FAKERAD
Reference Manual
(for version 20110810)

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Contents

1. Description of Fakesat_menu Sub-Menus

In this section of the guide are descriptions of each of the `fakesat_menu` sub-menus. They are listed in alphabetical order with each sub-menu description starting on a new page. Note that many of the sub-menus listed will not be available to users who use the simplified version of the menu obtained by issuing the command `run`. The simplified version of the menu should be sufficient for most users. The more complete and therefore more complicated version of the menu is obtained by issuing the command `run -c`.

There are six major sub-menus that control what tasks `fakesat_menu` can perform. These are the mode:, spacecraft:, options:, telescope options:, data options: and extra plots: sub-menus. The user is advised to refer to the description of these sub-menus to get a full picture of what functions the software can perform. Also remember that only those sub-menus required to accomplish a particular task are displayed. Thus changing the task to be accomplished changes the sub-menus that are displayed.

array: sub-menu

In this 'many' pushbutton sub-menu the user (de-)selects any VLBI ground array they wish to use. Once a ground array has been (de-)selected those members of that ground array are (de-)selected from the list of selected ground radio telescopes in the telescopes: sub-menu. Note that more than one ground array can be selected.

ENV

The European VLBI Network.

OTHER

The OTHER array is NOT an official VLBI array. The antennas listed as OTHER are those antennas that are not in the EVN arrays.

data options: sub menu

This 'only one' pushbutton sub-menu is revealed when the data > pushbutton of the options: sub-menu is selected. In this sub-menu various simulated data generation and manipulation task are performed. The SNR below which to flag data and the source model to be used are shown in the model info: sub-menu.

uv-distance

Plot of correlated flux density (in Jy) versus baseline length (measured in units of Earth diameters). Earth-Earth baselines are shown in light blue (cyan) if un-flagged and orange if flagged. Similarly space-Earth baselines are shown in green if un-flagged and red if flagged.

SNR-plot

Plot of Signal to Noise Ratio (SNR) versus baseline length (measured in units of Earth diameters). Earth-Earth baselines are shown in light blue (cyan) if un-flagged and orange if flagged. Similarly space-Earth baselines are shown in green if un-flagged and red if flagged.

The following options are only available when the complex version of the menu is used and are still under development.

To invoke the complex menu type `run -c`. These options provide an interface between `fakesat` and Caltech VLBI package programs. With the exception of the modelfit pushbutton this interface is provided via the `fakesat_system` C shell script file. At the moment these pushbuttons only produce X windows output.

modelfit

Automatic model-fitting of a single Gaussian component. This model-fitting is performed with an adaptation of the Caltech model-fitting program, `modelfit`. In order to use this option the answer 'y' must be provided to the 'Do you want to perform automatic model-fitting ?' asked by the `fakesat_init` C shell installation script.

modplot

A contour plot of the source model, whose name is specified by the MODEL file parameter of the model info: sub-menu, is plotted convolved with the CLEAN restoring beam appropriate to the u-v coverage that would be generated from the parameters and pushbuttons shown on the menu. For this pushbutton to work correctly the Caltech VLBI package programs, `invert` and `modplot`, must exist and the directory in which they reside must be in the user's path. Note that if no source name is specified this option will not work.

visplot

Plots of the visibility amplitude versus time on different baselines. For this pushbutton to work correctly the Caltech VLBI package program, `visplot`, must exist and the directory in which it resides must be in the user's path.

dirty beam

Produce the dirty beam of a simulated experiment. For this pushbutton to work correctly the Caltech VLBI package program, `invert`, must exist and the directory in which it resides must be in the user's path.

CLEAN map

Produce the CLEAN map from a simulated experiment. The source model For this pushbutton to work correctly the Caltech VLBI package programs, `invert`,`clean`, `mapstat`, and `mapplot` , must exist and the directory in which they reside must be in the user's path. The number of CLEAN components is set to 1000. To change this number, edit the `fakesat_system` file and change the value of NITER from 1000 to whatever is desired. In this simulation only thermal amplitude and phase errors are added to the u-v data.

east longitude at start of plot: sub-menu

This is 'parameter' sub-menu is only used when the ground track pushbutton of the extra plots: sub-menu has been selected.

E. Long (°)

Eastern longitude for the start of the spacecraft ground-track plot.

eclipses for n days: sub-menu

In this 'parameter' sub-menu menu the user sets the number of days over which they wish to calculate the spacecraft eclipse history. The first day of the eclipse history is determined from the observation date: sub-menu.

n days

Number of days over which the eclipse history is to be calculated.

every n days and h hours: sub-menu

This 'parameter' sub-menu is only used when the time-uvplot pushbutton of the options: sub-menu has been selected. With this sub-menu the user sets the time interval between u-v plots to be n + (h/24) days. The first u-v plot to be produced is set by the observation date: sub-menu and the length of time of each u-v plot is set by the observation time: sub-menu.

n days

Time interval between u-v plots is n + (h/24) days.

h hours

Time interval between u-v plots is n + (h/24) days. Setting the time interval in terms of hours rather than days can be useful is examining how much data is collected at different points in the spacecraft orbit.

extra plots: sum-menu

This 'only one' pushbutton sub-menu is revealed if the extra plots > pushbutton of the options: sub-menu has been selected. This sub-menu, with the exception of the source view option, contains less frequently used features that are concerned with the operation of the spacecraft.

The following two options are still under development

source view

View of the rotating Earth as seen from the source. Earth-Earth baselines are shown in red and space-Earth baselines in green. A communication link between the spacecraft and tracking station is shown in brown. The tracking station that is being used is shown in green at the bottom left of the screen. A red NO TELEM message is displayed, when no tracking is available. On the bottom right hand corner there is a clock that shows the time an observation has lasted for in hours. If the show uv-plot option of the show uv-plot ?: sub-menu has been selected then a u-v plot will created above the rotating Earth.

sat view

This option shows the view of the Earth as seen from the spacecraft. When the spacecraft is above (below) the elevation limit of a tracking station the location of the tracking station is shown as a green (red) square. The spacecraft ground track is shown in green when the spacecraft is visible from a tracking station and red when it is not. In the bottom left hand of the plot there is an altimeter that shows the height of the spacecraft from the Earth's surface in km. In the bottom right hand corner of the plot there is a clock that shows the length of time that the observation has lasted for in hours. The field of view of the plot is controlled by the FOV(°) parameter of the field of view sub-menu. This is the field of view of the plot in degrees and is the angle between the center of the screen and edge of the screen. Thus when this parameter is set to 90° a complete half-hemisphere is plotted. The cross-hairs in the center of the screen subtend a angle of 10°.

ground track

Produce the sub-satellite ground track of the spacecraft. When the spacecraft is visible from at least one tracking station the ground track is shown in green. If the plot red option of the plot red ?: sub-menu has been selected, a red dotted line is plotted when the spacecraft is not visible from any of the tracking stations. The eastern longitude of the left hand of the plot is controlled by the E. Long(°) parameter of the east longitude at start of plot: sub-menu. Small circles are plotted on the ground track every hour.

