

Best Pair II User Guide (V1.2)

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Introduction

Best Pair II is a port of Jim Burrows' BestPair DOS program for Macintosh and Windows computers. It is designed to select the "best" pair of alignment stars for performing a 2-star alignment of a Meade LX200 telescope (or a telescope using the AutoStar controller) in Alt-Azimuth mode. The application looks at the pointing errors involved with performing an alignment with each pair of Meade's choice of 33 stars (or 78 if the AutoStar is used), examining only those that will be visible at the place and time specified. The pair of stars chosen is that with the smallest error.

In Jim Burrows' words:

"Using a linear model of the Meade 2-star altaz alignment algorithm, and for each pair of stars, compute the 4x4 covariance matrix P of the errors in the estimate of the 4 alignment parameters: latitude, sidereal time, altitude and azimuth encoder biases as a factor times centering error variance. In terms of the 2x4 observation matrix H at some position, the pointing covariance matrix is $HP^{-1}H'$. The whole-sky RMS pointing error for each pair is found by averaging the pointing covariance matrix over a range of altitudes and azimuths, and the best pair minimizes the whole-sky RMS pointing error."

Requirements

There are three separate versions of the application. Download and use the version applicable to your computer.

Best Pair II (Fat)

For Macintosh computers running Mac OS 7.5 or later. Both PPC and 68K processors are supported. Will also run on Mac OS X in Classic mode.

Requires: 1MB disk space and 4MB+ RAM

Best Pair II (Carbon)

For Macintosh computers running Mac OS X 1.0 or later. Will also run on Mac OS 9 and later, but somewhat slower than the above version.

Requires: 1MB disk space and 4MB+ RAM

Best Pair II.exe

For 32-bit Windows (Win 95, Win 98, Win ME, Win 2000, Win NT, etc.)

Requires: 1MB disk space and 4MB+ RAM

Installation

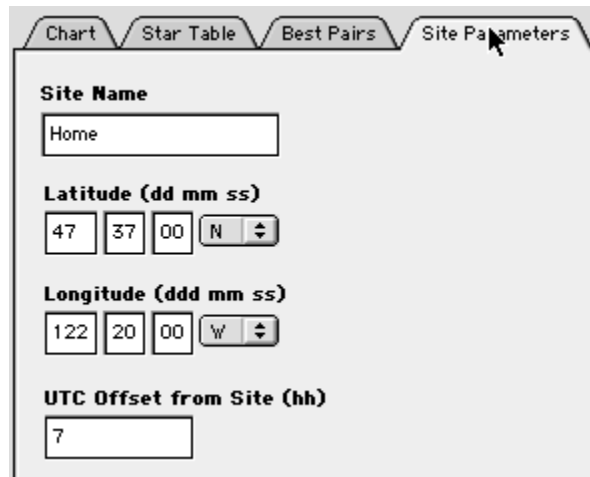
Put the application file in a suitable folder. No other files are necessary. The application will create a file called BestPair.prefs in the Preferences folder (on the Mac) or in the Windows directory on the Windows OS.

Operation

Double-click the application icon.


Click on the "Site Parameters" tab.

Set up the site parameters to reflect the place, date and time you want to do the alignment. Enter the latitude and longitude of your observing site. Make sure the UTC Offset is set to the number of hours that GMT is ahead of your local time (or negative if you are east of GMT). You can also change this to the number of hours your site is ahead of GMT by means of a preferences setting (see below). Remember to take into account daylight-saving time if applicable.



You can also give your site a name (up to 20 characters). The Sites menu allows you to define up to six different sites. Whichever site you have selected in the Sites menu will govern the site parameters you are editing.

You will also need to enter the local date and time at the bottom of the window. If your computer's clock is reasonably accurate and you want to choose the alignment stars for the current time and date, set the "Use computer time" and "Use computer date" check boxes and the computer's clock will be used.

