The XMM ODF Access Layer library

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Abstract

OAL: ODF-related utility functions and access to non-science data sets in the ODF

1 Introduction

The ODF Access Layer library provides ODF-related utility functions and gives access to a limited set of non-science ODF data sets. The purpose is to provide a central repository for ODF-access functionality which is likely to be needed by more than one SAS task. Please note: The OAL is *not* intended to fully insulate the SAS tasks from the structure and contents of the data sets in the ODF. This is especially true for the science data sets which must be directly read by the task via the XMM Data Access Layer package **dal**.

2 Requirements

The OAL requires that a complete ODF is available on a file system accessible from the host the SAS session is being run on. The ODF needs to reside in a single directory the name of which must be specified via an environment variable (see Sect. 3.2 for details).

3 User-visible functionality

3.1 ODF data set name completion

The OAL provides functionality to expand a pair of two or a tuple of four identifiers into a valid ODF data set name which can then be used to physically open the set, e.g. with the **dal** `open` method. The corresponding OAL routine receives a string which is either a valid data set name or of the form

```
odf(<instr>, <mode>[, <expnr>, <ccdnr>[, scheduledFlag]])
```

or

```
oal(<instr>, <mode>[, <expnr>, <ccdnr>[, scheduledFlag]])
```

The four fields have the following meaning:

`<instr>`: a string which must uniquely identify an instrument. The following table lists the possible values:

identifier	meaning
`XMM`	selects satellite specific data sets or sets for which the instrument field is not applicable
XRT1/XRT2/XRT3	the mirror systems 1, 2, (in front of EMOS1/RGS1 and EMOS2/RGS2), and 3 (in front of EPN)
EMOS1/EMOS2	EPIC MOS camera units 1 and 2
EPN	EPIC PN camera unit
ERM	EPIC Radiation Monitor
RGS1/RGS2	units 1 and 2 of the RGS
OM	the optical monitor

`<mode>`: a string which must uniquely identify a data mode; see App. A for a list of allowed values

`<expnr>`: a numeric value identifying an exposure number within the current observation period; must be set to 0 if not applicable

`<ccdnr>`: a numeric value specifying a CCD chip of the selected instrument. CCD numbers are in the range 1–7 for EMOS1/EMOS2, 1–12 for EPN, and 1–9 for RGS1/RGS2; the numbering follows that used in the **cal**. For OM this is the science window identifier. Example: 1 for EMOS1 specifies the central chip on EMOS camera 1 and 12 for EPN the bottom right chip of the EPN camera as viewed from the mirror platform through the telescope tube onto the focal plane. For data sets for which the field is not applicable a value of 0 must be given. If neither `expnr` nor `ccdnr` are applicable as this is the case for some files in the satellite scope, the form

```
odf(<instr>, <mode>)
```

can be used in lieu of the above full form. Example: `odf(XMM, Attitude)` refers to the Attitude History File a single instance of which applies to the the entire observation period the current ODF covers.

`<scheduledFlag>`: the letter 'S' or 'U' for Scheduled/Unscheduled; the field is optional, if omitted no check for the scheduled status of the exposure will be done.

For the two non-numeric fields `<instr>` and `<mode>` abbreviations can be used to designate a wanted value, e.g. `Im`, or `Ima`, `Image` are all valid reference to 'Imaging Mode'. If an abbreviated string value cannot be unambiguously expanded into its full form a fatal error condition is raised. Case is insignificant for both fields.

The ODF file name completion needs access to the Summary File of the ODF in question. Therefore, the name of the directory containing an ODF must be specified by the user, either in the form of a proper task parameter or in an environment variable. See Sect. 3.2 for details.

3.2 Environment variables

3.2.1 SAS_ODF

The OAL functions need to access various constituents in the ODF that is currently being processed. The name of the directory containing the ODF can be passed to the OAL in either of the following two ways:

1. Each task making use of the OAL has an optional command line parameter `--odf` (short form: `-o`) whose value is taken as the ODF directory name.
2. The user can specify the name via the environment variable

   `SAS_ODF`

   e.g. `SAS_ODF=/home/fred/odf1`.

The name of the summary file is assumed to end in `SUM.SAS` or `SUM.ASC` with the former taking precedence over the latter.

A command line override supersedes any assignment made to `SAS_ODF`, i.e., the directory pointed at via `SAS_ODF` is ignored in this case. A fatal error condition is raised if neither `SAS_ODF` is set nor an ODF is specified on the command line via `--odf`.

It is also possible to assign directly the name of an ODF summary file to `SAS_ODF` or the task's `--odf` parameter. This should be used if a directory contains more than one ODF.

For more information please consult the documentation of package **taskmain**.

3.2.2 SAS_VERBOSITY

The amount of error, warning and diagnostic messages issued by the OAL is controlled by the environment variable

`SAS_VERBOSITY`

which must be given an integer value in the range 0–2. 0 means "mute" - only messages resulting from fatal error conditions will be issued. Setting `SAS_VERBOSITY` to 2 will lead to detailed diagnostic messages the meaning of which will not necessarily be obvious to the normal user. Level 1 will generate a moderate amount of informative messages. Please consult the documentation of package **error** for further information on the general SAS error messaging system.