The following options are only available when the complex version of the

`menu_defaults` file is used.

tracking-azel

For the tracking stations that are selected in the tracking stations sub-menu, this option plots various parameters as a function time, when the spacecraft is above an elevation of 0°. At present it does NOT use the tracking station elevation limits. There are plots of elevation, azimuth, and range as well as their derivatives as functions of time. At the bottom of the plot is a polar diagram of zenith angle versus azimuth for the various spacecraft passes. Small circles are plotted every hour to enable track lengths to be quickly estimated.

The following option is still under development

telemetry ant

This is plot ,similar to the tracking-azel option but is the view of the tracking stations from the spacecraft.

yz-angle

The user obtains a plot of the range of angyz that meet the spacecraft constraints as function of time. Green indicates that the spacecraft constrains are met for a certain value of angyz at a certain time. It is assumed that if the spacecraft constraints are met for any angyz at a particular epoch then RadioAstron can observe.

eclipse

With this option the user can produce the spacecraft eclipse history. The n days parameter of the eclipses for n days: sub-menu determines on how many days to determine the eclipse history. The default is 50 days. Several plots and diagnostic information are produced. There is a plot of eclipse length versus day number as well as a histogram of eclipse length. However the most useful diagnostic is the plot of the range of true anomaly occupied by the eclipse as a function of day number. The true anomaly is the angle between spacecraft position vector at a certain time and the spacecraft position vector when the spacecraft is at perigee (i.e., the closest point in the orbit to the Earth). Thus, if the true anomaly is near zero, data will be lost near perigee, and if it is near 180°, data will be lost near apogee. As the spacecraft has a high angular velocity near perigee the loss of data near perigee can be much more than indicated by the eclipse length relative to the orbital period. The converse is true for eclipses near apogee.

field of view: sub-menu

In this 'parameter' sub-menu menu the user sets the field of view for the sat view option of the extra plots sub-menu.

FOV (°)

The field of view of the plot in degrees. The field of view is defined as the angle between the center of the screen and edge of the screen. Thus when this parameter is set to 90° a complete half-hemisphere is plotted. The cross-hairs in the center of the screen subtend a angle of 10°.

min # of telescopes: sub-menu

With this 'parameter' sub-menu the user sets the minimum number of telescopes that need to be simultaneously observing the source before any u-v points are created. The default value is 2, since RadioAstron will be of an exploratory nature and model-fitting will be undertaken for many experiments. Closure information is not required for model-fitting.

min #

Minimum number of radio telescopes that must be observing the source before any u-v points are created.

mode: sub-menu

This 'only one' pushbutton sub-menu controls what mode the interactive menu system is in and what high level functions to perform.

input

When this button is selected the menu is in 'input' mode. In this mode pushbuttons and parameters in the various sub-menus can be changed with the mouse.

run

Create the `.fakesat-tmp.csh` C shell script and execute it as a background process. This is how jobs are run. Once the user is satisfied with the parameters that have been set and the pushbuttons that have been selected, a job is executed by hitting the 'run' button. After a job has been created as a background process this sub-menu returns to 'input' mode. By default the menu is in 'run' mode.

system info

List what fakesat processes are running, the number and size of the default and plot files that have been created and the source model file in the `model` directory.

save menu

Write out a new version of the `fakesat_menu` defaults file, `menu_defaults`. The `menu_defaults` file stores information on all the pushbuttons and parameters that can be set on the `fakesat_menu` menu. Since `fakesat_menu` reads the `menu_defaults` file when it is started, writing out a new version of the `menu_defaults` is equivalent to saving the present version of the menu for subsequent re-use. For each spacecraft a separate set of defaults is stored. A new defaults file with a unique name beginning with `def-` is also created.

initial menu

Re-set the interactive menu and the `menu_defaults` file to their original values. This option is useful if the user wants to return the menu to the default configuration.

update

On selecting this pushbutton the `fakesat_menu` menu will be updated with any changes that have been made to the `stations.cat` file. The information stored in the `stations.cat` file includes the spacecraft orbital elements, which ground radio telescopes, ground arrays, and tracking stations to use along with system temperature information for the ground radio telescopes and spacecraft. See Appendix B in Volume 2 for more details on the information contained in this file and how to update the menu.

exit

Exit from the `fakesat_menu` program.

model info: sub-menu

This is a 'parameter' sub-menu. Many of the task performed by `fakesat_menu` require a source model to work correctly. The parameters in this sub-menu control both what the source model to use and the signal to noise ratio below which u-v data is to be flagged.

MODEL file

The name of a source model file to use. Source model files need to be located in the `model` sub-directory of the directory in which `fakesat_init` was run in. `Fakesat_init` creates the `model` subdirectory and places some example source model files in this subdirectory. By convention source model files have a .src suffix. The source model files that already exist in the src subdirectory can be listed by selecting the system info pushbutton of the mode: sub-menu. These files follow the usual Caltech VLBI convention for describing source models. The following text describing source models is taken directly from the Caltech VLBI package help file.

Model files are text files that can be typed or printed directly; they can be modified or created using the standard text editors. A model file consists of one line for each component of the model, with up to 7 numbers on each line (in free format):

1. Component flux density S (Jy).
2. Distance of center of component from origin r (milliarcsec).
3. Position angle of center of component with respect to the origin θ (degrees, North through East).
4. Major axis of component a (milliarcsec). For all component types, this is the full width, not the half-width; for circular components, it is the diameter.
5. Axial ratio α (minor/major, i.e., < 1).
6. Position angle of major axis ϕ (degrees, North through East).
7. Type:
   - 0 or 1: delta function (if major axis is 0) or elliptical Gaussian (major axis is FWHM);
   - 2: elliptical disk of uniform brightness;
   - 3: optically thin ellipsoid;
   - 4: elliptical ring of zero thickness;
   - 5: rectangle of uniform surface brightness (major axis is length of longer side; axial ratio is ratio of sides).