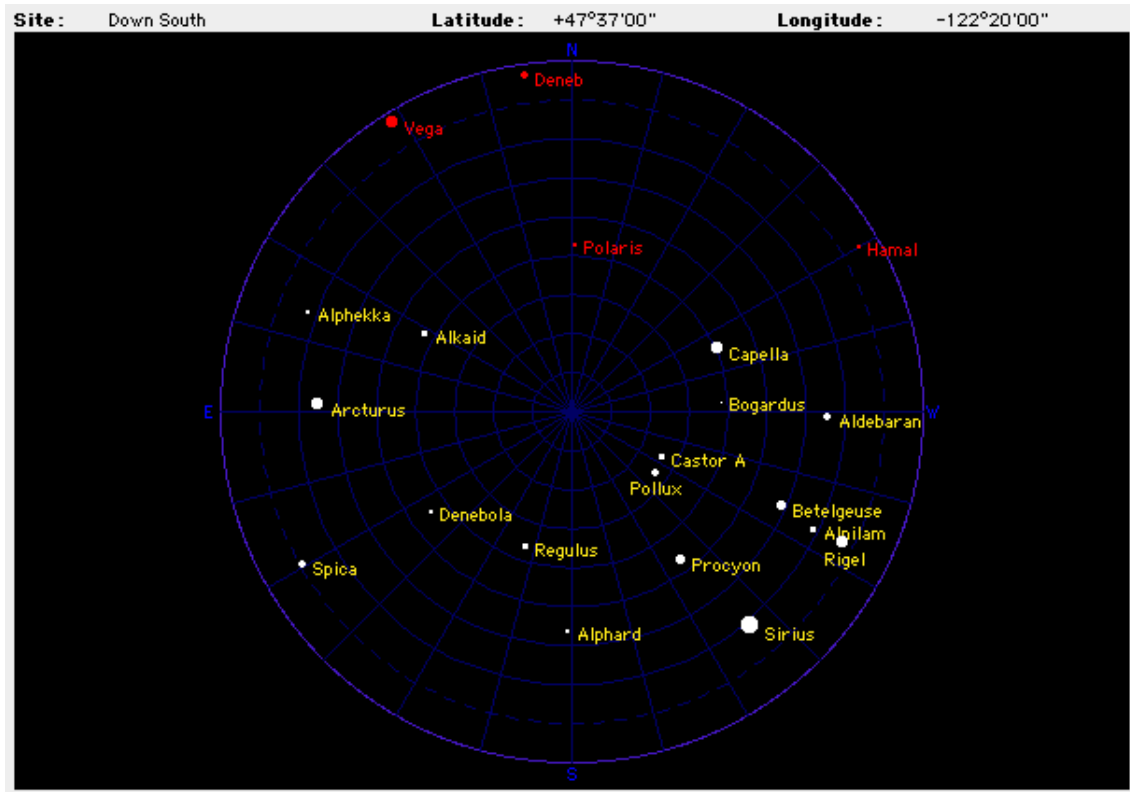


The Julian Date, Greenwich Mean Sidereal Time (GMST) and the Local Sidereal Time (LST) for your location are then calculated, allowing the application to figure out what stars can be seen at the specified place and time.

Local Date	Julian Date	GMST	LST
Thu, Sep 6, 2001	2452158.9802	17h 35m 11s	09h 25m 51s

The above settings will be remembered between runs.

Click on the Compute Visibility button to compute and display the alignment star positions and visibility in the Chart tab.



A map is displayed showing the sky view at the time specified. The displayed stars are those that are (theoretically) above the horizon. Also shown here is an altitude/azimuth grid in 10°/15° steps. Note that the default chart will look different from this since some user preferences have been set (see below)

If you have the Use Computer Time option set, you can automatically compute and display visibility by setting the Auto check box. This will be computed every time your computer time is retrieved.

The list on the Star Table tab shows the status of the alignment stars (you may have to lengthen the window to see all of them).

