

User guide for REPA program (REsidual Plotting and Ambiguity resolution)

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Abstract:

This document describes the program REPA, the graphics tool for visualization of observables, residuals, manual ambiguity resolution and toggle observation suppression status.

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1 Purpose

REPA (REsidual Plots and Ambiguities) is an interactive tool which plots residuals of a VLBI solution and allows the users:

- to shift ambiguity of a single point (for delays only);
- to toggle suppression status of a single point;
- to shift ambiguities for all points at the baseline (for delays only);
- to suppress all observations with residuals at the baseline greater than the value which the cursor is pointing at;
- to restore all observations with residuals at the baseline greater than the value which the cursor is pointing at;
- to plot delays, delay rates, their supported linear combinations, meteorological parameters, station and baseline calibrations;
- to use as an argument time, elevation angle, azimuth, air temperature.
- to plot delay, delay rate, station calibration and many other parameters.
- to display fringe plot by clicking at the point by the mouse;
[* not implemented]

2 User interface

REPA displays plots of a one-dimension dependence VALUE(ARGUMENT). ARGUMENT runs along the horizontal axis, VALUE runs along the

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vertical axis. REPA supports many different types of ARGUMENT and VALUE. REPA uses Multi_DiaGi interactive plotting utility. Multi_DiaGi places a graphic window on the screen and provides two-level user interface. At the upper level (Multi_DiaGi level) a set of plots is displayed and the column of command buttons. When in Multi_DiaGi level user positions the cursor on a plot and hits the Left Mouse Button, it enters the lower level (DiaGi). At DiaGi level only the plot for the specific baseline is displayed. REPA supports of four modes of binding mouse keys: <DiaGI>, <SngAmb>, <GrpTgl>, <GrpAmb>

2.1 Properties

Plots are determined by seven properties.

- 1) BASELINE_NAME. It specifies either the baseline name or ALL. ALL means REPA is in the Multi_DiaGi mode.
- 2) PLOTTING_FRAME. It determines the plotted area. It may include
 - only good observations;
 - good and bad, but recoverable observations;
 - all observations: good, bad and unrecoverable.
- 3) ARGUMENT_TYPE. For instance, time.
- 4) VALUE_TYPE. For instance, delay
- 5) MOUSE_MODE. The mode determines the use of three mouse buttons. The following modes are supported:
 - ESC) DiaGI mode -- native mode of DiaGi;
 - F1) SngAmb mode -- single point ambiguity shift and toggle suppression status;
 - F2) GrpAmb mode -- multiple points ambiguity shift;
 - F3) GrpTgl mode -- multiple points toggle suppression status.
- 6) PAGE_INDEX. The index of the page displayed. Maximum 25 baselines are displayed at one page. If the database has more than 25 baseline this property determines which
- 7) MARKED_SOURCE. Name of the marked source or "NO", if no source is marked.

When the database is loaded, the default properties are set. When REPA is invoked, a user can change properties. The properties are stored in a scratch file. When REPA is invoked the second time, stored properties will be used.

The configuration determines the user preferences: color of points, default baseline, default plotting box, default argument and value. The configuration is stored in the file REPAXx in WORK_DIR directory. solve_reset will copy REPA_TEMPLATE file to REPAXx if REPAXx file does not exist. If the file REPAXx exists, solve_install does not change it.

By default good points are displayed with green color, bad points are displayed with red color. Unrecoverable points are displayed with black circles. NB: CRES options invoked from OPTIN page by hitting ? define whether bad and/or unrecoverable points should be shown. If this option is set "not to show unrecoverable points", then REPA will not show them at all.

2.2 Multi_DiaGi Commands

Plots are displayed using the Multi_DiaGi utility. it displays up to 25 plots in one page in the baseline mode "ALL". At the right hand side of the plot a column of buttons are displayed. Each button has a letter code. When a user hits the key with the button letter code or position the cursor

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and hits the left mouse button, an operation associated with the box is executed.