If less than 7 numbers are specified, the omitted numbers are taken to be zero. Thus for Gaussians and delta-functions, the Type can be omitted; for delta-functions, the major-axis, axial-ratio, position-angle and type can be omitted. (Not all the

programs understand types 2–5.) The *origin* is an arbitrary phase-reference point. The maximum number of components varies depends on the individual program.

Blank lines and lines beginning with an exclamation mark (—!—) in a model file are ignored.

The following is an example of a model file. A comment is included to label the columns. There are two Gaussian components, with the stronger one situated at the phase center and the weaker one 4.29 milliarcsec away:

```
!  Flux      Radius     Theta        Axis       Ratio       Phi  Type
 1.6816      0.0000      0.00      0.7985     0.11917      4.88     1
 0.1840      4.2899    194.47      1.4077     0.57033    121.14     1
```

If however the model file specified by the MODEL file parameter does does NOT exist, a single Gaussian component source model will be used whose parameters are described in this sub-menu.

SNR-flag

Signal to Noise ratio (SNR) below which simulated VLBI data should be flagged. If this parameter has a negative value then NO SNR flagging is performed and all simulated data is left un-flagged.

a (mas)

Major axis (in milliarcseconds) of the single Gaussian component source model. This model is used if the model file specified by the MODEL file parameter does NOT exist.

S(Jy)

The flux density (n Jy) of the single Gaussian component source model. This model is used if the model file specified by the MODEL file parameter does NOT exist.

b/a

Axial ratio (minor/major axis) of a the single Gaussian source model. This model is used if the model file specified by the MODEL file parameter does NOT exist.

PA (°)

Position Angle (N thru E) of the major axis (in degrees) of a the single Gaussian source model. This model is used if the model file specified by the MODEL file parameter does NOT exist.

number of plots per axis: sub-menu

This 'parameter' sub-menu is only used when the time-uvplot option of the options: sub-menu has been selected. With this sub-menu the user set the layout of multiple u-v plots on a page.

n-xaxis

Number of u-v plots along the x-axis.

n-yaxis

Number of u-v plots along the y-axis

number of uv-plots: sub-menu

This sub-menu is only used when the time-uvplot option of the options: sub-menu has been selected. With this sub-menu the user sets the number of u-v plots to be created.

N uv-plots

Produce a set of N u-v plots, where N is an integer.

obs parameters: sub-menu

In this 'parameter' sub-menu menu the user sets the integration period, the bandwidth and the digitization quantization level. The values of these parameters are used in thermal noise calculations. The integration period is also the time step used in the simulation and has a default value depending on which spacecraft and which options are being simulated.

For RadioAstron or a ground-only experiment the default integration period is 300 s for all observing bands. The only exception to these rules is for options that either create a large plot files or need to run quickly (and thus must have a long integration period). These options include the all-sky uv-plot option from the options: sub-menu and the source view option from the extra plots: sub-menu.

τ (s)

Integration period in seconds.

B (MHz)

The observing bandwidth in MHz.

1 or 2 bit

The quantization level of the digital sampling. Acceptable values are 1 or 2. The sampling is assumed to occur at the Nyquist rate.

observation date: sub-menu

In this 'parameter' sub-menu the user sets the year, number of the month, and the day of the month for a particular observation as follows:

obs-year

Year in which observation takes place.

obs-month

Number of the month in which observation takes place. For example May is month number 5.

obs-day

Day of the month on which observation takes place. If you want to use day number instead of day of the month set the epoch-month to 1.

observation time: sub-menu

In this sub-menu the user sets the start and stop times for a particular observation as follows:

start hh:mm:ss

Start time of the observation in the format hh:mm:ss.

stop hh:mm:ss

Stop time of the observation in the format hh:mm:ss.

Note: Start and Stop times MUST be in the above format. Thus 20.5 for 20:30:00 is NOT acceptable.

observing band: sub-menu

In this 'only one' pushbutton sub-menu the user sets the observing band.

327 MHz

Observe at P-band (0.327 GHz).

1.6 GHz

Observe at L-band (1.6 GHz).

5 GHz

Observe at C-band (5 GHz).

22 GHz

Observe at K-band (22 GHz).

options: sub-menu

This is a 'only one' pushbutton sub-menu. This sub-menu have been selected the following pushbuttons will be shown:

all-sky uvplot

For a particular epoch, produce a set of uv-plots as a function of right ascension and declination. This option is useful in determining in which areas of the sky good u-v coverages are obtained. The solar constraints of RadioAstron mean that the angle between the observed radio source and the Sun must be in the range of 90°-165°. Thus observations of most sources will be seasonal. The range of right ascensions and declinations for this plot is controlled by the RA and Dec ranges: sub-menu. The default is to produce a u-v plot every 2 hours in right ascension and every 20° in declination from -80° to +80°. Also by default the plotting of Earth-Earth baselines has been suppressed by setting the n-th parameter of the plot every n-th uv-point on Earth baseline to a large value (2000). The reason for this is that the hardcopy plot files for this option can be very large, if all the Earth-Earth baselines are plotted. Also plotted are the location of the Sun, the 90° and 165°, solar avoidance curves, the orbital plane, the orbit normal and orbit anti-normal directions (labeled as N), and the apogee and perigee directions (labeled as A and P respectively).

time-uvplot

The option produces a set of u-v plots for an observation of a particular source at equally spaced time intervals. This plot is used to determine how long a particular source can be monitored for. The number of u-v plots to produce, the time interval between plots , and the layout of the plots on the page are controlled by the N uv-plots:, the every n days and h hours :, and the # plots per axis: sub-menus respectively. Time interval between plots along the x axis is one period, and time interval between plots along the y axis is defined by every n days and h hours : sub-menu.

uvplot

Produce a u-v plot for a particular observation.

constraints

If the no constraints option of the constraints: sub-menu has been selected this option produces a tracking station timeline. D. Meier (JPL) developed a algorithm that is used in this software that decides which tracking station to use, if several are simultaneously available to track the spacecraft. The selected tracking station is shown is green, while other tracking stations that could track the spacecraft are shown in yellow. At the top of the plot is shown the spacecraft height as a function of time. This is useful as it often shows that the spacecraft cannot be tracked near perigee. If the spacecraft constraints are applied, this plot contains additional information. Below the tracking station timelines are the spacecraft constraint timelines. These timelines enable the user to see which spacecraft constraints have the most impact on a particular observation. At present spacecraft has 6 constraints. The tracking station

timelines are shown in white if the spacecraft is visible from a tracking station but the spacecraft constraints are broken.

telescopes >

Display the telescopes options: sub-menu.

data >

Display the data options: sub-menu.

extra plots >

Display the extra plots: sub-menu.