STAR	RA	Dec	Mag.	Name	Visible	Azimuth wrt S	Altitude	Reject	Always
13	01h38m	-57°14'	0.5	Achernar	No			<input type="checkbox"/>	<input type="checkbox"/>
121	12h27m	-63°06'	1.3	Acrux	No			<input type="checkbox"/>	<input type="checkbox"/>
223	19h31m	27°58'	3.1	Albireo	Yes	289.0°	54.1°	<input checked="" type="checkbox"/>	<input type="checkbox"/>
33	04h36m	16°31'	0.8	Aldebaran	No			<input type="checkbox"/>	<input type="checkbox"/>
140	13h48m	49°19'	1.9	Alkaid	Yes	110.9°	59.4°	<input type="checkbox"/>	<input type="checkbox"/>
50	05h36m	-01°12'	1.7	Alnilam	No			<input type="checkbox"/>	<input type="checkbox"/>
95	09h28m	-08°40'	2.0	Alphard	No			<input type="checkbox"/>	<input type="checkbox"/>
165	15h35m	26°43'	2.2	Alphekka	Yes	44.1°	63.8°	<input type="checkbox"/>	<input type="checkbox"/>
226	19h51m	08°52'	0.8	Altair	Yes	301.6°	36.4°	<input type="checkbox"/>	<input type="checkbox"/>
177	16h29m	-26°26'	1.0	Antares	Yes	6.1°	15.7°	<input type="checkbox"/>	<input type="checkbox"/>
147	14h16m	19°11'	0.0	Arcturus	Yes	62.6°	47.0°	<input type="checkbox"/>	<input type="checkbox"/>
56	05h55m	07°24'	0.5	Betelgeuse	No			<input type="checkbox"/>	<input type="checkbox"/>
58	06h00m	37°13'	2.6	Bogardus	No			<input type="checkbox"/>	<input type="checkbox"/>
63	06h24m	-52°42'	-0.7	Canopus	No			<input type="checkbox"/>	<input type="checkbox"/>
42	05h17m	46°00'	0.1	Capella	Yes	176.2°	3.7°	<input checked="" type="checkbox"/>	<input type="checkbox"/>
78	07h35m	31°53'	2.0	Castor	No			<input type="checkbox"/>	<input type="checkbox"/>
232	20h41m	45°17'	1.2	Deneb	Yes	251.9°	51.9°	<input type="checkbox"/>	<input type="checkbox"/>
114	11h49m	14°34'	2.1	Denebola	Yes	90.2°	19.7°	<input type="checkbox"/>	<input type="checkbox"/>
8	00h44m	-17°59'	2.0	Diphda	No			<input type="checkbox"/>	<input type="checkbox"/>
238	21h44m	09°53'	2.4	Enif	Yes	276.5°	19.3°	<input type="checkbox"/>	<input type="checkbox"/>
247	22h58m	-29°37'	1.2	Fomalhaut	No			<input type="checkbox"/>	<input type="checkbox"/>
144	14h04m	-60°22'	0.6	Hadar	No			<input type="checkbox"/>	<input type="checkbox"/>
17	02h07m	23°28'	2.0	Hamal	No			<input type="checkbox"/>	<input type="checkbox"/>
249	23h05m	15°13'	2.5	Markab	Yes	257.9°	9.6°	<input checked="" type="checkbox"/>	<input type="checkbox"/>
20	02h19m	-02°58'	3.0	Mira	No			<input type="checkbox"/>	<input type="checkbox"/>
19	02h33m	89°16'	2.0	Polaris	Yes	180.6°	47.0°	<input type="checkbox"/>	<input type="checkbox"/>
81	07h45m	28°01'	1.1	Pollux	No			<input type="checkbox"/>	<input type="checkbox"/>
80	07h39m	05°13'	0.4	Procyon	No			<input type="checkbox"/>	<input type="checkbox"/>
100	10h08m	11°58'	1.4	Regulus	Yes	106.7°	1.0°	<input checked="" type="checkbox"/>	<input type="checkbox"/>
41	05h15m	-08°12'	0.1	Rigel	No			<input type="checkbox"/>	<input type="checkbox"/>
67	06h45m	-16°43'	-1.5	Sirius	No			<input type="checkbox"/>	<input type="checkbox"/>
138	13h25m	-11°10'	1.0	Spica	Yes	53.8°	15.0°	<input type="checkbox"/>	<input type="checkbox"/>
214	18h37m	38°47'	0.0	Vega	Yes	286.3°	69.6°	<input type="checkbox"/>	<input type="checkbox"/>

The STAR column is the Meade LX200 STAR number of the alignment star, RA and Dec its position (Epoch J2000.0), Mag. is the visual magnitude, Name is the common name of the star as given in the Meade hand controller database, Visible is "Yes" if the star is above the horizon, Azimuth and Altitude is current Alt-Az position of the star (blank if the star isn't visible).