T Change Argument	-- Change the argument. A new window will be invoked with the list of supported arguments of the plot in a box menus mode. The current argument is drawn by darker color. A user moves the cursor to the box with desired argument and hits the Left Mouse Button for changing the argument. Hitting the Right Mouse Button causes REPA to apply the new argument, exit the menu and re-make the plot according to user preference.
V Change Argument	-- Change the value. A new window will be invoked with the list of supported values of the plot in a box menus mode. The current argument is drawn by darker color. A user moves the cursor to the box with desired value and hits the Left Mouse Button for changing the argument. Hitting the Right Mouse Button causes REPA to apply the new argument, exit the menu and re-make the plot according to user preference.
G Frame good points	-- Change the plotting frame for all plots to "good points only". REPA will show all points which are within the box which is determined as the box between minimal and maximal values of all arguments and all values of good points.
B Frame good&bad points	-- Change the plotting frame for all plots to "good and bad points only". REPA will show all points which are within the box which is determined as the box between minimal and maximal values of all arguments and all values of good and bad points.
L Frame all points	-- Change the plotting frame for all plots to "good, bad and unrecoverable points". REPA will show all points which are within the box which is determined as the box between minimal and maximal values of all arguments and all values of all points. NB: even if unrecoverable points are not shown, REPA will account them in determining the bounding box.
S Set box symmetric	-- Set the plotting frame in such a way that Ymin = -Ymax, and Ymax is the maximum of absolute values over all points, either good or good&bad depending on previous setting. The bounding box will look symmetric with respect to the horizontal line that comes through zero.
R Set box around all	-- Set the plotting frame in such a way that the lower boundary is a little be upper than Ymin, and the upper boundary is a little bit lower than Ymax. Ymin and Ymax are computed over all points, either good or good&bad depending on previous setting. The bounding box will not necessarily look symmetric with respect to the horizontal line that comes through zero.
M Mark a source	-- Invokes the screen and invites a user to mark a source. The screen for source selection shows boxes. Each box corresponds to one source. Inside source box three values are printed: a) source name -- big black sources; b) number of good points -- green digits in the lower left corner; c) number of bad points -- red digits in the lower right corner. At the end of the box set, an additional box "Unmark" is displayed. The current selection is shown with brighter

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color.

In order to mark a source a user position the cursor to the a box with the name of that box and hits either left or central mouse button. In order to unmark the source, a user should position the cursor to the box with name "Unmarked" and hits either left or central mouse button. In order to leave the selection screen, a user hits either the right mouse button or the key X.

Exit -- exits REPA and calls OPTIN.

Prior Page -- the same as PageUp key. Displays the prior page. If the current page is the first one, REPA will display the last page. NB: This button is shown only if the total number of baselines exceeds 25.

Next Page -- the same as PageDown key. Displays the next page. If the current page is the last one, REPA will display the first page. NB: This button is shown only if the total number of baselines exceeds 25.

2.3 Additional DiaGi commands are supported:

At the DiaGi level REPA in addition to the DiaGi plot layout shows four boxes with supported mouse modes: ESC, F1, F2, and F3. The box with the current mouse mode is displayed with the darker color.

The following commands are supported:

key	Command
{Q}	-- quit plot and exit to OPTIN level;
{X}	-- quit plot and exit to Multi_DiaGi level;
[ESC]	-- sets the current mouse mode to "native DiaGi";
[F1]	-- sets the current mouse mode to "SngAmb";
[F2]	-- sets the current mouse mode to "GrpAmb";
[F3]	-- sets the current mouse mode to "GrpTgl";
[PgUp]	-- move to the next baseline;
[PgDn]	-- move to the prior baseline;
[Home]	-- applies changes in observables (ambiguities and suppression status), exits REPA and calls OPTIN;
[F10]	-- Interrupt: does not apply changes in observables (ambiguities and suppression status) and changes the baseline mode to ALL;
[M]	-- set plotting frame for this baseline all observations: good, bad and unrecoverable;
[Alt/M]	-- set plotting frame for this baseline good and bad observations;
[Cntrl/M]	-- set bounding box around good observations only;
[Alt/M]	-- set plotting frame for this baseline good and bad observations;
[Cntrl/N]	-- set symmetric bounding box around good observations only;
[Alt/N]	-- set symmetric plotting frame for this baseline good and bad observations;
[Cntrl/Left_mouse]	-- show information about the point which is the closest to the cursor. Information includes observation index, baseline name, source name, suppression status, argument, value, error (if applicable). If the value type is delay or delay rate, SNR and quality codes for both bands are shown.
[Backspace]	-- undo. The sequence of operation ambiguity shift and toggle

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suppressions status is stored in the stack. Operation undo
reverses the effect of the previous command written in the
stack and decrements the stack counter;

[Cntrl/Right_mouse] -- display fringe plot of the X-band observation.
[Alt/Right_mouse] -- display fringe plot of the S-band observation.

2.4 Mouse binding modes

{ESC} -- native DiaGi mode:

[Left_mouse] -- Inquire of the coordinate of the point
where cursor is pointed. Information is
printed in DiaGi mode: argument, value and
error.

[Central_mouse] -- Changes of the boundary of the plotting
box nearest to the cursor;

[Right_mouse] -- Terminate execution of DiaGI, the same as quit.
REPA applies changes in observables (ambiguities
and suppression status), and enter the upper
level of interface, Multi_DiaGi mode.

[Cntrl/Right_mouse] -- display fringe plot of the X-band observation.

[Alt/Right_mouse] -- display fringe plot of the S-band observation.

