

FAQ's related to the Win-Tensor program

Questions regularly arise from the users of TENSOR programs (mostly for the Win-Tensor program). They are reported in this FAQ, with the reply that I gave. Some may seem no more relevant as the programme is regularly updated. The user might find here solutions on some of their questions. More formal guidelines are in preparation.

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1. Permission to use Tensor and Win-Tensor

Q: I would like to ask you if it is possible to send me your stress-inverse program and to give me the permission to use it in my research and for scientific publication matters.

R: The TENSOR program is available from the author, or by download from the Tensor web at <http://www.damiendelvaux.be/Tensor/tensor-index.html>.

TENSOR and Win-Tensor are provided free of charges for non-commercial applications, only for scientific and education purposes. For any other application, written consent should be obtained directly from the author.

2. How to cite the Win-Tensor?

If you find Win-Tensor useful and use it in your publication, please cite it preferably using the following paper:

Delvaux, D. and Sperner, B. (2003). Stress tensor inversion from fault kinematic indicators and focal mechanism data: the TENSOR program. In: New Insights into Structural Interpretation and Modelling (D. Nieuwland Ed.). Geological Society, London, Special Publications, 212: 75-100. [On-line copy](#)

The first reference to the TENSOR program is an abstract presented at the EGU in 1993:

Delvaux, D. (1993). The TENSOR program for paleostress reconstruction: examples from the east African and the Baikal rift zones. EUG VII Strasbourg, France, 4-8 April 1993. Abstract supplement N°1 to Terra Nova, vol. 5, p. 216.

3. Do I need to de-install the old Win-Tensor version before installing a new one?

For installing a new version, the old one will have to be removed. This can be done directly by running a first time the Win-Tensor.msi file. A message proposing two options will appear: Repair the existing file or Remove it. Select Remove. Executing a second time the same Win-Tensor.msi file will install the new version.

4. Procedure for data input

Q: I can not understand why there is a shadow at certain boxes within de data sheet while entering new data and it is NOT taken into consideration by Win-Tensor (no stereonet, no nothing). It is not a problem of validation. Please, explain me how to enter data, step by step, row by row. I well remember it was the same trouble with the DOS version and the No and ID labels for every row are very confusing!!!.What is the difference?

I type data but a gray shadow starts in the “comments” and as I said this specific data in not taken into consideration.

By the way, I suggest that every dot in the Mohr circle should have an identification number which also appears in the histogram. In this way one knows which data is not fitting and can be another way for separation or deletion.

R: The row number is line in the left column in Excel; it is not related to a data line. The Data ID is linked to a particular data line and is serving to identify it. You will see the interest of the DataID relative to the Data Row, when you sort the data (double click on the top of any column).The data lines will be sorted (in ascending or descending way) according to the column selected. The DataID will be reordered as the rest of the data lines but the DataRow numbers will always remain in a Ascending way, so the relation between the Row number and the Data ID will no be the same any more.

When you create a new file, you will first get an empty page. Start by entering the site properties. Do not forget the Outcrop Code as this will be used as a prefix for the Data ID. Once this is done, click on the first (empty, white) line of the data table. Pre-determined values will appear for some parameters. With the right arrow, move to the first orientation data to be introduced. Type successively the orientation data and move to the next (right) cell.

Once the cell for entering the Slip Sense is reached, the orientation data will be displayed on the stereonets. Continue moving right by filling the cells. Once you reach the field “Comment”, type eventually any text for describing the data.

To add one more line, press the down arrow within the last active cell (white color) at bottom of Column “Comments”. A new line will be added and the cursor will come in the corresponding cell of the column “Type”. This is the first data you might normally want to change, if a different data type than the preceding one will be entered. Repeat this operation until the end of your data. The upper stereogram is displaying the current data and the lower one, all data together. These are updated as the data are entered.

If data has to be added to an existing file, the file has to be unlocked before. When a data file is loaded, it is not allowed to add a new file (to prevent unwanted black data lines at the bottom of the table). To unlock the file, click on “Unlock” button on the toolbar on top of the data sheet or use menu Edit > UnlockFile, or press F7. When the file is unlocked, the “Unlock” button on the toolbar appears as pressed and the Comments column in the data table is expanded.

This procedure is effectively the same as in the Dos-Tensor version, but it is not a remaining bug. It is what I call “Controlled Data Input”. If you did not like this way of working, you can type directly your data within an Excel file. To generate an empty Excel data file within the appropriate format for Tensor, create a new file within Tensor, then save it as an Excel sheet immediately after. Once the sheet has been filled with data, it can be re-opened within Win-Tensor. When loading the sheet (as for any type of datafile), Win-Tensor is controlling the format and consistency of the data. Invalid data will not be displayed the corresponding data fields will be left empty. I can expand this explanation later if you need. Once considered as valid, a data line is compiled in a standard format and the results are displayed in the columns at the right side of the Comments column. These columns are shadowed because these cannot be modified directly. Instead, these data can be copied and pasted elsewhere (in an excel sheet for example).