3.2.3 SAS_TIMECORR

The conversion of Spacecraft-Onboard-Time (OBT) to Mission-Elapsed-Time (MET) tags can use either standard Time Correlation (TCS) data produced in real-time or Reconstructed Time Correlation data (TCX) produced through a reprocessing process designed to eliminate anomalies present in real-time data, stemming from timing issues in the XMM Ground Segment.

The environment variable allows the user to control this in the following manner:

value of `SAS_TIMECORR`	meaning
`TCS`	consider TCS data only; raise error condition if missing from ODF
`TCS:TCX`	first consider TCS data; if missing but TCX is present read TCX data; raise error condition otherwise, i.e. if both are missing
`TCX:TCS`	first consider TCX data; if missing but TCS is present read TCS data; raise error condition otherwise, i.e. if both are missing
`TCX`	consider TCS data only; raise error condition if missing from ODF

If the variable is not set the default behavior is identical to the setting `SAS_TIMECORR=TCX:TCS`.

3.2.4 SAS_TIMECORR_TCX

The Reconstructed Time Correlation data provided in an ODF covers the entire revolution in which the observation was performed. If the TCX file is finally used through selection process described above the environment variable SAS_TIMECORR_TCX controls whether the entire dataset is used, or just the data corresponding the observation period. Using the entire data set may improve the fit under certain circumstances.

value of SAS_TIMECORR_TCX	meaning
OBS	Use just the observation period for constructing the data fit
ALL	Use the entire revolution when constructing the fit

If the variable is not set the default behavior is identical to the setting SAS_TIMECORR_TCX=OBS. This variable is ignored for TCS data, which covers just the observation period.

3.2.5 SAS_OBT_MET_FIT

The conversion of Spacecraft-Onboard-Time (OBT) to Mission-Elapsed-Time (MET) tags makes use of a polynomial to which the data in the ODF Time Correlation File has been fitted. This is controlled through five parameters, viz: *method* (see below), *deg* (maximum degree of the polynomial), *rms* (Root-Mean-Square abandoning criterion for the fit), *frac* (fraction of OBT-MET data points that are allowed to be removed from the fitting procedure to fulfill the RMS criterion), and *igngshov* (see below). Default values are (0, 4, 5.e-5, .9, 1).

method can either be given as 0 or 1. A value of 0 means that the OBT-MET fit uses ready-made time correlation data that have been corrected for signal propagation delays using predicted orbit data. time. A value of 1 forces this calculation to be re-done with more accurate reconstructed orbit data. This value is ingored if TCX data is used, since the Reconstructed Time Correlation data is already corrected.

The value assigned to *deg* chooses one of two possible options for the interpolating function:

- $deg > 0$: the maximum degree of the computed fit polynomial. Please note: the *actual* value after the fitting process can be smaller if the RMS criterion can be achieved with a smaller degree.
- $deg < 0$: the time correlation data are not fitted by a single global function but by piecewise-linear segments through the instantaneous data values.

igngshov can either be given as 0 or 1. A value of 1 means that all groundstation handovers in the time correlation data are ignored, i.e., all data from all stations are considered in the construction of the fit polynomial. *igngshov*=0 on the other hand will trigger that all time correlation data after a handover are *not* taken into account, i.e. the fit polynomial is constructed just on the basis of the data from the first ground station alone. In the past there have been cases where the ground times of different stations varied by an amount large enough to make the OBT-MET fit fail. If this happens the *igngshov* provides a way to work around the problem such that processing of the ODF in question can be performed. Please note that this can only be a temporary measure and that the anomaly should be brought to the attention of the SOC. The default value of *igngshov* is 1.

The actual values of *method*, *deg*, *rms*, *frac*, and *igngshov* shall be written to corresponding attributes TFIT_RPD, TFIT_DEG, TFIT_RMS, TFIT_PFR, TFIT_IGH in the event list being processed.

Caution: Please alter the above parameters via SAS_OBT_MET_FIT only when you exactly know what you are doing. Out-of-range conditions are caught but improper values can lead to inaccurate event arrival times.

3.2.6 SAS_OBT_MET_LINEAR

Setting this variable to a comma separated list of two numbers $slope, frac$ with $0 <= frac <= 1$ overrides any values given to SAS_OBT_MET_FIT. It enforces a linear relationship between OBT and MET with a slope of *slope*. For this only one data point from the Time Correlation File is needed. The point taken is $N \times frac$ with N being the total number of points available, e.g. $frac = 0$ selects the first, $frac = 1$ the last point.

Caution: Please alter the above parameters via SAS_OBT_MET_LINEAR only when you exactly know what you are doing. Out-of-range conditions are caught but improper values can lead to inaccurate event arrival times.

3.2.7 SAS_ORBIT

There can be two types of orbit data in an ODF, viz. predicted and reconstructed ones. The former contain estimates values of the satellite state vector over the course of one revolution. Reconstructed orbit data have been computed on-ground using real position measurements and are hence intrinsically more accurate.

