

# ORBIT DATA CALCULATOR TOOL - FILE TRANSFER DOCUMENT

## 1. INTRODUCTION

This is the File Transfer Document for the executable routine that computes relevant orbit data from a given EO CFI-compatible orbit file, e.g. a EO XML Restituted Orbit File.

### 1.1 Change History

Issue	Change Description
1.0	First issue
1.1	Executable CalcOrbitANXDataList has been added to the package.

### 1.2 Distribution List

Project/Unit	Name	Project/Unit	Name	Project/Unit	Name

### 1.3 Reference Documents

[RD 01] Earth Observation Mission CFI Software. EO\_DATA\_HANDLING Software User Manual.  
Ref. EO-MA-DMS-GS-0007. Issue 4.5 - 01/03/13

[RD 02] Sentinel-3: Orbit Data File for GSV Test- File Transfer Document  
Ref. EOCFI-FTD-017. Issue 1.1 - 15/04/2013

[RD 03] Earth Observation Mission CFI Software. Conventions Document.  
Ref. EO-MA-DMS-GS-0001. Issue 4.5 - 01/03/13

[RD 04] OPS Angle Computation using EO Mission Software CFI  
Ref. PE-TN-ESA-GS-344. Issue 1.0 - 28/09/2012

## 2. ARCHIVE CONTENT

The following archive file has been delivered (generated with the zip utility):  
EOCFI-FTD-018\_1\_1.zip

The archive has the following MD5 checksum:  
18f82d7475832764218f4b74c7f3d892

The archive contains the following files:

```

CalcOrbitData_v1_1/INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF
CalcOrbitData_v1_1/INPUT/S3A_TEST_MPL_ORBRES_20120627T220116_99999999T999999_0001.EOF
CalcOrbitData_v1_1/INPUT/S3B_TEST_AUX_ORBRES_20130618T204000_20130715T224000_0001.EOF
CalcOrbitData_v1_1/INPUT/S3B_TEST_MPL_ORBRES_20120627T211046_99999999T999999_0001.EOF
CalcOrbitData_v1_1/INPUT/config_data_list.txt
CalcOrbitData_v1_1/INPUT/config_data_list_anx.txt
CalcOrbitData_v1_1/LINUX64/CalcOrbitData
CalcOrbitData_v1_1/LINUX64/CalcOrbitANXDataList
CalcOrbitData_v1_1/LINUX64/CalcOrbitDataList
CalcOrbitData_v1_1/MACINTEL64/CalcOrbitData
CalcOrbitData_v1_1/MACINTEL64/CalcOrbitANXDataList
CalcOrbitData_v1_1/MACINTEL64/CalcOrbitDataList
CalcOrbitData_v1_1/OUTPUT/S3A_output_anx_data_0.txt
CalcOrbitData_v1_1/OUTPUT/S3A_output_anx_data_1.txt
CalcOrbitData_v1_1/OUTPUT/S3A_output_data.txt
CalcOrbitData_v1_1/OUTPUT/S3A_output_data_0.txt
CalcOrbitData_v1_1/OUTPUT/S3A_output_data_1.txt

```

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CalcOrbitData\_v1\_1/WINDOWS32/CalcOrbitData.exe  
CalcOrbitData\_v1\_1/WINDOWS32/CalcOrbitANXData.exe  
CalcOrbitData\_v1\_1/WINDOWS32/CalcOrbitDataList.exe  
CalcOrbitData\_v1\_1/WINDOWS32/pthreadVC2.dll

