LEVEL 1B PRODUCT FOR METOP SECOND GENERATION MICROWAVE IMAGER RADIOMETER

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ABSTRACT

In the framework of the Phase A of Metop Second Generation system study, CORISTA is developing a Level 1b processor for the microwave imager (MWI) and ice and cloud imager (ICI) radiometers . In the Level 1b processor, the instrument measurements (counts) have to be converted into engineering units (temperatures), auxiliary data have to be separated from measurements and selected calibration have to be applied to the measurements.
Furthermore channels measurements have to be geolocated and co-registered in order to account for different pointing of antenna beams.
Level 1b data are not re-sampled, but only geometrically characterised, annotated with satellite position and pointing, geolocation inferred from satellite pointing information and preliminary pixel classification (e.g. land/water/cloud mask).
More specifically, in the case of imaging radiometer such as MWI/ICI for the Met-OP second generation mission, Level 1b data represent calibrated and geo-located scene brightness temperature.
In this paper the processor architecture will be showed and discussed.

1. INTRODUCTION

In this paper an analysis of Level-1b processor for MWI/ICI instruments foreseen for the Met-Op Second generation mission will be performed. This software will analyse data coming from two imaging radiometer
These instruments are both conically scanning imaging microwave radiometers.
All the data, commands timing and telemetry signals, and power, pass through the rotating part to the fixed part via the power and signal transfer device (PSTD).
The fixed part of the instrument comprises the assembly of scan mechanism and allocates the units interfacing with platform.
The calibration targets, Cold Calibration Reflector (CCR) and Hot Load (HL), are accommodated in such a way that the CCR is constantly pointing to the deep space in the opposite side of Sun direction (see *Figure 1*)

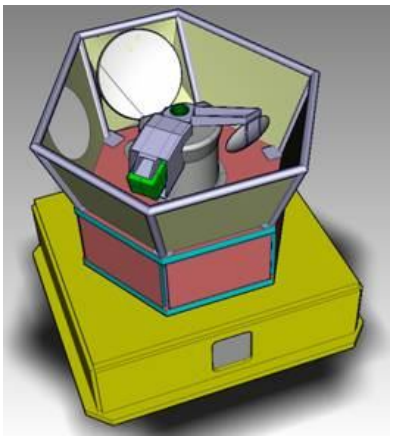

Figure 1: *Conical scan microwave imaging radiometer layout*

Basically the level1b processor software converts the instrument measurements (counts) in engineering units (temperatures), data auxiliary are separate from measurements and selected calibration are applied to the measurements.

2. PROCESSOR ARCHITECTURE DESCRIPTION

An architecture of Level 1 b processor is shown in *Figure 2*. The main processing modules are:

- Data extraction
- Radiometric calibration
- Brightness temperature evaluation

- Orbit & Geolocation
- Level 1b data formatting
- Configuration Data & Constants (made of auxiliary files available on ground)
- Ground Characterisation Data (consisting of inputs available on ground)
- Counts and Telemetries (coming from spacecraft)

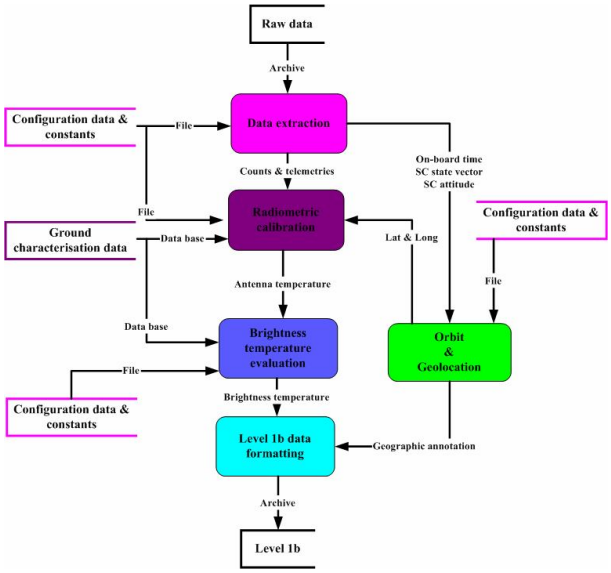

Figure 2: MWI/ICI architecture for Level 1b processing chain.

3. DATA EXTRACTION

Data extraction is the function devoted to access to instrument raw data (Level 0) archive and to decode information needed for Level 1b processing. The extracted data are instrument measurements (count), telemetries that, essentially, are constituted by in-flight temperature values provided by on-board thermistors and on-board time stamps.

An out-of-bound check on counts will be introduced for every scan to evaluate if there are problems due to missing or invalid input. In accordance with the results of the check, the appropriate actions for the instrument calibration will be taken, such as flagging the data.

Calibration measurements provided by both references are averaged before to be used for antenna temperature retrieval.

Within this function also physical temperatures are evaluated taking into account the appropriate calibrations/corrections to in-flight temperatures provided by thermistors.

In *Figure 3* a flow diagram of data extraction function is shown.

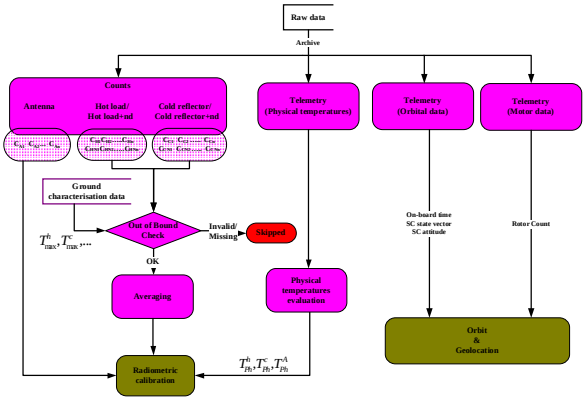

Figure 3: Flow diagram of data extraction function (pink blocks) for MWI Level 1b processing chain.

