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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Technical Note: REFIR-PAD level 1 data analysis and performance characterization" *by* G. Bianchini and L. Palchetti

G. Bianchini and L. Palchetti

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Page 368 Line 20: Mention is made of of the EU funded REFIR project in which an FTS is described as capable of resolving the OLR (0.5 cm-1) with a signal-to-noise of greater than 100 in 7s. Later the operative scan time is said to be 30s, how are these times related and what temporal criteria is required for a typical variable scene.

Reply: The satellite integration time comes from the requirement of 50 km horizontal resolution along track, while for the balloon flight the requirement is relaxed mainly due to the much lower platform ground speed.

The wording refering to the dual input/output ports is a little confusing. The authors should make clear that one input port is set to a stabilised target while the other cycles through calibration and scene targets. How these target input ports relate to the output

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ports should also be made clear, as both are seeing a combination of the inputs.

Reply: The sentence will be made clearer.

Page 370 line 24: It is not clear how the non-linearity errors have been calculated. Presumably the linearity is detetermined by looking at the gradient of the detector output Vs input load. Each point on fig.2 will then be a deviation from a straight line fit? Each point will also then be relative to a base load or adjacent load? What precision/accuracy is required of the blackbody temperatures for this measurement. The power spectrum will have a non-zero off-set (as the authors themselves suggest in section 2.3) which is dependent on the noise level, is this accounted for in the integration of the spectra used in the non-linearity tests. Presumably the detectors are temperature stabilised? Is there a temperature dependence to the gain that has been evaluated.

Reply: Yes, the linearity is determined by looking at the gradient of the detector output vs. input load and each point on Fig. 2 is then a deviation from the straight line fit and it is relative to a base load. The non-linearity relative error is the difference from the linear response relative to the average response. Calculations were not performed using the power spectrum, this will be corrected.

DLATGS detectors tipically require a working condition with constant temperature. However we did not evaluate the gain dependence on temperature since they are stabilised around 20 C, where the response shows a constant behaviour over a wide interval of tens of degrees.

Page 373 line 10: What do the authors mean by constant resolution in the last paragraph. Is this due to a variability in the resampled interferogram number of points. If so what is the typical variation under laboratory and flight conditions. Could the authors use the laser fringe timings to get a broad understanding of the vibration environment (acoustic and transmitted) in which the instrument is operating, ie perform a fft on these timings.

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Reply: Due to the equal-time sampling method, it is not possible to achieve a constant number of interferogram points directly from the instrument. The constant resolution is thus imposed when the equal-space resampling is performed, according to the Brault method.

Page 374 line 21: reference to Fig 6: You say typical results but were similar measurements made across the entire range of the blackbody to determine if any significant thermal gradients exist between the monitoring PT sensor and the emitting surface. It is not clear where the sensors is placed relative to the emitting surface, at 287K one might not expect a thermal gradient to be significant, but at higher temperatures this is unlikely to be the case.

Reply: It should be noted that figure 6 is used only to perform an assessment of the accuracy of the thermometers in a standard laboratory conditions, not the thermal gradients inside of the sources. These gradients have been studied and fully characterized in operating conditions (see Palchetti et al. 2007). The effective radiance of a blackbody as a function of the readings of the three thermometers (including gradients) is calculated with the model presented in the above mentioned work.

Page 375 line 5: The use of the laser source for frequency calibration is a function of the relative optical axis of the laser and FIR interferometers. Are misalignments negligible? if not than this technique is flawed.

Reply: The laser frequency is calibrated using the center frequency of atmospheric lines in the measured spectra, thus misalignment between laser and infrared is automatically taken into account. Fine-tuning of frequency calibration is then performed during data analysis (introducing a fitted frequency correction coefficient) in order to correct for possible small fluctuations of the laser frequency due to thermal excursions.

Page 376 line 10: I assume that the authors do not mean "if the RBB does not vary sensibly..." but "significantly".

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Reply: Right, it will be corrected.

Page 376 line 23: The fact that there is water vapour in the interferometer will cause a path dependent assymetry in the absorption lines, these will cause high frequency phase variation and potentially fill in the measured absorption depth of the lines, will this be taken into account by your calibration process?

Reply: The most of the water vapour absorption occurs outside of the optical path difference (optical path inside of the instrument is about 2 m while maximum optical path difference is 1 cm). Thus the effect is almost completely corrected from the calibration procedure. The use of a complex calibration procedure allows us to correct for the small contribution due to water vapour in the path difference, which gives a small phase error with narrow features that cannot be corrected by the low-resolution phase correction process.

Page 379 line 12: The temperature off-sets shown in fig 6 correspond to temperatures close to the CBB and cannot be assumed to be applicable to the HBB. As previously mentioned this also has significance for the overall calibration process.

Reply: As stated above, figure 6 only show the typical accuracy of the thermometers (that is not strongly dependent on temperature), while the effect of temperature on the blackbody emissivity (for example through gradients), is taken into account through a mathematical model of the blackbodies (Palchetti et al. 2007).

Page 381 line 25: The measurement points shown are at a higher sampling rate than the 0.5 cm-1 resolution and are presumably points obtained by padding the interferogram with zeros and hence are interpolated points, how much of the shape is instrumental and how much imposed by the interpolation method. Also, can the authors be sure that the chosen line is not saturated (which will broaden the "true line" profile), as under resolving will tend to hide this effect.

Reply: An amount of zero-padding is performed in order to reach a power of 2 in the

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number of points and to speed-up the Fourier transform process. This does not have any influence on the lineshape, since the zero padding points do not add information to the spectrum (Shannon's sampling theorem).

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