Kernel Summary Applications

The contents of binary kernels can be summarized using kernel summary tools.

- ***brief*** **displays the bodies and associated time coverage in an SPK file or set of SPK files.**
  - ***brief also*** **works on binary PCK files**
- ***ckbrief*** **displays the structure(s) and associated time coverage in a CK file or set of CK files.**
- ***dskbrief*** **displays a summary of spatial coverage and attributes for a DSK file or set of DSK files.**
- ***spacit*** **displays a segment by segment summary of the contents of a CK, SPK, binary PCK, or EK/ESQ file.**
  - ***spacit*** **also identifies the SPK or CK data type present in each segment.**
  - ***spacit*** **does not work on DSK files.**

BRIEF

- *brief* is a command line program for summarizing the contents of SPK or binary PCK files
- The files to be summarized can listed on the command line, given in a meta-kernel provided on the command line, or provided in a list file
- *brief* provides command line options for
  - displaying coverage boundaries as date UTC, DOY UTC, or ET seconds past J2000 (default time format is calendar ET)
    - » to display time as UTC an LSK file must be provided on the command line
  - displaying centers of motion along with the bodies
  - treating all input files as if they were a single file
  - displaying a summary only for files covering a specified time or time range or containing data for a specified body
  - displaying a summary in tabular format or grouped by coverage
  - and many others ...

BRIEF - Usage

Navigation and Ancillary Information Facility

Terminal Window

```
$ brief
...
   BRIEF is a command-line utility program that displays a summary for
   one or more binary SPK or binary PCK files. The program usage is:

      % brief [-options] file [file ...]

   The most useful options are shown below. For the complete set of
   options, run BRIEF with the -h option. The order of options is not
   significant. The case of option keys is significant: they must be
   lowercase as shown below.

      -c            display centers of motion/relative-to frames
      -t            display summary in a tabular format
      -a            treat all files as a single file
      -utc          display times in UTC calendar date format (needs LSK)
      -utcdoy       display times in UTC day-of-year format (needs LSK)
      -etsec        display times as ET seconds past J2000

   An LSK file must be provided on the command line to display times in
   UTC formats. FK file(s) must be provided on the command line to
   display names of any frames that are not built into the Toolkit.
```