### 3. ARCHIVE CONTENT DESCRIPTION

File	Description
INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF	Sentinel-3A Restituted Orbit File example (based on ESOC FD Reference Orbit, see [RD 02])
INPUT/S3A_TEST_MPL_ORBSCT_20120627T220116_99999999T999999_0001.EOF	Sentinel-3A Orbit Scenario File
INPUT/S3B_TEST_AUX_ORBRES_20130618T204000_20130715T224000_0001.EOF	Sentinel-3B Restituted Orbit File example (based on ESOC FD Reference Orbit, see [RD 02])
INPUT/S3B_TEST_MPL_ORBSCT_20120627T211046_99999999T999999_0001.EOF	Sentinel-3B Orbit Scenario File
INPUT/config_data_list.txt	Example of input configuration file for the executable <i>CalcOrbitDataList</i>
INPUT/config_data_list_anx.txt	Example of input configuration file for the executable <i>CalcOrbitANXDataList</i>
LINUX64/CalcOrbitData	Executable tools for Linux 64-bit
LINUX64/CalcOrbitANXDataList	
LINUX64/CalcOrbitDataList	
MACINTEL64/CalcOrbitData	Executable tools for Mac Intel 64-bit
MACINTEL64/CalcOrbitANXDataList	
MACINTEL64/CalcOrbitDataList	
OUTPUT/S3A_output_data.txt	Example of output file generated by the executable <i>CalcOrbitData</i>
OUTPUT/S3_output_anx_data_0.txt	Example of output files generated by the executable <i>CalcOrbitANXDataList</i>
OUTPUT/S3_output_anx_data_1.txt	
OUTPUT/S3_output_data_0.txt	Example of output files generated by the executable <i>CalcOrbitDataList</i>
OUTPUT/S3_output_data_1.txt	
WINDOWS32/CalcOrbitData	Executable tools for Windows 32-bit
WINDOWS32/CalcOrbitANXDataList	
WINDOWS32/CalcOrbitDataList	
WINDOWS32/pthreadVC2.dll	Auxiliary library for Windows

### 4. INSTALLATION

The archive can be expanded with the command unzip (in Linux/Mac Intel) or with Winzip / 7-zip (in MS Windows).

### 5. USAGE

#### 5.1 Executable program *CalcOrbitData*

For a requested UTC time interval, the executable program *CalcOrbitData* computes the position and

velocity vectors, the geodetic coordinates and the OPS angle (with a given time step). The executable tool expects as input, among other parameters, an EO CFI-compatible orbit file, e.g. a Restituted Orbit File (see [RD 01]). The data generated by the executable is stored in an output file.

### 5.1.1 Command line input parameters description

The command line parameters of the executable routine are the following (provided in the order in which they have to be supplied):

INPUT PARAMETERS	Definition	Value
Satellite ID	Satellite identifier	SENTINEL3A SENTINEL3B
Input Orbit File (Orbit Scenario File, Predicted Orbit File or Restituted Orbit File)	Filename (it may include the path to the file)	Given by the user
UTC Start Time	UTC start time of the time interval CCSDS-A ASCII format with microseconds (YYYY-MM-DDTHH:mm:ss.uuuuuu)	Given by the user
UTC Stop Time	UTC stop time of the time interval CCSDS-A ASCII format with microseconds (YYYY-MM-DDTHH:mm:ss.uuuuuu)	Given by the user
Time Step [s]	Time step (in seconds) for the computation of intermediate data	Given by the user
Output Data File	Filename (it may include the path to the file)	Given by the user.

### 5.1.2 Output file format description

The executable program *CalcOrbitData* generates as output a file. The filename is an input parameter given by the user. The output file includes comments (starting with the symbol #) describing the input and output data.

The format of the output file is the following:

- Column 1: UTC Time in calendar format (CCSDS-A ASCII format “yyyy-mm-ddThh:mm:ss.uuuuuu”)
- Column 2: UTC Time in MJD2000 reference [decimal days]
- Column 3: X Coordinate of the Earth Fixed position vector [m]
- Column 4: Y Coordinate of the Earth Fixed position vector [m]
- Column 5: Z Coordinate of the Earth Fixed position vector [m]
- Column 6: X Coordinate of the Earth Fixed velocity vector [m/s]
- Column 7: Y Coordinate of the Earth Fixed velocity vector [m/s]
- Column 8: Z Coordinate of the Earth Fixed velocity vector [m/s]
- Column 9: Geocentric Longitude [deg]
- Column 10: Geodetic Latitude [deg]
- Column 11: Geodetic Altitude [m]
- Column 12: Orbit Position Schedule (OPS) Angle in Earth Fixed [deg]

### 5.1.3 Example

#### 5.1.3.1 Running the executable

The executable program can be called in the following way:

- From Linux/Mac shell

```
./CalcOrbitData SENTINEL3A ./INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF 2013-07-07T00:00:00.000000 2013-07-08T00:00:00.000000 60.0 ./OUTPUT/S3A_output_data.txt
```