If the ground only pushbutton of the spacecraft: sub-menu has been selected, only the following pushbuttons are allowed:

source view

View of rotating Earth as seen from the source. Earth-Earth baselines are shown in light blue (cyan). On the bottom right hand corner is a clock that shows the time an observation has lasted for in hours. If the show uv-plot option of the show uv-plot ?: sub-menu has been selected then a u-v plot will created above the rotating Earth.

uvplot

Produce a u-v plot of a particular observation.

data >

Display the data options: sub-menu.

orbit: sub-menu

This sub-menu contained information on the Keplerian orbital elements for a particular spacecraft at a reference epoch. It was present in the FAKESAT version. In the FEKERAT version the orbit is given by the table of state vectors. Nevertheless, equivalent Keplerian orbital elements for a given time are shown in some figures for your understanding:

a (km)

Orbit semi-major axis in km.

e

Orbit eccentricity = (apogee height - perigee height) /2× semi-major axis.

i (°)

Orbit inclination in degrees (= 0° for an equatorial orbit, = 90° for a polar orbit).

Ω (°)

Right ascension of the ascending node in degrees. Ω is the angle between the first point of Aries (i.e., right ascension = declination = 0) and the point in the orbit plane where the spacecraft crosses the celestial equator heading north.

ω (°)

The argument of perigee in degrees. ω is the angle between the closest approach of the spacecraft to the Earth (perigee) and the point in the orbit where the spacecraft crosses the celestial equator heading North.

M (at 0 UT)

Mean anomaly of the spacecraft in degrees at 0 UT on the date of the reference epoch. The mean anomaly at any instant is defined such that the spacecraft last past through perigee M/360 orbital periods ago. Thus a spacecraft with a mean anomaly of 0 ° is at perigee and one with a mean anomaly of 180 ° is at apogee.

output options: sub-menu

Two versions of this 'parameter' sub-menu are available depending whether or not the task to be performed is suitable for production of hardcopy output or not. For example output of the uvplot pushbutton is suitable for a hardcopy device whereas the output of the source view pushbutton is not.
If the output is suitable for a hardcopy device, the following devices are available:

Xwindows

Xwindows output

ps: plot+menu

Create a PostScript file that contains both a copy of the plot produced by `fakesat` and a copy of the `fakesat_menu` screen used to create the plot. This is the preferred hardcopy output option.

ps: plot (b+w)

Create a grey-scale PostScript plot file.

ps: plot (color)

Create a color PostScript plot file.

If the output is NOT suitable for a hardcopy device, only one output device is available:

Xwindows

Xwindows output.

plot every n-th uv-point on Earth baselines: sub-menu

This 'parameter' sub-menu is only used when the uvplot, all-sky uvplot or time uvplot options of the options: sub-menu have been selected. In a space VLBI simulation there are many more Earth-Earth u-v points produced compared to Earth-space uv-points. In order to save time and disk space it is often desirable to plot only every n-th u-v point for Earth-Earth baselines.

n-th

Only every n-th u-v point is plotted for Earth-Earth baselines. A very high number suppresses the plotting of Earth-Earth baselines entirely.

plot grt names ? : sub-menu

This 'toggle' pushbutton sub-menu menu allows the user to choose whether or not they want to plot names of the ground radio telescopes and is only used when the GRT map pushbutton of the telescope options: sub-menu has been selected.

plot names

Plot ground radio telescope names.

no names

Do not plot ground radio telescope names.

plot red ?: sub-menu

This 'toggle' pushbutton sub-menu is used to determine whether or not to plot the spacecraft ground-track when the spacecraft is not visible from any of the tracking stations.

plot red

Plot in red the spacecraft ground-track when the spacecraft is not visible from any tracking station.

not plot

Do not plot the spacecraft ground-track when the spacecraft is not visible from any tracking station.

plot uv-limits: sub-menu

This 'parameter' sub-menu is used to set the u-v limits for any plots that require u-v limits to determine what range of u-v points should be plotted. The default u-v limits are set when the observing band is chosen from the band: sub-menu.

u-max (Gλ)

Maximum u coordinate to be plotted in Gλ.

v-max (Gλ)

Maximum v coordinate to be plotted in Gλ.

plotting parameters: sub-menu

This 'parameter' sub-menu controls the width of lines and points to be plotted.

line width

Integer that specifies the line thickness. Must be in the range 1-21. 1 is the default and gives a thin line. For hardcopy output it may desirable to produce thicker line output. Some experimentation is needed to come up with a good choice as the actual line width obtained depends on the device resolution.

dot size

Integer that specifies the dot size. Must be in the range 1-21. 1 is the default and gives a small dot.

RA and Dec: sub-menu

In this 'parameter' sub-menu the 1950 coordinates of the source to be observed are set, if they have not been set by the source name: sub-menu.

RA hh:mm:ss.ss

Right ascension of the source in 1950 coordinates in the format hh:mm:ss.ss.

Dec dd:mm:ss.ss

Declination of the source in 1950 coordinates in the format hh:mm:ss.ss.

RA and Dec ranges: sub-menu

This 'parameter' sub-menu is only used when the all-sky uvplot option of the options: sub-menu has been selected. With this sub-menu the ranges in right ascension and declination for a grid of u-v plots to be created are set. The default is to produce a u-v plot every 2 hours in right ascension and every 20° in declination, from -80° to +80°.

RA-min (h)

Right ascension of the u-v plots at the left hand of the grid. Format is hh.dd, that is, a decimal representation of right ascension in hours and NOT the hh:mm:ss.ss format used in the observation time: sub-menu.

RA-max (h)

Right ascension of the u-v plots at the right hand of the grid. Format is hh.dd, that is, a decimal representation of right ascension in hours and NOT the hh:mm:ss.ss format used in the observation time: sub-menu.

RA-step (h)

Difference in right ascension between u-v plots on the grid. Format is hh.dd, that is, a decimal representation of right ascension in hours and NOT the hh:mm:ss.ss format used in the observation time: sub-menu. In order to correctly interpret the all-sky u-v plot that is produced it is useful to choose RA-min (h) > RA-max (h) and use a negative RA-step (h).