For the Identification of the data in the graphics, It is a good idea. This is planned for the future developments.

5. How to add a new active line to data table?

In the data table (the grid at the bottom of the Data Worksheet, active cells (which can be edited) are displayed with a white background while inactive cells (which cannot be edited) are displayed with grey background. When creating a new file, the data table is displayed with only one active line, with all cells empty. Clicking on the table will bring the focus of the cursor to that line and default values will appear.

The data cells have to be filled successively from left to right. Moving from one cell to the adjacent one (on his right side) can be done using one of the following keys: Tab, KeyLeft or KeyDown (as this is the last active line, the downward movement will redirected to a rightward one).

After filling the data cells of that first active line, the cursor should end up in the right-most active cell, corresponding to column “Comments”. Within that cell, press KeyDown button

and a new active line (with white background) will appear and the cursor will position itself to the lowermost cell of the Type column*

* In order to facilitate data input, the cursor is positioned automatically to the Type column because this is usually the first data cell that might be changed from one input to the other. The Id is automatically generated and the Format is normally the same for the entire file. However, these can be changed if necessary (use KeyLeft to move to these cells).

6. Digitizing module

Q: I just downloaded your latest version 1.3.0.121 with the new option to digitize the PT and obtain the original fault population. This is what I needed indeed and for me it is more useful than the previous beachball with indication of extensional tectonics.

Please, be so kind and describe briefly for me the steps to follow, since I just pointed to the every P on my scanned “composed” beachball and don’t know if the Ts are also to be pointed (I guess NO). And how the Program knows whether it is a compressive or extensional solution? Of course, the orientation of every P tells us about it, but there could be combinations where this could not apply (well, I am guessing!).

Here is an attempt to explain the procedure to follow. Tell me if it is clearer after that.

In the Digitize window, after you define the Net center and radius (Step 1), you go to Step 2 and select the option « Focal mechanism as P and T axes ».

Then you point to the first T axis and click on it, but maintain the left button pressed. A great circle will appear on the stereonet, whose pole is the P axis you just defined. That great circle corresponds to all areas of the stereogram which lie at 90° (orthogonal) from the P axis and contains the both T axis (tension, square) and B axis (intermediate, triangle), at 90° from each other. The P and T axes are displayed on that great circle with their location in function of the position of the mouse. Moving the mouse with the left button still pressed will circulate the P and T axes along the great circle, at 90° from each other. Once the square (digitized T axis) is adjusted to an appropriate T axis of the scanned stereogram, releasing the left button will accept that orientation and store the data in the table.

The advantage of this system is the possibility to associate easily a T axis with a given P axis, knowing that it should be orthogonal to the P axis, so lying on the great circle whose P axis is the pole. This limits the number of possibilities, but when a lot of data are plotted or when several T axes are plotted next to each other, it remains difficult to make the proper choice. If you make some wrong associations however, it may happen that it is not possible to associate one or more of the remaining P axes with a T axis. In that case, you have to repeat the whole operation, starting with those particular P axes which you could not associate to a T axis. Working like that, after 2-3 trials, it should be possible in most cases to associate properly all T axes with the P axes.

7. How to digitise a focal mechanism as beachball :

- 1/ Load or paste the corresponding image with the beachball
- 2/ Define the center and radius of the stereonet (= Step 1)

- a. Select mode
- b. Mark the two points in function of the mode
- c. Click on Validate

3/ Digitize the data (= Step 2)

- a. Select the data type for focal
- b. Example: a focal mechanism defined as two focal planes
- c. Bring the mouse arrow over a point on the circle representing a focal plane.
- d. Press the left button and maintain it pressed (this is called a Mouse Down event).
- e. Keeping the left button pressed, move along the same focal plane on a point on the plane at about 90° from the first point
- f. Mark that second point by releasing the left button (this is called a Mouse Up event).
- g. The first focal plane is now defined and marked on the stereogram. At the same time, a proposed auxiliary plane will appear.
- h. Keeping the left button unpressed, move the mouse pointer on a point along the auxiliary plane, again at about 90° from its intersection with the first plane.
- i. Mark that third point by pressing the left button (Mouse Down event).
- j. Keep the left button pressed while moving the pointer over the extensional dieder (the one filled in dark color). The corresponding dieder will blink as you move (this is a Mouse Move event).
- k. Mark the extensional dieder by releasing the left button (Mouse Up event).
- l. The digitalisation of the focal mechanism is now completed and the result appear in the table underneath

4/ For digitizing a new focal mechanism, press “New Image”

5/ For transferring data to the Data sheet, press “Transfer”

8. Copy/Paste Function

Q: is there a way to copy/paste data from, for example WordPad to the tensor program?

It is possible to past data from any program, directly in the data sheet. Once the data is pasted, it will be checked for its validity.