BRIEF - Example

Navigation and Ancillary Information Facility

Terminal Window

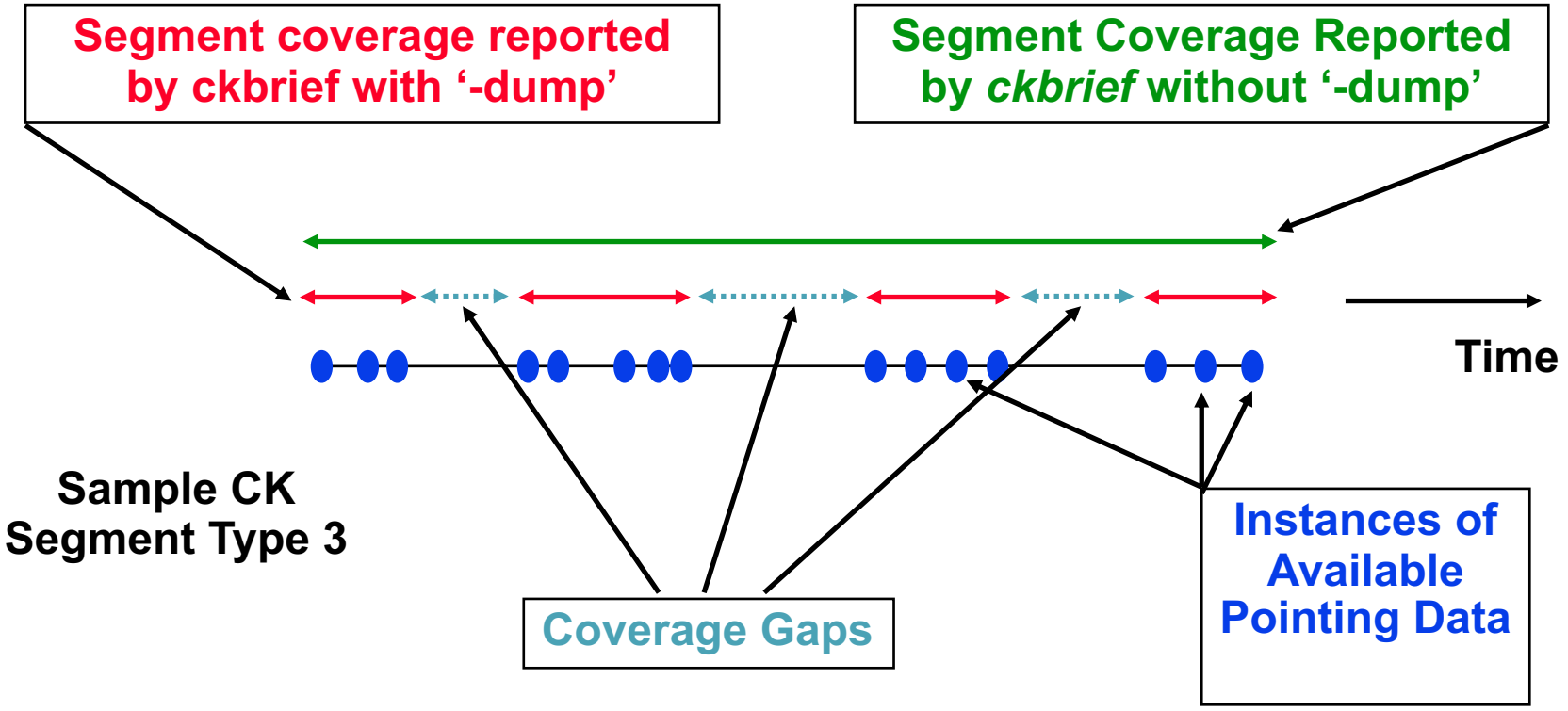
```
$ brief de405s.bsp m01_cruise.bsp

BRIEF -- Version 3.0.0, January 14, 2008 -- Toolkit Version N0063


Summary for: de405s.bsp

Bodies: MERCURY BARYCENTER (1)  SATURN BARYCENTER (6)   MERCURY (199)
        VENUS BARYCENTER (2)    URANUS BARYCENTER (7)   VENUS (299)
        EARTH BARYCENTER (3)    NEPTUNE BARYCENTER (8)  MOON (301)
        MARS BARYCENTER (4)     PLUTO BARYCENTER (9)    EARTH (399)
        JUPITER BARYCENTER (5)  SUN (10)                MARS (499)
        Start of Interval (ET)              End of Interval (ET)
        ----------------------------        ----------------------------
        1997 JAN 01 00:01:02.183            2010 JAN 02 00:01:03.183


Summary for: m01_cruise.bsp

Body: MARS SURVEYOR 01 ORBITER (-53)
      Start of Interval (ET)              End of Interval (ET)
      ----------------------------        ----------------------------
      2001 APR 07 16:25:00.000            2001 OCT 24 05:00:00.000
```

CKBRIEF

- *ckbrief* is a command line program for summarizing the contents of CK files
- The files to be summarized can be listed on the command line, given in a meta-kernel provided on the command line, or provided in a list file
- *ckbrief* provides command line options for
  - displaying coverage at interpolation interval level
  - displaying coverage boundaries using UTC, DOY UTC, SCLK, or encoded SCLK (default time format is calendar ET)
    - » To display times as ET, UTC, or SCLK, both an LSK file and a SCLK file(s) must be provided on the command line
  - displaying frames with respect to which orientation is provided
  - displaying the names of the frames associated with CK IDs
    - » An FK file(s) defining these frames must be provided on the command line
  - treating all input CK files as if they were a single file
  - displaying summary only for files with data for a given CK ID
  - and many others ...

CKBRIEF – Interval Summary

- There often are coverage gaps within a CK segment
- Using the '-dump' option allows one to get a complete list of continuous coverage intervals for each segment



CKBRIEF – Usage

Navigation and Ancillary Information Facility

Terminal Window

```
$ ckbrief

...
   CKBRIEF is a command-line utility program that displays a summary for
   one or more binary CK files. The program usage is:

      % ckbrief [-options] file [file ...]

   The most useful options are shown below. For the complete set of
   options, run CKBRIEF with the -h option. The order of options is not
   significant. The option keys must be lowercase as shown below.

      -dump        display interpolation intervals
      -rel         display relative-to frames (may need FK)
      -n           display frames associated with CK IDs (may need FK)
      -t           display summary in a tabular format
      -a           treat all files as a single file
      -utc         display times in UTC calendar date format (needs LSK&SCLK)
      -utcdoy      display times in UTC day-of-year format (needs LSK&SCLK)
      -sclk        display times as SCLK strings (needs SCLK)

   LSK and SCLK files must be provided on the command line to display times
   in UTC, ET, or SCLK formats. FK file(s) must be provided on the command
   line to display names of any frames that are not built into the Toolkit.
```