Dec-min (°)

Declination of the u-v plots at the bottom of the grid. Format is hh.dd, that is, a decimal representation of Right Ascension in hours and NOT the hh:mm:ss.ss format used in the observation time: sub-menu.

Dec-max (°)

Declination of the u-v plots at the top of the grid. Format is dd.dd, that is, a decimal representation of Declination in degrees and NOT the dd:mm:ss.ss format used in the observation time: sub-menu.

Dec-step (°)

Difference in declination between the u-v plots on the grid. Format is dd.dd, that is, a decimal representation of declination in degrees and NOT the dd:mm:ss.ss format used in the observation time: sub-menu. In order to correctly interpret the all-sky u-v plot that is produced it is useful to choose Dec-min (°) < Dec-max (°) and use a positive Dec-step (°).

show angles ?: sub-menu

This 'toggle' pushbutton sub-menu is only used in conjunction when the source view option of the extra plots: sub-menu has been selected. When show angles ? is toggled on various diagnostic angles are shown depending on whether the spacecraft constraints are allied or not. The following information and angles are displayed:

- The time from the start of the observation in hours, the height of the spacecraft in km, and various spacecraft pointing angles, where a pointing angle is the angle between the spacecraft pointing direction (i.e., the source direction) and various other objects. For the case of no spacecraft constraint only the angle between the spacecraft pointing direction and the orbit normal is shown. If this angle is near 0° (180°) the source lies near the orbit (anti-)normal direction and 2-D u-v coverage is obtained. If this angle is near 90° the source lies near the orbital plane and approximately 1-D u-v coverage is obtained. When the spacecraft constraints are applied: earth, moon, and sun pointing angles are also shown. Also plotted are the angle from the center of the Earth to the Earth's limb, the angle from the center of the Earth to the sun, and the difference between these angles. If this difference is positive (negative) then these angles are plotted in green (red).
- Tracking stations are shown in green (red) if all the constraints are (not) met for that tracking station i.e., if the spacecraft is above the elevation limit for that tracking station and the spacecraft constraints are met, if they are applied. If the spacecraft constraints are applied, three angles are also plotted for each tracking station. These are the elevation angle (elev) of the spacecraft from the tracking station, the spacecraft yz-rotation angle (ang_yz) for which the spacecraft constraints are met and the angle (ang_tel) between the spacecraft telemetry antenna axis and the tracking station. These are last two angles are set to -10.00, if the spacecraft is not visible from the tracking station or the spacecraft constraints are broken. When there are no spacecraft constraints only the spacecraft elevation angle is plotted.
- Ground radio telescopes are shown in green (red) if the source is above (below) the telescope elevation limit. The elevation angle of the source is plotted after the telescope name.

show angles

Display diagnostic angles.

NO angles

Do NOT display diagnostic angles.

show uv-plot ?: sub-menu

This 'toggle' pushbutton sub-menu is only used when the source view pushbutton of the extra plots: sub-menu has been selected. When show uv-plot is toggled on the u-v coverage will be shown building up above the rotating Earth.

show uv-plot

Produce a u-v plot above the rotating earth.

NO uv-plot

Do NOT produce a u-v plot above the rotating earth. d

source name: sub-menu

In this 'parameter' sub-menu the name of the source to be observed is set.

source

Source name. Once a source name has been entered, `fakesat-menu` checks to see if the source name exists in the `sources.cat` file. If the source name does exist in this file, the source coordinates are entered into the RA and Dec: sub-menu. If the source name does not exist, the RA and Dec parameters of the RA and Dec: sub-menu are both set to 00:00:00 unless the source name is of the form IJKL+MNP (or IJKL-MNP), where I,J,K,L,M, N and P are integers. If this is the case, the RA parameter is set to IJ:KL:00 and the Dec parameter is set to +MN:6P:00 (or -MN:6P:00). This mechanism enables rough source positions to be quickly entered.

spacecraft: sub-menu

This 'only one' pushbutton sub-menu is used to select which spacecraft to simulate or to simulate a 'ground-only' experiment.

RADIOASTRON

Simulate a VLBI observation with the RadioAstron spacecraft.

ground only

Simulate an VLBI experiment without any spacecraft.

spacecraft constraints: sub-menu

This sub-menu is used to determine if the spacecraft constraints are to be applied of not.

If the RadioAstron option of the spacecraft: sub-menu has been selected the following options are allowed:

constraints

Use the RadioAstron spacecraft constraints.

no constraints

Do not use any spacecraft constraints.

telescopes: sub-menu

In this 'parameter' sub-menu are shown the ground radio telescopes that can operate at the frequency band chosen from the band: sub-menu. These telescopes may belong to the various arrays listed in the array: sub-menu. Next to each telescope name is a number. For RadioAstron experiments this number is 1-σ noise level in mJy on the space-Earth baseline between the spacecraft and the telescope. For ground only experiments this number is such that taking the square root of the produce of the two numbers from two different telescopes will give the 1-σ noise level in mJy on the baseline between these two telescopes. The integration period, bandwidth, and quantisation level for this calculation are specified by the parameters from the obs parameters: sub-menu.

telescope options: sub-menu

This 'only one' pushbutton sub-menu is revealed when the telescopes > pushbutton of the options: sub-menu is selected.

timeline

Produce a timeline of when a particular telescope can observe the source. For ground radio telescopes the timeline is green when the telescope can observe the source. For a space radio telescope, the timeline is green if at least one ground radio telescope can observe the source at the same time as the spacecraft. Yellow indicates that the spacecraft can observe the source but that their are no ground radio telescopes that are co-observing at this time. This is a warning that spacecraft data is being lost.

N vs t plot

Produce a plot that shows how many telescopes can observe the source as a function of time. Two separate graphs are produced. The lower graph shows how many ground radio telescopes are available as a function of time. The upper graph shows how many telescopes are available when the spacecraft can observe. Above these two plots is shown the spacecraft altitude as a function of time.

F(>N) plot

Produce a plot that shows the fraction of the time at least N telescopes can observe the source. Two separate curves are plotted. In yellow is shown the curve for ground radio telescopes only and in green is shown the curve when at least one of the antennas is the spacecraft. This plot is useful for showing what fraction of the time closure phase (N=3)and closure amplitude (N=4) information will be obtained.