4. RADIOMETRIC CALIBRATION

Radiometric calibration is the core function since it is devoted to evaluate antenna temperature taking into account instrument calibration procedure. In case of MWI instruments, two-point calibration procedure is normally used, while the four-point calibration procedure is applied only on selected channels. [1],[2]

Calibration measurements of channels calibrated with two-point calibration are provided using an additional reflector in view of deep space (with known temperature of 2.7 K) and by hot blackbody load that acts as a blackbody emitter.

The calibration function uses parameter values contained in auxiliary files that are needed for selecting possible different processing algorithms and for fixing constant values.

In *Figure 4* a flow diagram of radiometric calibration function is shown

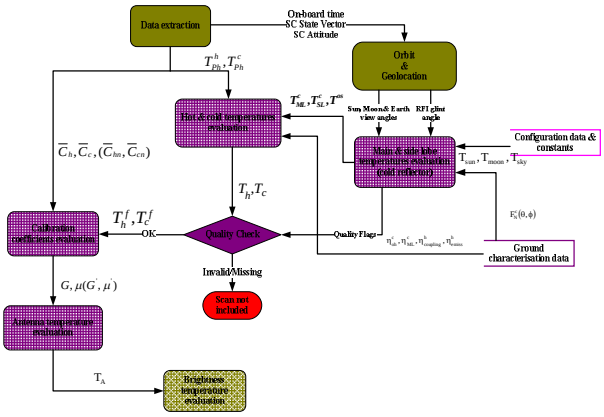

Figure 4: Flow diagram of radiometric calibration function (purple blocks) for MWI Level 1b processing chain.

5. BRIGHTNESS TEMPERATURE EVALUATION

The brightness temperature evaluation is the module devoted to retrieve the brightness temperature. In order to provide this measure is necessary to remove the effects of secondary lobes of main reflector and to take into account the antenna beam efficiency. [3]
In addition, correction for cross-polarisation and spillover effects shall be applied.

In *Figure 5* a flow diagram of brightness temperature evaluation function is shown

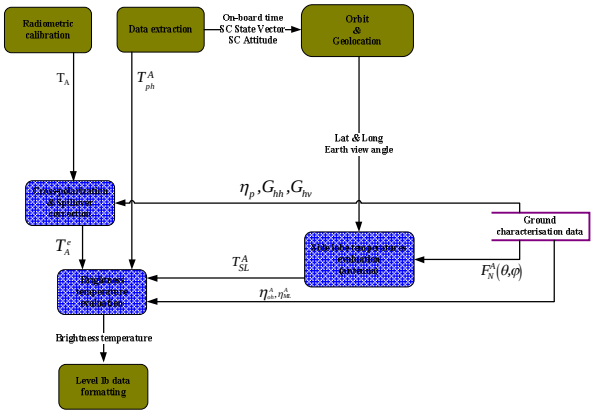

Figure 5: Flow diagram of brightness temperature function (blue blocks) for MWI Level 1b processing chain.

6. ORBIT AND GEOLOCATION

Geolocation means that for each measurement footprint (central point), the location on Earth's geoid is evaluated. The required co-ordinates are the latitude and longitude of the pixel on the reference ellipsoid. The co-ordinates of the pixel correspond to the intersection of the line of sight (the direction of the instantaneous optic axis as it leaves the scan mirror) with the reference ellipsoid. The problem, then, is to determine this point of intersection, given the satellite position and attitude and the orientation of the scan mirror.

In *Figure 6* a flow diagram of orbit and geolocation function is shown.

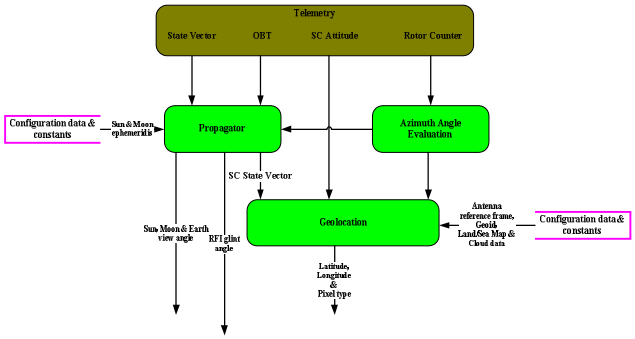

Figure 6: Flow diagram of orbit and geolocation function (high light green blocks) for MWI Level 1b processing chain.

7. LEVEL 1B DATA FORMATTING

Data coming out from the two function "Brightness Temperature" and "Orbit & Geolocation" are correlated and formatted in Level 1b data. These location data are needed for the successive processing steps of footprint resampling (matching) to be performed at higher data level (level 2).

8. CONCLUSION

In the framework of the Phase A of Metop Second Generation a Level-1b processor for the microwave imager (MWI) and ice cloud imager radiometers (ICI),has been developed.

In this paper the processor architecture has been showed. The main processing modules have been described and the flow diagrams of each module have been discussed.

9. REFERENCES

1. Meissner, T., Wentz, F., Draper, D. *GMI Calibration Algorithm and Analysis Theoretical Basis Document*, Remote Sensing Systems, Santa Rosa, CA, United States

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