- From Windows command prompt window

```
CalcOrbitData.exe SENTINEL3A INPUT\S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF 2013-07-07T00:00:00.000000 2013-07-08T00:00:00.000000 60.0 OUTPUT\S3A_output_data.txt
```

The executable program shows the following messages:

```
CalcOrbitData v1.0
-----

Input data:
Satellite: SENTINEL3A
Orbit File: ./INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF
Start Time: 2013-07-07T00:00:00.000000
Stop Time: 2013-07-08T00:00:00.000000
Time Step: 60.000000 <s>
Output Filename: ./OUTPUT/S3A_output_data.txt

TIME INITIALIZATION

ORBIT INITIALIZATION

CALCULATING ORBIT DATA...

Output file created successfully in ./OUTPUT/S3A_output_data.txt
```

### 5.1.3.2 Output File

The output file *S3A\_output\_data.txt* is created. Excerpt of the example output file:

```
# Generated with executable tool CalcOrbitData v1.0
# Satellite: SENTINEL3A
# Orbit File: ./INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF
# Start Time: 2013-07-07T00:00:00.000000
# Stop Time: 2013-07-08T00:00:00.000000
# Time Step: 60.000000 <s>
# Output Filename: ./OUTPUT/S3A_output_data.txt
#
# Calendar UTC Time      MJD2000 UTC Time      Position (X,Y,Z) in EF CS [m]      Velocity (VX,VY,VZ)
in EF CS [m/s]      Geocentric Longitude [deg]  Geodetic Latitude [deg]  Geodetic Altitude [m]  OPS Angle
in EF CS [deg]
# -----
# -----
2013-07-07T00:00:00.000000 4936.000000000000 +3576232.002000 -3018202.452000 +5439725.260000 -
5532.531016 +1979.255335 +4723.909651 +319.836919 +049.464290 +809799.821566 +050.063843
2013-07-07T00:01:00.000000 4936.000694444445 +3238142.641000 -2892237.143000 +5712415.030000 -
5733.138327 +2218.526599 +4362.816970 +318.229479 +052.927648 +810554.709875 +053.634966
2013-07-07T00:02:00.000000 4936.001388888889 +2888739.314000 -2752117.893000 +5962925.694000 -
5909.553477 +2450.867094 +3984.846303 +316.387431 +056.370693 +811293.325802 +057.206326
[...]
```

## 5.2 Executable program *CalcOrbitDataList*

For a list of requested UTC time intervals, the executable program *CalcOrbitDataList* computes the position and velocity vectors, the geodetic coordinates and the OPS angle (with a given time step). The executable tool expects as input, among other parameters, an EO CFI-compatible orbit file, e.g. a Restituted Orbit File (see [RD 01]). The data generated by the executable is stored in an output file.

The difference between *CalcOrbitDataList* and *CalcOrbitData* is that, in case the user needs to calculate output orbit data for many different time intervals (using the same input orbit file), *CalcOrbitData* has to be called several times, meaning that the orbit file is initialized each time.

On the other hand, *CalcOrbitDataList* only initializes the orbit file once and then calculates the orbit data for the list of time intervals, saving execution time. This may be useful if the orbit file given as input has a significant size.

### 5.2.1 Command line input parameters description

The command line parameters of the executable routine are the following (provided in the order in which they have to be supplied):

INPUT PARAMETERS	Definition	Value
Input Configuration File	Filename (it may include the path to the file)	Given by the user

### 5.2.2 Input Configuration File parameters description

The configuration file contains the following input parameters (provided in the order in which they have to be supplied):

INPUT PARAMETERS	Definition	Value
Satellite ID	Satellite identifier	SENTINEL3A SENTINEL3B
Input Orbit File Orbit Scenario File, Predicted Orbit File or Restituted Orbit File	Filename (it may include the path to the file)	Given by the user
Number of Time Intervals	Number of time intervals to be generated	Integer value > 0, given by the user

Then, for each time interval, the following parameters are supplied:

INPUT PARAMETERS	Definition	Value
UTC Start Time	UTC start time of the time interval CCSDS-A ASCII format with microseconds (YYYY-MM-DDTHH:mm:ss.uuuuuu)	Given by the user
UTC Stop Time	UTC stop time of the time interval CCSDS-A ASCII format with microseconds (YYYY-MM-DDTHH:mm:ss.uuuuuu)	Given by the user
Time Step [s]	Time step (in seconds) for the computation of intermediate data	Given by the user
Output Data File	Filename (it may include the path to the file)	Given by the user.