GRT map

Produce a map of the world showing the location of the ground radio telescopes used in the observation. Each telescope is represented by a green disk.

time step: sub-menu

In this 'parameter' sub-menu menu the time step for options, such as the sat view option of the extra plots: sub-menu, that need to run quickly is set.

τ **(s)**

Time step for the simulation in seconds.

tracking stations: sub-menu

Data on the tracking stations are stored in the `stations.cat` file.

For RadioAstron only tracking stations in Puschino will be used:

PUSCHINO

Russian tracking station at Puschino , near Moscow, Russia.

yz rotation angle: sub-menu

This sub-menu is only used when the telemetry ant option of the extra plots: sub-menu has been selected. See the description of the telemetry ant option in the section on the extra plots: sub-menu for more details.

With this sub-menu one value of the yz-rotation angles is selected. This is an approximation to the operation of the real spacecraft where a range of yz-rotation angles is allowed.

yz rotation angle

Angle between the projection of the sun vector in the yz-plane and the +z axis.

A Required Files and Environmental Variables

This appendix describes the files used by `fakesat` and various environmental variables that may need to be set to make `fakesat` work correctly.

The `fakesat_init` C shell script creates the following five files which are needed by the `fakesat` and `fakesat_menu` programs in the directory in which the user want to perform space VLBI simulations. The user must have read and write privileges for this directory:

1. `run`: Run is a simple C shell script used to run the `fakesat_menu` program.
2. `menu_colors` : This file contains information on the color scheme to be used for the interactive menu. In this guide it will be assumed that the default color scheme is being used. This files needs only to be read. More information on this file can be found in Appendix D.
3. `menu_defaults`: This file is quite complex and does not need to be accessed by the average user. Every parameter that is seen on the interactive menu is stored in this file. This file must be able to be read and written to. More information on this file can be found in Appendix C.
4. `stations.cat`: This file contains information on the spacecraft, ground radio telescopes, and tracking stations. More information in this file can be found in Appendix B.
5. `sources.cat`: This file contains information on the names and coordinated of VLBI radio sources. It is copy of the Caltech package file with the same name. Users may wish to add their favourite sources to their own local copy of this file.
6. `.lock`: The `fakesat_init` C shell script has to only be run once from the particular directory in which the user wishes to work in. When the `fakesat_init` C shell script has been run successfully the `.lock` file is created to prevent `fakesat_init` from being run gain. If the use wishes to re-run `fakesat_init` from the same directory then either the `.lock` file must be removed or the command `run -f` must be executed.

`fakesat_init` also creates the following soft links to the following files, programs, and directories :

1. `fakesat`: The Space VLBI simulation program `fakesat`.
2. `fakesat_menu`: The X windows interactive interface to the `fakesat` program.
3. `fakesat_system`: A C shell script that performs system dependent functions required by the `fakesat` program. This file may need to be edited if a call to `fakesat_system` does not behave as required.

4. `.worldmap`: A file that contains longitude and latitude information. It is used to produce a complex map of the world with each country outlined.
5. `.worldmap2`: A file that contains longitude and latitude information to produce a simplified map of the world.
6. `tex`: A subdirectory that contains all the latex help files for each sub-menu.

`Fakesat_init` also creates a subdirectory called `model`. It is in this subdirectory that the user must place any model files they wish to use.

When running `fakesat_menu` using the `run` C shell script a few PGPLOT environmental variables may need to be set up. Please edit the `run` C shell script and follow the instructions of how to set up these variables.

When `fakesat_menu` is started, it creates a couple of files that it needs: `.stations.cat.c` is a copy of the `stations.cat` file and `.tmp-n` is a file that is used to determine if the stations.cat file has changed since the last time `fakesat_menu` was run. Removing the `.stations.cat.old` file will cause the `fakesat_menu` menu to be re-initialized to the default configuration.

B The `stations.cat` File

The `stations.cat` file contains technical information on the ground radio telescopes, space radio telescopes and orbiters used by both `fakesat_menu` and `fakesat`. This file was adapted for Space VLBI scheduling studies by D. Meier (JPL) from a similar file that is used by various Caltech VLBI package programs. Since this file (or a very similar one) is used both for Space VLBI scheduling studies and ground based VLBI work some of the information in this file is not used by `fakesat_menu` and `fakesat`. The `stations.cat` file released with the fakesat software (v1.3) has been designed to match the information in the VSOP Proposer's Guide. Most users will not have to edit this file. However, for those who wish to experiment a little and even undertake simulations with `fakesat` that are unrelated to VSOP proposals, a description of this file and the answers to some questions relating to this file are provided.

The `stations.cat` file itself is split into several records, with one record for each ground radio telescope, space radio telescope, or tracking station. Each record is composed of a number of key-words with values attached to each key-word via the equal (=) sign. Key-words can either represent a single variable or an array of variables. For an array of variables, values for the the different array elements are separated by a comma. Each record begins with the STATION key-word and is terminated with a slash (/) or an end of file (EOF) marker. Since there is automatically an EOF marker at the end of the `stations.cat` file this means that every record EXCEPT for the last one in the file is terminated with a slash (/). The last record is then terminated by the EOF marker. If a value of a key-word is not set then it assumes its default value or values. The TYPE key-word is used to determine how to interpret the record. Comment lines begin with a ! and can appear anywhere within the file.

Below we describe the key-words as they are used in the ground radio telescope, space radio telescope, tracking station record, and array records. The array record is a special record that is used to determine which ground radio telescope arrays appear on the `fakesat_menu` array: sub-menu.

B.1 Ground Radio Telescope Key-Words

STATION Telescope name. If the name is longer than 8 characters then only the first eight characters are used. It is this name that appears on the `fakesat_menu` telescopes: sub-menu.

TYPE If TYPE=10, then the record is a ground radio telescope record. If the value is a negative integer then `fakesat` does NOT use this record. It is by changing the value of the TYPE key-word that one may add or remove ground radio telescopes that are used by `fakesat_menu` (see Section **??** and B.5.2 for more details).

DIAM Telescope diameter in m. The value of this key-word along with the values of the TSYS and EFFIC key-words are used by `fakesat_menu` and `fakesat` in thermal noise calculations, IF the TSYSJY key-word is NOT used. That is, the

value of the TSYSJY key-word overrides the system temperature in Jy calculated using the values of the DIAM, EFFIC, and TSYS key-words.

ELEV Height of the telescope (in m) either from the center of the earth or above 'sea level'.

LONG Western longitude of the ground radio telescope in degrees, minutes, and seconds.

