. Does the claim that the 0.3hPa variance equals the uncertainty depend on the model being derived from the fit of the measurements actually being correct? How does the fit vary if you repeat it with different data? Should this variability be captured in your uncertainty budget?

10) Section 3.6.1 p 2602. 'This result suggests that the error...'. Is 'error' the correct word here? The first 4 lines on the page feature 'standard error', 'error', 'uncertainty', 'standard-error uncertainty' This reviewer finds it difficult to read because of possible ambiguity in the terms, even though they might be being used correctly.

11) Section 3.6.2 What does the FAA define as 'error'? Is this equivalent to a standard uncertainty, so that 30-odd percent of the time it is expected that the measured altitude is more than 80 ft away from the specified altitude? Is it a gaussian distribution? How often is the RVSM system calibrated, and to what standard to ensure compliance?

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12) Section 3.6.3. A typo. The text refers to a d-value, the figure refers to a D-value.

13) Section 4. Are the static/dynamic pressures sampled frequently enough for this to be statistically significant? 15m difference at 150m/s true airspeed implies samples more frequently than 10hz. This reviewer didn't come across a statement of sample frequency (of the dynamic/static pressure) system in the paper, though one is given for LAMS.

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Interactive comment on *Atmos. Meas. Tech. Discuss.*, 7, 2585, 2014.

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