If a star shown on the chart and marked visible is, in fact, not visible from your location (behind a tree?), you can mark it as not visible (rejected) in one of the following ways:

- Click the star on the chart.

or

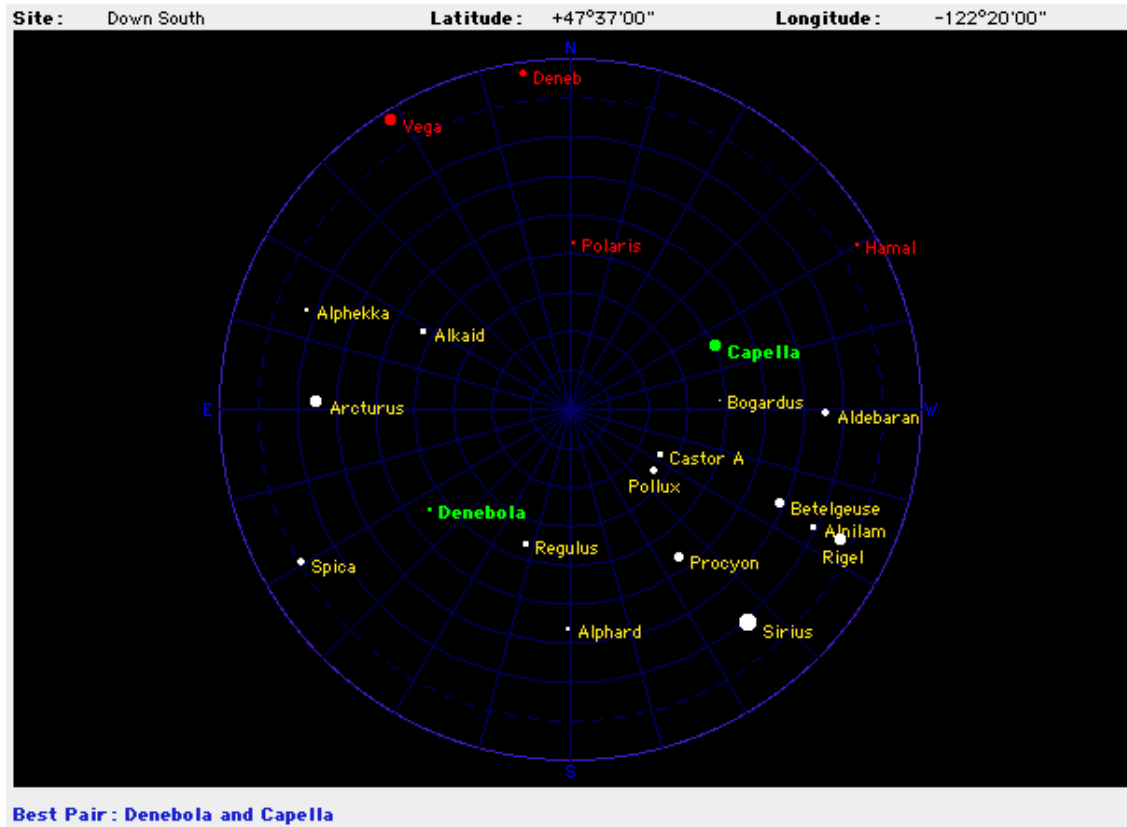
- Click the check box in the Reject column of the listing.

In each case the star on the chart will turn red and will be disregarded when the best-pair selection is done. You can "permanently" reject certain stars by setting the check box in the "Always" column. This will be remembered between runs. e.g. you may wish to avoid Polaris as an alignment star.

Once all stars are accepted/rejected, click on the Compute Best Pair button. A calculation is then performed, which might take a little time on a slow computer. When complete, the two chosen stars are plotted in green on the chart and specified underneath.

If one or both stars are unacceptable, reject them as mentioned above and try the Compute Best Pair button again.

If you had the Auto check box set before performing this operation, it will be reset to avoid overwriting the best pair selection.



The Best Pairs tab shows the best pairs of alignment stars in order of increasing error. The pairs of stars are shown with their magnitudes and the angular separation between them.