### 5.2.3 Output file format description

The executable program *CalcOrbitDataList* generates a set of output files. The filenames are input parameters given by the user. The output files include comments (starting with the symbol #) describing the input and output data.

The format of the output files is the following:

- Column 1: UTC Time in calendar format (CCSDS-A ASCII format “yyyymmddThh:mm:ss.uuuuuu”)
- Column 2: UTC Time in MJD2000 reference [decimal days]
- Column 3: X Coordinate of the Earth Fixed position vector [m]
- Column 4: Y Coordinate of the Earth Fixed position vector [m]

- Column 5: Z Coordinate of the Earth Fixed position vector [m]
- Column 6: X Coordinate of the Earth Fixed velocity vector [m/s]
- Column 7: Y Coordinate of the Earth Fixed velocity vector [m/s]
- Column 8: Z Coordinate of the Earth Fixed velocity vector [m/s]
- Column 9: Geocentric Longitude [deg]
- Column 10: Geodetic Latitude [deg]
- Column 11: Geodetic Altitude [m]
- Column 12: Orbit Position Schedule (OPS) Angle in Earth Fixed [deg]

## 5.2.4 Example

### 5.2.4.1 Input Configuration File

Example of input configuration file *config\_data\_list.txt*:

```
SENTINEL3A
./INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF
2
2013-06-20T00:00:00.000000
2013-06-22T00:00:00.000000
60.0
./OUTPUT/S3A_output_data_0.txt
2013-07-07T14:00:00.000000
2013-07-10T04:00:00.000000
10.0
./OUTPUT/S3A_output_data_1.txt
```

### 5.2.4.2 Running the executable

The executable program can be called in the following way:

- From Linux/Mac shell

```
./CalcOrbitDataList ./INPUT/config_data_list.txt
```

- From Windows command prompt window

```
CalcOrbitDataList.exe INPUT\config_data_list.txt
```

The executable program shows the following messages:

```
CalcOrbitDataList v1.0
-----

Input data:
Satellite: SENTINEL3A
Orbit File: ./INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF
Number of Time Intervals: 2

TIME INITIALIZATION

ORBIT INITIALIZATION

TIME INTERVAL #0
Start Time: 2013-06-20T00:00:00.000000
Stop Time: 2013-06-22T00:00:00.000000
Time Step: 60.000000 <s>
Output Filename: ./OUTPUT/S3A_output_data_0.txt

CALCULATING ORBIT DATA...

Output file created successfully in ./OUTPUT/S3A_output_data_0.txt
```

```

TIME INTERVAL #1
Start Time: 2013-07-07T14:00:00.000000
Stop Time: 2013-07-10T04:00:00.000000
Time Step: 10.000000 <s>
Output Filename: ./OUTPUT/S3A_output_data_1.txt

CALCULATING ORBIT DATA...

Output file created successfully in ./OUTPUT/S3A_output_data_1.txt

```

### 5.2.4.3 Output files

The output files *S3A\_output\_data\_0.txt* and *S3A\_output\_data\_1.txt* are created. Excerpt of the example output files:

#### *S3A\_output\_data\_0.txt*

```

# Generated with executable tool CalcOrbitDataList v1.0
# Satellite: SENTINEL3A
# Orbit File: ./INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF
# Start Time: 2013-06-20T00:00:00.000000
# Stop Time: 2013-06-22T00:00:00.000000
# Time Step: 60.000000 <s>
# Output Filename: ./OUTPUT/S3A_output_data_0.txt
#
# Calendar UTC Time      MJD2000 UTC Time      Position (X,Y,Z) in EF CS [m]      Velocity (VX,VY,VZ)
in EF CS [m/s]      Geocentric Longitude [deg]      Geodetic Latitude [deg]      Geodetic Altitude [m]      OPS Angle
in EF CS [deg]
# -----
-----
2013-07-07T00:00:00.000000 4936.0000000000000 +3576232.002000 -3018202.452000 +5439725.260000 -
5532.531016 +1979.255335 +4723.909651 +319.836919 +049.464290 +809799.821566 +050.063843
2013-07-07T00:01:00.000000 4936.0006944444445 +3238142.641000 -2892237.143000 +5712415.030000 -
5733.138327 +2218.526599 +4362.816970 +318.229479 +052.927648 +810554.709875 +053.634966
2013-07-07T00:02:00.000000 4936.0013888888889 +2888739.314000 -2752117.893000 +5962925.694000 -
5909.553477 +2450.867094 +3984.846303 +316.387431 +056.370693 +811293.325802 +057.206326
2013-07-07T00:03:00.000000 4936.0020833333334 +2529492.266000 -2598293.852000 +6190288.425000 -
6061.170129 +2675.170659 +3591.469551 +314.231285 +059.787246 +812000.764025 +060.777900
[...]
```