{F1} -- "SngAmb" mode:

[Left_mouse] -- Decrements the ambiguity counter for the point
which is the closest to the cursor and moves the
point one ambiguity down. Makes no effect, if the
value is not the delay for which the operation
of ambiguity changes is defined.

[Central_mouse] -- Toggles suppression status of the point. Changes
the color of the point. Makes no effect if the
point has the status unrecoverable.

[Right_mouse] -- Increments the ambiguity counter for the point
which is the closest to the cursor and moves the
point one ambiguity up. Makes no effect if the
value is not the delay for which the operation
of ambiguity changes is defined.

[Cntrl/Right_mouse] -- display fringe plot of the X-band observation.

[Alt/Right_mouse] -- display fringe plot of the S-band observation.

{F2} -- "GrpAmb" mode:

[Central_mouse] -- Resolves ambiguities in such a ways that all
points are shifted in order to be within
[-0.5, -0.5] ambiguity spacing with respect to
the cursor position. Makes no effect, if the

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value is not the delay for which the operation of ambiguity changes is defined,

```
{F3}  -- "GrpTgl" mode:
-----

[Left_mouse]  -- Suppresses all points with residuals by module
                greater than the value which corresponds to
                the current cursor position.

[Right_mouse] -- Restores all recoverable points with
                residuals by module less than the value which
                corresponds to the current cursor position.
```

2.5 Configuration file

Example of the configuration file REPAXx:

```
REPA Configuration file. Format version of 2006.06.01
#
#  Template REPA Configuration
#
#  Last update: 25-MAY-2006 10:41:59
#
Good_Color:      1      ! "green"
Bad_Color:       3      ! "red"
Unrc_Color:      13     ! "black"
Marked_Color:    13     ! "black"
Box_plot:        Good
Default_Baseline: All
Default_Argument: Time
Default_Value:   Delay
Default_Mode:    DiaGi
Box_Symmetric:   No
Inquiry_Data:    OBS_TYPE, OBS_INDEX, BAS_NAME, SOUR_NAME, TIME_LONG, OBSERVABLE, QUAL_CODE, SNR
Marked_Source:   No
```

Currently, a configuration file should contain 12 keywords. The syntax is, keyword, colon, one or more whitespaces, value, comment which follows exclamation sign. First 4 keywords define colors. Colors are coded with an integer number in the range [1, 32]. An auxiliary program diagi_dec displays supported colors.

Good_color defines the color index for good points used in the solution.

Bad_color defines the color index for bad, but recoverable points not used in the solution. NB: unrecoverable points will be shown if a special option in CRES menu "(B) To show conditionally bad observations" is set to yes. Default: yes

Unrc_Color defines the color index for unrecoverable points not used in the solution. NB: unrecoverable points will be shown if a special option in CRES menu "(U) To show unrecoverable observations" is set to yes. Default: No

Marked_Color defines the color index for the circle which is drawn around the marked sour.

Box_plot: Supported values "Good", "Bad&Good" and "All"

"Good" means that the bounding box will be drawn around good points only;

"Bad&Good" means that the bounding box will be drawn around bad and good points;

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"All" means that the bounding box will be drawn bad, good, and unrecoverable points.

Default_Baseline: Name of the base line in the form STATION1/STATION2 or All
Tells to REPA plots of which baseline to show.
If All is selected than the preview page of up to 25 baselines is shown. IF the experiment has more than 25 baselines, the previous page will show the first 25 baselines, and the user will be able to list pages by using keys PgDn and PgUp.

Default_Argument: Argument of the plots. Supported values:

"Time" -- Time in hours from the nominal session start;
"Del_Err" -- Delay re-weighted error;
"Elev_St1" -- Elevation at station #1;
"Elev_St2" -- Elevation at station #2;
"Azim_St1" -- Azimuth at station #1;
"Azim_St2" -- Azimuth at station #2;
"Temp_St1" -- Air temperature at station #1;
"Temp_St2" -- Air temperature at station #2;

Default_Value: Value of plots. Supported values:

"Delay" -- Time delay residual;
"Rate" -- Delay date residual;
"SNR_X" -- SNR at X-band;
"SNR_S" -- SNR at S-band;
"Temp_St1" -- Air temperature at station #1;
"Temp_St2" -- Air temperature at station #2;
"Pres_St1" -- Air pressure at station #1;
"Pres_St2" -- Air pressure at station #2;
"GrIon_D1" -- Contribution of the ionosphere to group delay;
"PhIon_D1" -- Contribution of the ionosphere to phase delay;
"SpAmb_Gx" -- Group delay ambiguity spacings at X-band;
"SpAmb_Gs" -- Group delay ambiguity spacings at S-band;
"SpAmb_Px" -- Phase delay ambiguity spacings at X-band;
"SpAmb_Ps" -- Phase delay ambiguity spacings at S-band;
"Cal1_St1" -- The first station calibration at site #1;
"Cal1_St2" -- The first station calibration at site #2;
"Cal2_St1" -- The second station calibration at site #1;
"Cal2_St2" -- The second station calibration at site #2;
"Cal3_St1" -- The third station calibration at site #1;
"Cal3_St2" -- The third station calibration at site #2;
"Cal4_St1" -- The fourth station calibration at site #1;
"Cal4_St2" -- The fourth station calibration at site #2;
"Cal5_St1" -- The fifth station calibration at site #1;
"Cal5_St2" -- The fifth station calibration at site #2;
"Cal6_St1" -- The sixth station calibration at site #1;
"Cal6_St2" -- The sixth station calibration at site #2;
"Cal7_St1" -- The seventh station calibration at site #1;
"Cal7_St2" -- The seventh station calibration at site #2;
"Cal8_St1" -- The eighth station calibration at site #1;
"Cal8_St2" -- The eighth station calibration at site #2;

Default_Mode: The first mode from which REPA will start to work.
Four modes are supported:

DiaGi -- generic DiaGi mode;
SngAmb -- Mode for toggling suppression status and changing ambiguity for a single point;
GrpAmb -- Mode for changing ambiguity for all points at a baseline;
GrpTgl -- Mode for toggling suppression status for all points at a baseline.

Box_Symmetric: Supported values: Yes or No .
Yes -- then the bounding box is set in such a way that

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Ymin = -Ymax, symmetric and Ymax is the maximum of absolute values over all points. The bounding box will look symmetric with respect to the horizontal line that comes through zero.

No -- then the bounding box will be drawn around all points, and the box will not be necessarily symmetric with respect to the horizontal line that comes through zero.

Inquiry_Data: A line with codes of quantities which will be shown in the inquiry status line. Currently 11 codes are supported. The value of the Inquiry_Data keyword may have any number of codes separated by comma.

OBS_TYPE -- Observable type: G -- good points, B -- band point, U -- unrecoverable point;

OBS_INDEX -- Index of the observation in the experiment;

BAS_NAME -- Baseline name in the form STATION1/STATION2

SOUR_NAME -- IVS source name

TIME_LONG -- Time tag in long form: YYYY.MM.DD-hh:mm:ss.sss

TIME_SHORT -- Time tag in short form DD-hh:mm:ss
where DD here is the number of days elapsed from the midnight, preceding to the observation, to the midnight, preceding the session nominal start.

OBSERVABLE -- Value of the point on the plot

QUAL_CODE -- Quality code in the form Q/ q were Q is one-letter quality code at the upper band, and 1 is the one-letter quality code at the low band;

SNR -- Signal to noise ratio at both bands

ELEV_DEG -- Elevation of the source at station #1 and at station #2 in degrees.

AZIM_DEG -- Azimuth of the source at station #1 and at station #2 in degrees.

Marked_Source: Either the name of the marked source or "No"
If the value of this keyword is not "No", then it is interpreted as the name of the marked source. A circle will be plotted around the point of the marked source.

2.6 Comments

1. In order to display fringe plots, first, the Mark4/5 correlator fringe output should be downloaded. Then the name of the fringe root directory should be defined in CRES (option "?" from the OPTIN menu). Third, PostsScript viewer should be checked. The name of the viewer is determined in \$Mk5_ROOT/include/glbc4.i . The name of the viewer can be overridden by environment variable SOLVE_PS_VIEWER.
2. Only superfiles created after 2005.01.31 contains information about fringe file names. If you have old super files, use databases or use utility AOB for transferring S-band data related information to the X-band.
3. Only databases processed after 2005.01.31 contains information about S-band fringe file. If you would like to see S-band fringe files, you either need to load the X band database, then S-band database, then run either GAMB or IONO. Alternative is to use utility AOB for transferring S-band data related information to the X-band.
4. Currently, fringe plots of the experiments processed only with

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Mark-4/Mark-5 correlator can be displayed.

2.7 History

When	Who	What
2003.02.12	V. Thorandt G. Engelhardt	Developed the original version of REPA
2004.12.01	L. Petrov	-- REPA 0.0 REPA forked into two branches: REPAB developed by V. Thorandt, G. Engelhardt and REPA developed by L. Petrov.
2004.12.16	L. Petrov	-- REPA 1.0 Release of the first version or REPA.
2005.01.28	L. Petrov	-- REPA 1.1 Implemented displaying fringe plots. Fixed several bugs.
2006.06.23	L. Petrov	-- REPA 1.2 Added several features: a) ability to customize inquire line; b) support of "set symmetric box" function; c) support of "mark a source" function.

Questions and comments about this guide should be sent to:

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