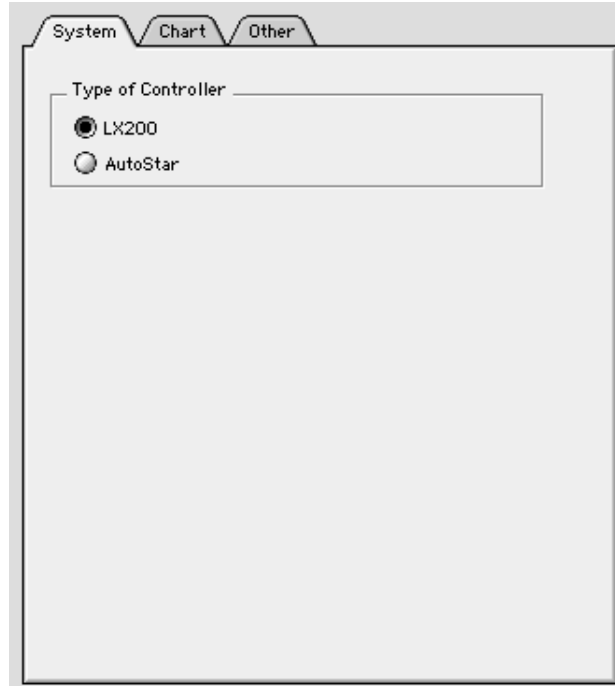
Order	First Star	Magnitude	Second Star	Magnitude	Separation	Error	Show
1	Deneb	1.2	Arcturus	0.0	90.7°	1.000	<input checked="" type="checkbox"/>
2	Altair	0.8	Alkaid	1.9	93.9°	1.002	<input type="checkbox"/>
3	Vega	0.0	Denebola	2.1	90.0°	1.009	<input type="checkbox"/>
4	Saif	2.4	Alkaid	1.9	100.4°	1.016	<input type="checkbox"/>
5	Albano	3.1	Alkaid	1.9	66.2°	1.039	<input type="checkbox"/>
6	Albano	3.1	Denebola	2.1	104.2°	1.045	<input type="checkbox"/>
7	Deneb	1.2	Denebola	2.1	106.2°	1.051	<input type="checkbox"/>
8	Deneb	1.2	Spica	1.0	111.2°	1.066	<input type="checkbox"/>
9	Markab	2.5	Alphekka	2.2	102.2°	1.066	<input type="checkbox"/>
10	Deneb	1.2	Alphekka	2.2	62.2°	1.076	<input type="checkbox"/>
11	Deneb	1.2	Alkaid	1.9	64.2°	1.090	<input type="checkbox"/>
12	Albano	3.1	Arcturus	0.0	71.2°	1.092	<input type="checkbox"/>
13	Markab	2.5	Alkaid	1.9	106.1°	1.095	<input type="checkbox"/>
14	Saif	2.4	Alphekka	2.2	97.0°	1.114	<input type="checkbox"/>
15	Saif	2.4	Arcturus	0.0	107.0°	1.118	<input type="checkbox"/>
16	Markab	2.5	Arcturus	0.0	121.0°	1.139	<input type="checkbox"/>
17	Vega	0.0	Arcturus	0.0	59.1°	1.145	<input type="checkbox"/>
18	Vega	0.0	Spica	1.0	97.0°	1.147	<input type="checkbox"/>
19	Vega	0.0	Alkaid	1.9	51.0°	1.157	<input type="checkbox"/>
20	Altair	0.8	Arcturus	0.0	91.2°	1.170	<input type="checkbox"/>

Select All Clear All

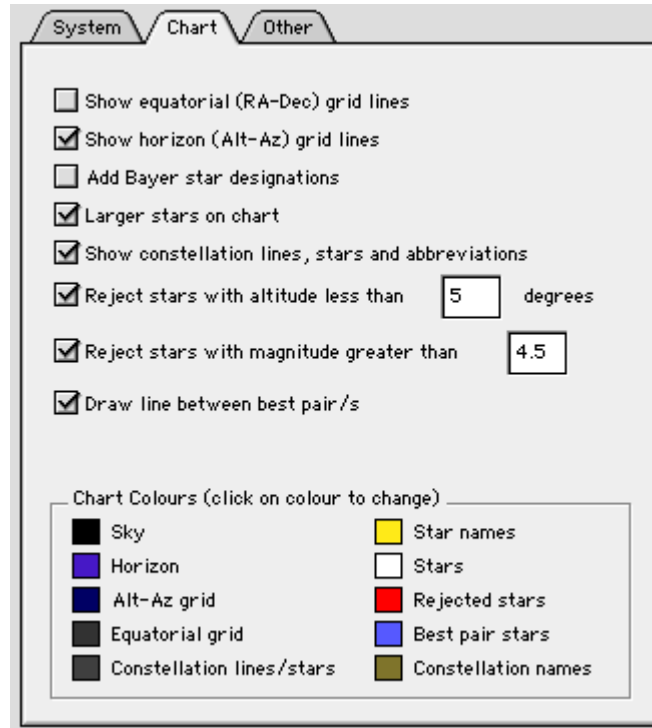
When the computation is done, the best pair (that with the smallest error) is selected in the Show column. It is possible to use the check boxes in that column to determine which pair or pairs are displayed on the chart. The Select All button will check all the boxes and the Clear All button will clear them all.