#### *S3A\_output\_data\_1.txt*

```

# Generated with executable tool CalcOrbitDataList v1.0
# Satellite: SENTINEL3A
# Orbit File: ./INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF
# Start Time: 2013-07-07T14:00:00.000000
# Stop Time: 2013-07-10T04:00:00.000000
# Time Step: 10.000000 <s>
# Output Filename: ./OUTPUT/S3A_output_data_1.txt
#
# Calendar UTC Time      MJD2000 UTC Time      Position (X,Y,Z) in EF CS [m]      Velocity (VX,VY,VZ)
in EF CS [m/s]      Geocentric Longitude [deg]      Geodetic Latitude [deg]      Geodetic Altitude [m]      OPS Angle
in EF CS [deg]
# -----
-----
2013-07-07T14:00:00.000000 4936.5833333333333 +3709761.658000 -5857133.222000 +1871495.971000 -
0372.855304 -2518.468730 -7105.129119 +302.349147 +015.192282 +804605.067968 +164.717107
2013-07-07T14:00:10.000000 4936.583449074074 +3705816.146224 -5882000.736417 +1800344.902664 -
0416.224541 -2454.979294 -7124.956519 +302.212013 +014.601835 +804594.424916 +165.311696
2013-07-07T14:00:20.000000 4936.583564814815 +3701437.626518 -5906231.721468 +1728999.406813 -
0459.456030 -2391.164161 -7144.014360 +302.075388 +014.011327 +804587.397680 +165.906272
2013-07-07T14:00:30.000000 4936.5836805555555 +3696627.502000 -5929822.956000 +1657467.189000 -
0502.544630 -2327.030439 -7162.300579 +301.939246 +013.420760 +804584.016210 +166.500835
[...]
```

### 5.3 Executable program *CalcOrbitANXDataList*

For a list of requested UTC time intervals, the executable program *CalcOrbitANXDataList* computes the position and velocity vectors, the geocentric longitude and the absolute orbit and relative for each orbit contained in the time interval. The executable tool expects as input, among other parameters, one EO CFI-compatible orbit file, e.g. a Restituted Orbit File (see [RD 01]) and a EO CFI Orbit Scenario File (see [RD 01]). The Orbit Scenario File is used only to calculate the correspondence between absolute orbit number and relative orbit number /cycle number. In order to obtain the correct relation between absolute and relative orbit number, the EO CFI-compatible orbit file provided as input must be consistent with the Orbit Scenario File. The data generated by the executable is stored in an output file.

#### 5.3.1 Command line input parameters description

The command line parameters of the executable routine are the following (provided in the order in which they have to be supplied):

INPUT PARAMETERS	Definition	Value
Input Configuration File	Filename (it may include the path to the file)	Given by the user

#### 5.3.2 Input Configuration File parameters description

The configuration file contains the following input parameters (provided in the order in which they have to be supplied):

INPUT PARAMETERS	Definition	Value
Satellite ID	Satellite identifier	SENTINEL3A SENTINEL3B
Input Orbit File Orbit Scenario File, Predicted Orbit File or Restituted Orbit File	Filename (it may include the path to the file)	Given by the user
Orbit Scenario File	Filename (it may include the path to the file)	Given by the user
Number of Time Intervals	Number of time intervals to be generated	Integer value > 0, given by the user

Then, for each time interval, the following parameters are supplied:

INPUT PARAMETERS	Definition	Value
UTC Start Time	UTC start time of the time interval CCSDS-A ASCII format with microseconds (YYYY-MM-DDTHH:mm:ss.uuuuuu)	Given by the user
UTC Stop Time	UTC stop time of the time interval CCSDS-A ASCII format with microseconds (YYYY-MM-DDTHH:mm:ss.uuuuuu)	Given by the user
Output Data File	Filename (it may include the path to the file)	Given by the user.

