Stabilisation of the line of sight of MIPAS-STR and its validation from atmospheric spectra obtained during APE-GAIA

This poster presents the investigations in the quality of the pointing system of the new MIPAS-STR instrument.

- The realisation of the in-flight stabilisation of the elevation of the line of sight and its quality is shown.
- The post-flight retrieval of the elevation from the atmospheric spectra measured on the 23.9.1999 is discussed.

**MIPAS-STR, measurement strategy and flight route on 23.9.1999**

- MIPAS-STR is a cooled Michelson interferometer, operating in the mid infrared spectral region.
- MIPAS-STR measures the emission of atmospheric trace gases by continuous limb and upward sounding.
- MIPAS-STR is mounted on the Russian high altitude aircraft M55-Geophysica.
- MIPAS-STR made its first scientific flight on 23.9.1999.

**Stabilisation of the elevation**

To realise a stable pointing, the rolling of the aircraft (in normal flight up to 3°/s) has to be compensated.

The input for the scan-mirror control loop is calculated from the roll angle (measured by the navigation system AHRS) and a pre-flight calibration of internal parameters. For real-time application an extrapolation is made in-flight.

**Quality of control system**

The quality of the control system is derived post flight. The elevation angle is calculated with 128 Hz. In contrast to in-flight, interpolation can be used instead of extrapolation, and discrepancies can be retrieved.

The left figure shows the difference between the mean value of the commanded and the actual elevation during the recording of each interferogram. The right figure shows the corresponding standard deviation.

**Quality of AHRS roll angle**

The AHRS (navigation system of MIPAS-STR) is compared with the navigation system of the Geophysica. In the left figure the mean roll angles over a time interval of 40 seconds are displayed. In the right figure the mean differences are shown. Notice the jump in the difference at 58500 where the aircraft changed direction.

Specified accuracy of roll-angle output: MIPAS-STR: 0.5° (1σ) Geophysica: 3° (1σ)

**Retrieval of the elevation from spectra**

The radiative transfer model KOPRA is used to calculate the spectra. Input in the model are temperature and pressure profiles from ECMWF analysis, interpolated to time and position of the measurements. By change of model parameters, the calculated spectra can be adapted to the measured spectra. For retrieval of the elevation, CO₂ lines are used, because the CO₂ mixing ratio is known. The spectrum between 936 and 960 cm\(^{-1}\) is taken, where only small radiance contributions from other gases are present.

The calculated radiance spectra are systematically lower than the measured ones. As shown in the upper figures, this effect is not multiplicative, but additive. A possible explanation is light scattering on the scan-mirror surface. For the retrieval of the elevation, the measured spectra are ‘light scatter corrected’: from all spectra the difference between calculation and measurement of the 3° spectrum is subtracted.

**Conclusion:**

- the control system worked well: 0° ± 20° (1σ).
- the AHRS seems to be not as good as specified.
- it is possible to retrieve the pointing offset from atmospheric spectra.
- the retrieved mean pointing offset is -0.4° ± 2.6° (1σ).