LAT Latitude of the ground radio telescope in degrees, minutes, and seconds.

STCODE Station code. NOT used by `fakesat`.

CONTROL Telescope control file format. NOT used by `fakesat`.

ZALIM Telescope zenith angle limits in degrees. If only one value is specified this is taken to be the maximum zenith angle limit, with the minimum zenith angle limit assumed to be 0°. The default is a minimum zenith angle limit of 0° and a maximum angle limit of 90°.

HALIM Telescope hour angle limit in hours. The default is 12 hours.

ARRAY Specifies which array or arrays the ground radio telescope belongs to. The telescope arrays that appear on the `fakesat_menu` array: sub-menu are controlled by the array record (see Section B.4)

BANDS Specifies which observing bands the telescope can operate at, where:

- P = P-band (327 MHz)
- L = L-band (1.6 GHz)
- C = C-band (5 GHz)
- K = K-band (22 GHz)

TSYS System temperature in K for the bands listed in BANDS. If the TSYSJY key-word is used then these values are not used in thermal noise calculations.

EFFIC Antenna efficiency for the bands listed in BANDS. If the TSYSJY key-word is used then these values are not used in thermal noise calculations.

TSYSJY System equivalent flux density (system temperature in Jy) for the bands listed in BANDS. IF this key-word is used then the values associated with it are used in thermal noise calculations overriding the values associated with the DIAM, EFFIC, and TSYS key-words.

RATE1 Telescope slewing rate. NOT used by `fakesat`.

RATE2 Telescope slewing rate. NOT used by `fakesat`.

OUTPUTS VLBI recording system or systems at the telescope. NOT used by `fakesat`.

B.2 Space Radio Telescope Key-Words

TYPE If TYPE=32, the spacecraft is RadioAstron.

AEIOWM The spacecraft orbital elements.

DATEorb The date on which the orbital elements are defined. The `fakesat` program assumes that these elements are defined at 0 UT. Thus `fakesat` does NOT use the **UTorb** to key-word to define the UT of the orbital elements.

The **STATION, DIAM, TSYS, EFFIC, TSYSJY** are the same as for the ground radio telescope key-words with the same name.

The **STCODE, CONTROL, UTorb, TELEDIR, TELANGLE, RATE1, RATE2, SUNAVOID, MOONAVOI, ANTISUN, OUTPUTS** key-words are NOT used by `fakesat`.

B.3 Tracking Station Key-Words

TYPE TYPE=22 or =23, In this context a tracking station is one which is capable of recording VLBI data.

The **STATION, ELEV, LONG, LAT, ZALIM,** and **HALIM** are the same as for the ground radio telescope key-words with the same name.

The **DIAM, RATE1, RATE2,** and **OUTPUTS** key-words are NOT used by `fakesat`.

B.4 Array Key-Words

The array record is a special record that is used to determine which ground radio telescope arrays appear on the `fakesat_menu` array: sub-menu.

STATION For the array record, STATION=ARRAY must be set.

TYPE For the array record, TYPE=40 must be set.

ARRAY The values associated with the ARRAY key-word are the names of ground radio telescope arrays that will be used on the `fakesat_menu` array: sub-menu. Ground radio telescope array membership is determined via the values associated the ARRAY key-word of individual ground radio telescopes.

OPTIONS The three values associated with this key-word are the default ground arrays that `fakesat_menu` uses as default ground arrays RadioAstron observation, and ground-only observations respectively.

B.5 How do I ?

B.5.1 Add a ground radio telescope to the telescopes: sub-menu ?

1. Edit the `stations.cat` file and add a record for the ground radio telescope you want to add to the telescopes: sub-menu. Remember to set TYPE=10 for a ground radio telescope.
2. Select the update pushbutton from the mode: sub-menu

Note: The `stations.cat` may already contain the radio telescope that you wish to use. At the end of the file is an extensive list of ground radio telescope records. These telescopes do not appear on the telescopes: sub-menu because TYPE=-10 with the minus sign telling `fakesat_menu` not to use this record. Changing the -10 to 10 will enable this record.

B.5.2 Remove a ground radio telescope from the telescopes: sub-menu ?

1. Edit the `stations.cat` file and change TYPE=10 to TYPE=-10 in the ground radio telescope record for the telescope you want to remove from the telescopes: sub-menu.
2. Select the update pushbutton from the mode: sub-menu

B.5.3 Change ground radio telescope technical information ?

The ground radio telescope technical information includes, for example, the bands the telescope operates at, the telescope diameter, the telescope system temperatures and aperture efficiencies.

1. Edit the `stations.cat` file and change the required values associated with the relevant key-words.
2. Select the update pushbutton from the mode: sub-menu.

B.5.4 Add a ground radio telescope to an array ?

1. Edit the ground radio telescope record in the `stations.cat` file and add the array name to the values associated with the ARRAY key-word.
2. Select the update pushbutton from the mode: sub-menu.

B.5.5 Remove a ground radio telescope from an array ?

1. Edit the ground radio telescope record in the `stations.cat` file and remove the array name from the values associated with the ARRAY key-word.
2. Select the update pushbutton from the mode: sub-menu.

B.5.6 Add an array to the array: sub-menu ?

1. Edit the `stations.cat` file and add the required array name to the values associated with the ARRAY key-word.
2. Select the update pushbutton from the mode: sub-menu.

B.5.7 Remove an array from the array: sub-menu ?

1. Edit the `stations.cat` file and remove the array name from the values associated with the ARRAY key-word.
2. Select the update pushbutton from the mode: sub-menu.

B.5.8 Add a tracking station to the tracking stations: sub-menu ?

1. Edit the `stations.cat` file and add a record for the tracking station you want to add to the tracking stations: sub-menu. TYPE=22 (or =23) for a tracking stations.
2. Select the update pushbutton from the mode: sub-menu.

B.5.9 Remove a tracking station from the tracking stations: sub-menu ?

1. Edit the `stations.cat` file and change TYPE=22(or 23) to TYPE=-22 (or -23) in the ground radio telescope record for the tracking station you want to remove from the tracking stations: sub-menu.
2. Select the update pushbutton from the mode: sub-menu.