#### 5.3.3 Output file format description

The executable program *CalcOrbitANXDataList* generates a set of output files. The filenames are input parameters given by the user. The output files include comments (starting with the symbol #) describing the input and output data.



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The format of the output files is the following:

- Column 1: ANX UTC Time in calendar format (CCSDS-A ASCII format “yyyy-mm-ddThh:mm:ss.uuuuu”)
- Column 2: ANX UTC Time in MJD2000 reference [decimal days]
- Column 3: X Coordinate of the Earth Fixed position vector at ANX [m]
- Column 4: Y Coordinate of the Earth Fixed position vector at ANX [m]
- Column 5: Z Coordinate of the Earth Fixed position vector at ANX [m]
- Column 6: X Coordinate of the Earth Fixed velocity vector at ANX [m/s]
- Column 7: Y Coordinate of the Earth Fixed velocity vector at ANX [m/s]
- Column 8: Z Coordinate of the Earth Fixed velocity vector at ANX [m/s]
- Column 9: ANX Geocentric Longitude [deg]
- Column 10: Absolute Orbit Number (see Section 6.4)
- Column 11: Relative Orbit Number, spans from 1 to 385 (cycle length), see convention used in Section 6.5.
- Column 12: Cycle Number (see Section 6.5)

## 5.3.4 Example

### 5.3.4.1 Input Configuration File

Example of input configuration file *config\_data\_list\_anx.txt*:

```
SENTINEL3A
./INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF
./INPUT/S3A_TEST_MPL_ORBSCT_20120627T220116_99999999T999999_0001.EOF
2
2013-06-20T00:00:00.000000
2013-06-22T00:00:00.000000
./OUTPUT/S3A_output_anx_data_0.txt
2013-07-07T14:00:00.000000
2013-07-10T04:00:00.000000
./OUTPUT/S3A_output_anx_data_1.txt
```

### 5.3.4.2 Running the executable

The executable program can be called in the following way:

- From Linux/Mac shell

```
./CalcOrbitANXDataList ./INPUT/config_data_list_anx.txt
```

- From Windows command prompt window

```
CalcOrbitANXDataList.exe INPUT\config_data_list_anx.txt
```

The executable program shows the following messages:

```
CalcOrbitANXDataList v1.0
-----

Input data:
Satellite: SENTINEL3A
Orbit File: ./INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF
Orbit Scenario File: ./INPUT/S3A_TEST_MPL_ORBSCT_20120627T220116_99999999T999999_0001.EOF
Number of Time Intervals: 2

TIME INITIALIZATION

ORBIT INITIALIZATION
```

```
ORBIT SCENARIO INITIALIZATION
EXPLORER_ORBIT >>> WARNING in xo_orbit_init_file: Input time correlations not compatible with
input file(s) time correlations.
```

```
TIME INTERVAL #0
Start Time: 2013-06-20T00:00:00.000000
Stop Time: 2013-06-22T00:00:00.000000
Output Filename: ./OUTPUT/S3A_output_anx_data_0.txt
```

CALCULATING ORBIT ANX DATA...

Output file created successfully in ./OUTPUT/S3A\_output\_anx\_data\_0.txt

```
TIME INTERVAL #1
Start Time: 2013-07-07T14:00:00.000000
Stop Time: 2013-07-10T04:00:00.000000
Output Filename: ./OUTPUT/S3A_output_anx_data_1.txt
```

CALCULATING ORBIT ANX DATA...