Allowed values for SAS_ORBIT are P (predicted) and R (reconstructed). If SAS_ORBIT is not set to either of the above values (or unset) the orbit access routines in the **oal** will first look for reconstructed orbit data in the ODF and, if none are found, for predicted ones.

The actual type of used orbit data shall be indicated by the boolean attribute ORB_RCNS (true: reconstructed orbit data, false: predicted orbit data) in the event list being processed.

Caution: Please use SAS_ORBIT only if you know exactly what you are doing. Inaccurate satellite positions can lead to wrong signal propagation delays (see above field *method* of SAS_OBT_MET_FIT).

3.2.8 SAS_ATTITUDE

There can be two types of star tracker attitude data in an ODF, viz. Attitude History Data (AHF) and Raw Attitude Data (RAF) both of which can serve as the primary source of spacecraft attitude data during the ODF processing. The environment variable allows the user to control this in the following manner:

value of SAS_ATTITUDE	meaning
AHF	consider AHF data only; raise error condition if missing from ODF
AHF:RAF	first consider AHF data; if missing but RAF is present read RAF data; raise error condition otherwise, i.e. if both are missing
RAF:AHF	first consider RAF data; if missing but AHF is present read AHF data; raise error condition otherwise, i.e. if both are missing
RAF	consider RAF data only; raise error condition if missing from ODF

If the variable is not set the default behavior is identical to the setting SAS_ATTITUDE=AHF:RAF. The source of ODF attitude data shall be recorded in the data set attribute ATT_SRC.

A Data Mode Identifiers

The following table lists the allowed data mode identifiers

mode identifier	meaning	applicable to instrument(s)
Imaging	Imaging Mode Data	EMOS1/EMOS2/EPN/OM
Timing	Timing Mode Data	EMOS1/EMOS2/EPN
ReducedImaging	Reduced Imaging Mode Data	EMOS1/EMOS2
CompressedTiming	Compressed Timing Mode Data	EMOS1/EMOS2
Auxiliary	Auxiliary Data	EMOS1/EMOS2/EPN/RGS1/RGS2
Diagnostic	Distgnostic Mode Data	EMOS1/EMOS2/EPN/RGS1/RGS2
OffsetVariance	Offset Variance Data	EMOS1/EMOS2
PeriodicHousekeeping	Periodic Housekeeping Data	EMOS1/EMOS2/OM
Burst	Burst Mode Data	EPN
OffsetData	Offset Mode Data	EPN
NoiseData	Noise Data	EPN
DiscardLinesData	Discard Lines Data	EPN
MainPeriodicHousekeeping	Main Periodic Housekeeping Data	EPN
AddPeriodicHousekeeping	Add Periodic Housekeeping Data	EPN
ERMCountRate	ERM Count Rate Data	ERM
ERMSpectra	ERM Spectra Data	ERM
Spectroscopy	Spectroscopy Data	RGS1/RGS2
HighTimeResolution	High Time Resolution Data	RGS1/RGS2
FullPeriodicHousekeeping	Full Periodic Housekeeping Data	RGS1/RGS2
DPP1NonPeriodicHousekeeping	DPP Non-Periodic Housekeeping Data - kind 1	RGS1/RGS2
DPP2NonPeriodicHousekeeping	DPP Non-Periodic Housekeeping Data - kind 2	RGS1/RGS2
TemperaturePeriodicHousekeeping	Temperature Periodic Housekeeping Data	RGS1/RGS2
SyspeakDiagnostic	System peak diagnostic Data	RGS1/RGS2
Fast	Fast Mode Data	OM
Engineering1	Engineering Mode Data (type 1)	OM
Engineering2	Engineering Mode Data (type 2)	OM
Engineering3	Engineering Mode Data (type 3)	OM
Engineering4	Engineering Mode Data (type 4)	OM
Engineering5	Engineering Mode Data (type 5)	OM
Engineering6	Engineering Mode Data (type 6)	OM
PriorityFieldAcquisition	Priority Field Acquisition Data	OM
PriorityWindowData	Priority Window Data	OM
PriorityFast	Priority Fast Mode Data	OM
TrackingHistory	Tracking History Data	OM
ReferenceFrame	Reference Frame Data	OM
NonPeriodicHousekeeping	Non-Periodic Housekeeping Data	OM
Attitude	Attitude Data	XMM
DummyAttitude	Dummy Attitude Data	XMM
PredictedOrbit	Predicted Orbit Data	XMM
ReconstructedOrbit	Reconstructed Orbit Data	XMM
TimeCorrelation	Time Correlation Data	XMM
ReconstructedTimeCorrelation	Reconstructed Time Correlation Data	XMM
HK1, HK2, HK3, ..., HK9	Periodic Housekeeping Data (type SYS_HK_SID0) + type SYS_HK_SID1); Periodic Attitude Housekeeping Data;	XMM
SummaryInformation	ODF Summary Information	XMM

References