C The `menu_defaults` File

Most users of `fakesat` will never need to edit this. However for those who have an interest in how the `fakesat_menu` interactive menu works this appendix describes the format of the most important file used by `fakesat_menu`. When `fakesat_menu` is started it begins by reading in the `menu_defaults` file. This file completely controls what appears on the interactive menu. The file has a fixed format of 133 columns wide and is separated into records with a single record for each `fakesat_menu` sub-menu. Each record is separated by a dashed line with numbers on it:

```
1-------------16|18-----------32|34-----------48|50-----------64|66-----------80|82-----------96|98----------112|
```

Within each record there are 7 fields to a line with the field separator being a vertical bar (|).
We will explain the format of this file by explaining the contents of the first two records of the `menu_defaults` file:

```
1-------------16|18-----------32|34-----------48|50-----------64|66-----------80|82-----------96|98----------112|
isat            |  1           |              |               |               |               |               |
1-------------16|18-----------32|34-----------48|50-----------64|66-----------80|82-----------96|98----------112|
mode:                                          |               |TT             |mode.tex                       |
imenu           |  1           |              |               |               |               |               |
inum            |  8           |  8           |  8            |               |               |               |
icol            |  8           |  8           |  8            |               |               |               |
irow            |  1           |  1           |  1            |               |               |               |
usevalue        |F             |              |               |               |               |               |
onlyone         |T             |              |               |               |               |               |
toggle          |F             |              |               |               |               |               |
                |input         |input         |input          |TTT            |TTT            |               |
                |run           |run           |run            |FFF            |FFF            |               |
                |stop job      |stop job      |stop job       |FFF            |FFF            |               |
                |system info   |system info   |system info    |FFF            |FFF            |               |
                |save menu     |save menu     |save menu      |FFF            |FFF            |               |
                |initial menu  |initial menu  |initial menu   |FFF            |FFF            |               |
                |update        |update        |update         |FFF            |FFF            |               |
                |exit          |exit          |exit           |FFF            |FFF            |               |
1-------------16|18-----------32|34-----------48|50-----------64|66-----------80|82-----------96|98----------112|
```

The first record the one with isat is the only record in the file that does not contain information on a `fakesat_menu` sub-menu. isat is an integer variable that can have the values 1, 2, or 3. If isat = 1(2) the `fakesat_menu` menu will display information about a VSOP (RadioAstron) observation. If isat = 3 the `fakesat_menu` menu will display information about a ground-only observation.
The second record contains the information on the mode: sub-menu. The first line of each sub-menu record stores the following information:

- The name of the sub-menu as it will be displayed on the menu. In this case the sub-menu name is mode:
- The values required for two logical variables (T= True, F=False). The first logical variable determines if the sub-menu will appear on the simple (default) version of the menu and the second logical variable determines if the sub-menu will appear on the complex version of the menu. In this case the mode: sub-menu will be used in both the simple and complex versions of the menu.

- A latex file name that contains the help information on the sub-menu. In this casa the latex filename is mode.tex

The second line of each sub-menu record stores the integer value of the imenu variable. The imenu variable is a unique integer for each sub-menu. The mode: sub-menu has imenu = 1.
The third, fourth, and fifth lines store the integer values of the inum, icol, and irow integer array variables. How a particular sub-menu will be displayed may depend on whether a VSOP (isat=1), RadioAstron (isat=2), or ground-only (isat=3) observation is being simulated and this is why there are 3 integers for each inum, icol, and irow. inum is the number of sub-menu items to be displayed, icol is the number of columns to be used to display these items, and irow is the number of row to be used to display these items. Thus for the mode: sub-menu there will be 7 items displayed in 7 columns by 1 row. This is true for a VSOP, RadioAstron, or a ground-only simulation.
The sixth, seventh, and eighth lines store the values of the usevalue, onlyone, and toggle logical variables. These logical variables determine the type of sub-menu. If usevalue is true, the sub-menu is a 'parameter' sub-menu. If onlyone is true, then the sub-menu is an 'only-one' pushbutton sub-menu. If toggle is true, then the sub-menu is an 'toggle' pushbutton sub-menu. If usevalue, onlyone, and toggle are all false, the sub-menu is a 'many' pushbutton sub-menu. As can be seen the mode: sub-menu is an 'only-one' pushbutton sub-menu.
For a pushbutton sub-menu, like the mode: sub-menu, the remaining lines of each record store the pushbutton names and the values for logical variables that determine if the pushbutton is depressed (T) or not-depressed (F). Each line corresponds to an individual pushbutton. There are three button names. The first is used for VSOP observations (isat=1), the second (isat=2) is used for RadioAstron observations, and the third (isat=3) is used for ground-only observations. Following the pushbutton names are stored the values for two sets of three logical variables. The first set of logical variables are the working values and are used by `fakesat_menu` to determine if a particular pushbutton is depressed or not. The second set are the default values. When the initial menu pusbutton of the mode: sub-menu is pushed the default logical variable values are copied to the working values.

For a 'parameter' sub-menu, like the source name: sub-menu, the remaining lines after the eighth line store parameter information with each line storing the information on a single parameter. Let us look at an example. Here is the source name: record:

```
1-------------16|18-----------32|34-----------48|50-----------64|66-----------80|82-----------96|98----------112|
source name:                                    |               |TT             |source.tex                     |
imenu           | 12            |               |               |               |               |               |
inum            |  1            |  1            |  1            |               |               |               |
icol            |  1            |  1            |  1            |               |               |               |
irow            |  1            |  1            |  1            |               |               |               |
usevalue        |T              |               |               |               |               |               |
onlyone         |F              |               |               |               |               |               |
toggle          |F              |               |               |               |               |               |
source          |1928+738       |1803+784       |3C345          |1928+738       |1803+784       |3C345          |
1-------------16|18-----------32|34-----------48|50-----------64|66-----------80|82-----------96|98----------112|
```

In this example since inum=1 information on only one parameter needs to be stored.

The parameter name is source and this name is used for a VSOP (isat=1), RadioAstron (isat=2), and a ground-only (isat=3) observation. Next are stored the working versions of the parameter values for a VSOP (isat=1), RadioAstron (isat=2), and a ground-only (isat=3) observation. Thus the parameter value —1928+738 is for a VSOP observation, 1803+784 for a RadioAstron observation, and 3C345 for a ground only observation. Following these working values are the three default values. When the initial menu pushbutton of the mode: sub-menu is pushed the default values are copied to the working values.

To re-cap the `menu_defaults` file is simply a list of records with each record, with the exception of the first record, storing information on a particular sub-menu. The `fakesat_menu` program uses the `menu_defaults` file to determine what sub-menus to display, how to display them, and what to display on them.