CKBRIEF – Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ ckbrief -sclk 981116_981228pa.bc sclk.ker

CKBRIEF -- Version 5.0.0, February 11, 2009 -- Toolkit Version N0063

Summary for: 981116_981228pa.bc

Object:  -82000
  Interval Begin SCLK      Interval End SCLK        AV
  ------------------------ ------------------------ ---
  1/1289865849.116         1/1293514473.118         N


$ ckbrief -utc sclk.ker naif0007.tls 990817_990818ra.bc

CKBRIEF -- Version 5.0.0, February 11, 2009 -- Toolkit Version N0063

Summary for: 990817_990818ra.bc

Object:  -82000
  Interval Begin UTC       Interval End UTC         AV
  ------------------------ ------------------------ ---
  1999-AUG-17 17:30:01.418 1999-AUG-17 23:05:42.039 N
  1999-AUG-17 23:05:45.289 1999-AUG-18 06:06:05.874 N
  1999-AUG-18 06:06:09.124 1999-AUG-18 11:52:17.741 N
  1999-AUG-18 11:52:20.991 1999-AUG-18 13:30:00.953 N
```

CKBRIEF - '-dump' Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ ckbrief mgs_spice_c_kernel_2004-099.bc MGS_SCLKSCET.00053.tsc naif0007.tls -dump
-rel -utc

CKBRIEF -- Version 5.0.0, February 11, 2009 -- Toolkit Version N0063

Summary for: mgs_spice_c_kernel_2004-099.bc

Segment No.: 1

Object:  -94000

  Interval Begin UTC       Interval End UTC         AV  Relative to FRAME
  ------------------------ ------------------------ --- -----------------
  2004-APR-08 00:00:59.809 2004-APR-08 06:53:47.805 Y   J2000
  2004-APR-08 06:54:07.805 2004-APR-08 06:54:07.805 Y   J2000
  2004-APR-08 06:54:19.805 2004-APR-08 06:54:35.805 Y   J2000
  2004-APR-08 06:54:51.805 2004-APR-08 06:54:55.805 Y   J2000
  2004-APR-08 06:55:07.805 2004-APR-08 06:55:07.805 Y   J2000
  2004-APR-08 06:55:23.805 2004-APR-08 06:55:23.805 Y   J2000
  2004-APR-08 06:55:35.805 2004-APR-08 11:59:55.802 Y   J2000
  2004-APR-08 12:00:55.802 2004-APR-08 23:59:55.795 Y   J2000
```

DSKBRIEF

- *dskbrief* is a command line program for summarizing the spatial coverage and additional attributes of DSK files
- DSK files to be summarized can be listed on the command line or given in a meta-kernel provided on the command line
  - Additional text kernels containing body, frame, and surface name-ID associations must also be provided to produce complete summary output
- *dskbrief* provides command line options for
  - generating extended, full, and segment-by-segment summaries
  - treating all input files as if they were a single file
  - displaying gaps in spatial coverage
  - controlling the number of significant digits in the output
  - and a few others

Comment Manipulation Tools

- Every kernel should contain metadata – called "comments" – describing the file contents, intended usage, etc.
- In binary kernels – SPKs, CKs, binary PCKs, DSKs and EKs – comments are stored in a special area of the file called the "comment area."
- *commnt* can read, extract, add, or delete comments stored in the comment area
  - Caution: you cannot add or delete comments if the kernel file is not in native format for the machine on which you're working.
    - » You can convert a non-native binary format file to native binary format by converting the file to "transfer format" using *toxfr* and then converting it back to binary format using *tobin*.
    - » Or use the *bingo* utility (available only from the NAIF website and Fortran toolkits).

COMMNT

- *commnt* is both a command line utility and an interactive menu-driven program
- In command line mode, *commnt* provides options to
  - print comments to the screen

    ```
    $ commnt -r kernel_file
    ```
  - extract comments to a text file

    ```
    $ commnt -e kernel_file text_file
    ```
  - add comments from a text file

    ```
    $ commnt -a kernel_file comment_file
    ```
  - delete comments

    ```
    $ commnt -d kernel_file
    ```
- Important
  - When comments are added, they are appended at the end of the existing comments
  - Comments should be deleted ONLY if being replaced with better comments

COMMNT - Command Line Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ commnt -r de405.bsp | more
; de405.bsp LOG FILE
;
; Created 1999-10-03/14:31:58.00.
;
; BEGIN NIOSPK COMMANDS