Options

The Edit menu contains a Preferences command that displays the Preferences dialog. All preferences are saved in the preference file between runs.



The System tab determines the type of controller. If LX200 is chosen the 33 alignment stars from the Meade LX200 telescope controller will be used. If the AutoStar option is selected then the 78 alignment stars from that controller will be used.



The Chart tab contains items related to the star charting.

The Equatorial grid lines option plots a RA/Dec grid in $1\text{h}/10^\circ$ steps.

The Horizon grid line option (on by default) plots an Alt-Az grid.

The Bayer star designations option adds the Bayer name (e.g. α Lyr for Vega) to the chart display.

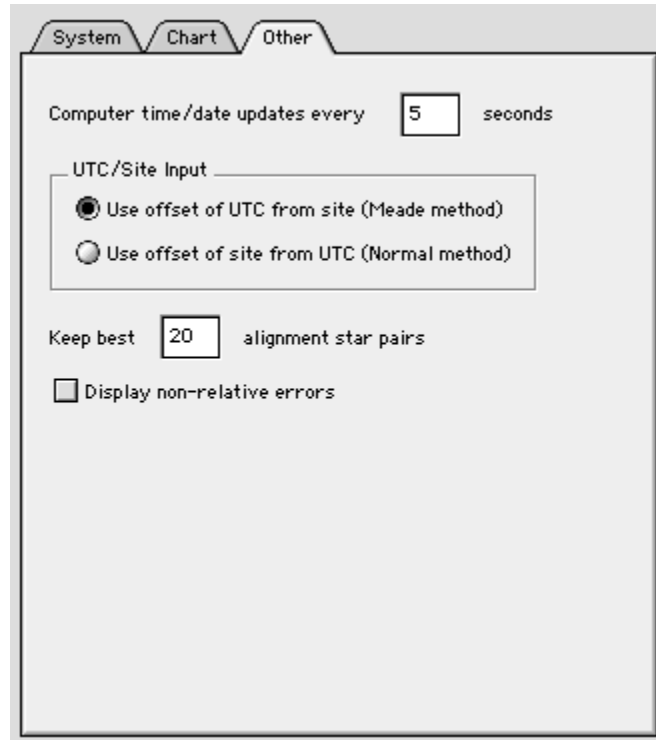
The Larger stars option plots bigger stars on the chart.

The Show constellation lines, stars and abbreviations shows all stars down to magnitude 4.5, constellation lines and the three-character abbreviation for each constellation.

The Reject stars options automatically reject low altitude stars (which are not recommended for accurate alignments) or stars with magnitude values greater than a given number, whenever the Compute Visibility button is used. It also draws a dotted line on the chart at the specified altitude (if the Horizon grid line option is chosen).

The Draw lines between best pair/s option will draw a dotted line on the chart between any pairs selected. This makes them easier to see, particularly if more than one pair is being displayed.

The Chart Colours option allows the various charting colours to be set according to user preference.



The Other tab defines miscellaneous settings.

The Update option specifies the rate at which the local time is retrieved from the computer. On some computers the default 1 second rate will cause disturbing flicker. This also affects the rate at which the visibility chart is updated if the Auto check box is set (see above).

The UTC/Site Input option defines whether you enter the UTC Offset in the method used by Meade (the offset of UTC/GMT from your site's local time) or the more common method (the negative of the Meade method) of using the site's offset with respect to GMT/UTC.

The Keep best alignment star option specifies how many pairs are displayed in the Best Pairs tab of the main window.

When the Display non-relative errors check box is unchecked, the errors displayed are relative to the best pair error, which is always 1. If this setting is checked, the actual un-normalised errors will be displayed. This can be useful for comparisons.