Output file created successfully in ./OUTPUT/S3A\_output\_anx\_data\_1.txt

### 5.3.4.3 Output files

The output files `S3A_output_anx_data_0.txt` and `S3A_output_anx_data_1.txt` are created. Excerpt of the example output files:

#### `S3A_output_anx_data_0.txt`

```
# Generated with executable tool CalcOrbitANXDataList v1.0
# Satellite: SENTINEL3A
# Orbit File: ./INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF
# Start Time: 2013-06-20T00:00:00.000000
# Stop Time: 2013-06-22T00:00:00.000000
# Output Filename: ./OUTPUT/S3A_output_anx_data_0.txt
#
# Calendar UTC Time      MJD2000 UTC Time      Position (X,Y,Z) in EF CS [m]      Velocity (VX,VY,VZ)
in EF CS [m/s]  Geocentric Longitude [deg]      Absolute Orbit Number      Relative Orbit Number within
Cycle      Cycle Number
# -----
-----
2013-06-19T22:46:07.613188 4918.948699226713 +7038785.517167 -1435988.314424 -0000000.000164 -
0336.428454 -1605.946558 +7366.346698 +348.469275 05092 030 015
2013-06-20T00:27:06.765059 4919.018828299294 +5754007.485534 -4300991.421343 -0000000.000159 -
0989.254724 -1309.001571 +7366.290275 +323.222711 05093 031 015
2013-06-20T02:08:05.935080 4919.088957581945 +3369896.380940 -6344406.329979 -0000000.000267 -
1452.933182 -0761.990688 +7366.279529 +297.975463 05094 032 015
2013-06-20T03:49:05.174126 4919.159087663495 +0342140.991283 -7175605.167655 -0000000.000167 -
1638.930675 -0069.567512 +7366.429556 +272.729860 05095 033 015
[...]
```

#### `S3A_output_anx_data_1.txt`

```
# Generated with executable tool CalcOrbitANXDataList v1.0
# Satellite: SENTINEL3A
# Orbit File: ./INPUT/S3A_TEST_AUX_ORBRES_20130618T195000_20130715T215000_0001.EOF
# Start Time: 2013-07-07T14:00:00.000000
# Stop Time: 2013-07-10T04:00:00.000000
# Output Filename: ./OUTPUT/S3A_output_anx_data_1.txt
#
# Calendar UTC Time      MJD2000 UTC Time      Position (X,Y,Z) in EF CS [m]      Velocity (VX,VY,VZ)
in EF CS [m/s]  Geocentric Longitude [deg]      Absolute Orbit Number      Relative Orbit Number within
Cycle      Cycle Number
# -----
-----
```

```
2013-07-07T13:13:51.929033 4936.551295474919 -4763316.989003 +5377433.632036 +000000.000124
+1233.759467 +1081.499514 +7366.457056 +131.534441 05343 281 015
2013-07-07T14:54:51.152006 4936.621425370439 -2014736.607867 +6895515.086318 +000000.000160
+1576.969535 +0451.907650 +7366.360379 +106.287345 05344 282 015
2013-07-07T16:35:50.452088 4936.691556158426 +1118896.832591 +7096156.770620 -000000.000079
+1618.971602 -0263.817090 +7366.302948 +081.039576 05345 283 015
2013-07-07T18:16:49.753042 4936.761686956504 +4038676.637183 +5941022.620619 +000000.000017
+1351.852749 -0929.176881 +7366.369337 +055.792336 05346 284 015
[...]
```

## 6. TECHNICAL DETAILS AND ASSUMPTIONS

### 6.1 Coordinate Systems

The description of the Coordinate Systems can be found In Section 5 of [RD 03].

The satellite position and velocity is provided in Earth-Fixed (EF) Coordinate System.  
The geodetic coordinates are defined with respect Earth Ellipsoid WGS 84.

The OPS angle is calculated according to [RD 04].

### 6.2 Earth Observation CFI Software Version

The executable tools have been generated using EO CFI v4.4.

### 6.3 Repeat Cycle and Cycle Length

In the sun-synchronous orbits, the ground track repeats precisely after a constant integer number of orbits and a constant duration. The duration in days of that period is called the repeat cycle, whereas the corresponding number of orbits is called the cycle length.

### 6.4 Absolute Orbit Number

The absolute orbit number considers the orbits elapsed since the first ascending node crossing after launch.

### 6.5 Relative Orbit Number and Cycle Number

The relative orbit number is a count of orbits from 1 to the number of orbits contained in a repeat cycle. The relative orbit number 1 corresponds to the orbit whose ascending node crossing is closest to the Greenwich Meridian (eastwards). The relative orbit number is incremented in parallel to the absolute orbit number up to the cycle length, when it is reset and the cycle number is incremented by one.

A cycle is defined as a full completion of the repeat period. A cycle starts by definition on an ascending node crossing closest to the Greenwich Meridian.