LEAPSECONDS_FILE    = /kernels/gen/lsk/naif0007.tls
SPK_FILE            = de405.bsp
  SOURCE_NIO_FILE   = /usr2/nio/gen/de405.nio
    BODIES          = 1 2 3 4 5 6 7 8 9 10 301 399 199 299 499
    BEGIN_TIME      = CAL-ET 1950 JAN 01 00:00:41.183
    END_TIME        = CAL-ET 2050 JAN 01 00:01:04.183

; END NIOSPK COMMANDS

A memo describing the creation of the DE405 generic planet ephemeris is avail
able from NAIF or from the author: Dr. Myles Standish of JPL's Solar System Dy
namics Group. Because this memo was produced using the TeX processor and inclu
des numerous equations



       >>> Beginning of extract from Standish's DE405 memo <<
...
```

MKSPK

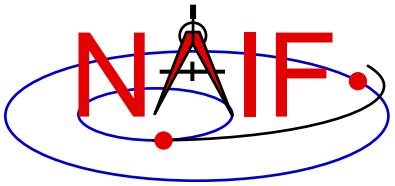
- ***mkspk*** **may be used to generate an SPK file from any of several types of data, such as discrete state vectors, classic orbital elements, and two-line elements**
- **Use of this program is discussed in a separate tutorial about making SPK files, and in the *mkspk* User's Guide.**

MSOPCK

- ***msopck*** **is a program for making CK files from orientation provided in a text file as a time tagged, space-delimited table**
  - **Has a simple command line interface**
  - **Requires all setups to be provided in a setup file that follows the SPICE text kernel syntax**
  - **Can process quaternions (SPICE and non-SPICE flavors), Euler angles, or matrices, tagged with UTC, SCLK, or ET**
  - **For more details see the "Making a CK File" Tutorial**

FRMDIFF

- *frmdiff* is a command line program for sampling the orientation of a reference frame or for computing the difference between orientations of two reference frames based on provided set(s) of SPICE kernels
- In sampling mode, *frmdiff* computes a set of transformations from one frame to another frame over a specified interval with a specified time step
- In comparison mode, *frmdiff* computes two sets of transformations for two pairs of "from" and "to" frames and then computes the difference in rotation and angular velocity between these transformations over a specified interval with a specified time step
- Depending on the execution mode and the requested output type *frmdiff* prints to the screen:
  - only the maximum rotation or the maximum rotation difference,
  - a complete table of rotations or differences (as angle and axis, SPICE- or engineering-style quaternions, matrices, or Euler angles), or
  - a statistical analysis of rotations or differences.



FRMDIFF – Comparison Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ frmdiff -k naif0009.tls cas00130.tsc cas_v40.tf -s 10 -b 2009-JAN-09 00:00 -e 2009-JAN-10 00:00 -t
dumpaa 09009_09025pa_fsiv_lud2.bc 09006_09011ra.bc > output.txt

$ cat output.txt
#
# Comparison of 3143 rotations
#    from 'J2000' (1) to 'CASSINI_SC_COORD' (-82000)
#    computed using
#       naif0009.tls cas00130.tsc cas_v40.tf
#       09009_09025pa_fsiv_lud2.bc
#
# with 3143 rotations
#    from 'J2000' (1) to 'CASSINI_SC_COORD' (-82000)
#    computed using
#       naif0009.tls cas00130.tsc cas_v40.tf
#       09006_09011ra.bc
#
# with a 10.000000000000 second (0:00:00:10.000000) step size
# within the non-continuous (with 1 gaps) time period
#
#    from '2009 JAN 09 15:17:06.359' TDB (284786226.35996 TDB seco...
#    to   '2009 JAN 10 00:01:06.184' TDB (284817666.18419 TDB seco...
#
# Times are TDB seconds past J2000.
# angle is shown in radians.
#
# time, angle, axis_x, axis_y, axis_z
+2.8478622635996E+08 +5.4958832051797E-05 +8.2101753099566E-01 +4....
+2.8478623635996E+08 +5.4931030131424E-05 +8.2046010733260E-01 +4....
```

MKDSK

- ***mkdsk*** **is a program for making DSK files from digital shape data provided in a text file**
  - **Has a simple command line interface**
  - **Requires all setups to be provided in a setup file that follows the SPICE text kernel syntax**
  - **Can process shape data in one of the following formats:**
    - » **plate-vertex table**
    - » **Gaskell shape model**
    - » **vertex-facet table**
    - » **Rosetta/OSIRIS “ver” table**
    - » **ASCII height grid**
  - **N0066 MKDSK can output only Type 2 (plate model) DSKs**
  - **For more details see the MKDSK User’s Guide**