CORONAL DIAGNOSTIC SPECTROMETER

SoHO

CDS SOFTWARE NOTE No. 45

Version 1 | 21 April 1997

CDS SOLAR FEATURE TRACKING

C D Pike
Rutherford Appleton Laboratories
Chilton, Didcot
Oxon OX11 0QX

cdp@astro1.bnsc.rl.ac.uk

1 Introduction

The Command and Data Handling Software on board CDS has a module which allows CDS to track solar features (ie compensate for solar rotation) for the duration of a raster. It does this by moving the OPS legs, which since they have step sizes of approximately one arcsecond at 45 degrees to the solar (X,Y) axes limits the corrective action that can be taken to about 1.7" in a westerly direction. It is important therefore not to confuse CDS's ability to feature track with the operation of a typical 'autoguider', where the spatial resolution of the guider is a lot less than the detector resolution.

At disk centre the minimum drift that can be compensated for will occur in about 600 secs. The optimum performance that can be expected (and has been shown to be achieved) is where the sun will drift in X by 1.7" relative to the slit and will then be kicked back into position (the time interval between kicks will be dependent upon latitude, longitude). The X location of the slit will therefore trace a saw-tooth path on the sun with an amplitude of just under 2".

2 Standard use of the feature tracking facility.

Planning to use the feature tracking is straightforward but planners should note the inherent limitations described above.

The use of the basic feature tracking is controlled by the 'Feature Track' button in MK_PLAN. This controls the status of tracking on a raster by raster basis. The routine PREPARE_FT is automatically run within XCPT and the tracking parameters are automatically loaded by the LOAD_PLAN script.

See the documentation on PREPARE_FT for details of how to fine-tune the parameters. Normally however the coarseness of the OPS movements means that the standard parameters are more than sufficient and applicable to any studies run the same day.

3 Optional extras

The CDHS feature tracking module takes its parameters from a single table stored on board. It therefore follows that only one set of parameters can be loaded at any one time, and hence since the loading is done by the planning and commanding software, it is not normally possible to cater for different tracking requirements. If needed however, two tracking parameters can be changed by the planner and these are provided as keyword inputs to the PREPARE_FT routine.

LATITUDE - specifies the heliographic latitude of the feature being tracked. Specifying this allows differential solar rotation to be taken into account. The default is to use latitude zero.

INTERVAL - specifies the interval in seconds after which the tracking module will calculate whether it needs to move the OPS. At disk centre the solar rotation is approximately 10" per hour. That means that the minimum readjustment it is possible to make with the OPS occurs in about 600 seconds (the default value), so usually there is little point in having the interval much less than this.

Do not be tempted to use too small a value of the interval on the asumption that the tracking module will then always catch any position change as soon as it is required. Every time the position is checked, an instruction to move is also issued - even if this is to the same location. Unfortunately commanding the OPS to move to the position it already is can have undesirable consequences since the commanded position and the OPS encoder readings may not be identical and it is possible to set the OPS oscillating with an amplitude of a step or two and a period equal to twice the tracking interval.

If two observations were to be planned during the day which required different tracking setup parameters, this could be achieved by running the planning software in two periods, but the second period must not be uplinked before the first's use of feature tracking has completed. It should be noted that this is a most unlikely scenario.

4 Subtleties to watch

Feature tracking is switched on and off at the beginning and end of each raster. The duration of a raster for this definition includes some data readout time, specifically it includes the time needed after the exposure has finished in order to clear the data through to the CDHS data store. When the data extraction is telemetry-limited (eg full NIS spectral extraction) this may make the raster last several minutes after the last exposure has finished.

If several rasters are planned sequentially at the same pointing, with feature tracking switched on, each raster should in theory be made at the correctly rotated location. The reason for this is that since all rasters are planned at the same location, no repointing commands will be issued between rasters and the Nth raster will simply start wherever the (N-1)th raster finished. This assumes however that feature tracking actually updated the position during the (N-1)th raster. It will only do that if:

a) the solar rotation required it during the duration of the raster

b) the timing interval allowed it to calculate the new location during the raster.

So, for instance, a series of 1000 second rasters (interval 600 secs) will have their positions updated, but they would not if the interval was set to 1200 secs, and a series of 500 second rasters would never have their positions updated, regardless of the interval set because during any raster the solar rotation would never reach a magnitude large enough to require correction.

5 Recommendations for use

The limited performance of the feature tracking makes it far from ideal for some uses. In particular do not use it if you require consistent corrections at the level of less than a few (3-5) arcseconds. Also be aware that if a lengthy raster has feature tracking on, any resultant image will have spatial discontinuities as well as time variation within it.

Feature tracking is perhaps most useful if lengthy 'sit and stare' rasters are used and it is required to maintain the pointing to a few arcseconds.

If short rasters are to be repeated all at approximately the same solar location over a period of several hours, it will always be better to plan them as separate entities with the start location specified at the planning stage. Calculation of start positions, allowing for solar rotation, has been added to MK_PLAN.

6 Engineering use of feature tracking

The feature tracking capability has been hijacked to help in the provision of NIS flat fields. This requires a different setup of the tracking parameters. The study FAST_TRK (or its latest variation) is used to take flat field data. This should be planned with feature tracking on. However, instead of running PREPARE_FT, as above, the procedure FAST_FT is run and the corresponding TCL command is

TCL> run CB2FEAT fast.dt

After the study has run, and before any normal use of feature tracking is resumed, both the PREPARE_FT procedure and standard TCL command MUST be run.