9. Saving data file under a different name

Q: When saving data under a different name, the input mode changes automatically from 24 to 11. This could be changed back by changing the value in the notepad, but this can't be done in the tensor program itself.

R: Better don't change the name of the file from the program itself.

10. Changing and transferring Subset Indexes

Q. Changing Subset Indexes in the Data Worksheet and transferring them to the Processing Worksheet. Once I have changed the subsets in the original file (worksheet), I expect that on processing, the indexes are carried forward or transferred accordingly so that I do not need to retype again! It doesn't seem so. I even tried to restart my computer and start the processing

again and I can not see changes-do I probably need to do something to make the process automatic?

R. What you changed in the Data Worksheet are the Input Indexes. In the Processing Worksheet, you are working with the Working Indexes. You therefore need to transfer the Input Indexes to the Working Indexes by using Menu / Data / Transfer Indexes / Input → Working Indexes. By doing so, the Input Indexes will be copied to the Working Index column. Be aware that this will erase the previous working indexes. If you want to keep record of them before replacing them by the Input Indexes, you can copy them to the Tmp Indexes by using Menu / Data / Transfer Indexes / Working → Tmp Indexes. This Tmp Indexes column can be used to store (copy) the indexes from the Working Index column.

There are three different subset indexes: the Input Index that can be introduced during the data input and can be copied to the Working Index. This column is visible only in the data table of the Data Worksheet. The two other columns (Tmp and Working) Indexes are visible only in the Processing Worksheet. Like this, the original values of the subset Index is not modified during the separation procedure in the Processing Sheet.

Be aware that, in the version of the program you have, the tree view of the subset manager is not refreshed after transferring the Input Indexes to the Working Indexes. In consequence, if new Primary Indexes are transferred (those with integer values only), they will not appear in Subset Manager. To do so, you have to save the file, close it and reopen it. This has been solved in the last version of the program.

11. Unknown sense of movement

Q: The program won't let you fill in an "X". When you don't know the sense of the shear, the program itself decides, even with one data only, that there should be a "I".

R: No. The program simply presents you the same sense as the previous data, to facilitate the input of series of similar data. You always have the control of the sense of movement, when this is input directly (in the case of type 1: faults with slip line). When the slip direction and sense is calculated indirectly as for pairs of conjugated fractures (type 2), movement plane and associated tension fracture and some formats for the input of focal mechanisms, the sense of movement is determined by the data you entered and you cannot modify it.

12. Faults without sense of movement

Q: The data we collected from the field consist of 2 types:

- 1- Measurements of fault planes and associated slip line WITH sense of movement.
- 2- Measurements of fault planes and associated slip line WITHOUT sense of movement (since it was difficult to determine sometimes).

The program only uses the measurements WITH sense of movement to calculate the paleostress. My question is: How can I make sure the program also uses the data from the fault planes and striations WITHOUT specified sense of movement?

Via: Tools -> Options -> Default Data Values I have selected Data Type 1: Fault plane with slip line (slickenside).

R: Effectively, the faults without sense of movement are not taken into account in the Right Dihedron module. For this one, a sense of movement is required. But this module should be used to constrain a first estimation of the stress tensor, which is used as a starting point in the Rotational Optimization module for finer determination. If you have only data sets without slip sense, you should go directly to the Rotational Optimization module.

However, working with such a data set is not recommended as in fine you need to make an hypothesis on the sense of movement as otherwise, you will get two fully symmetric solutions.

When you work with the Rotational Optimization module using 2 different data sets, you should normally get different results as the tensor is constrained by the fault population.

The alpha is equivalent to the Slip Deviation (SD) that I am using in Win-Tensor. It is the simple angular misfit deviation between observed and modelled slip directions. When the slip sense is known, the value of SD ranges from 0 to 180°. If no sense of movement is known, it ranges only from 0 to 90°. When the modelled and observed directions are parallel but of the opposite slip senses (hence the observed slip sense is known), SD will be close to 180° (worst). If the observed slip sense is not known, the same SD will be close to 0° (perfect fit). This explains why it is better to determine as much sense of movement in the field as possible. In practice, this is often difficult and it is also valid to work with data without sense of movement provided that enough other data have their sense well constrained. But you should not separate both types of data.

The quality factor Confidence Level reflects this degree of confidence in the slip sense determination. A great number of data with no sense of movement will lower the final quality of the tensor.

Reaction:

I am happy to read that your program does work with the faults and slip data without sense of movement! I tried to check whether the program works with the 'no sense of movement' data. If you let the program do the processing this time, you will see that the paleostress regime is exactly the same as the other file, even the counting deviation histogram is exactly the same. This is where I started doubting whether the 'no sense of movement' data is considered in your program. When I read your e-mail I had another look and noticed that in the Rotational Optimization there is a difference between the two files. Here (finally) come my questions: What does the alpha in the histogram means? Does it also have something to do with the misfit function? If you compare these 2 data files is it not strange that sigma 1, 2 and 3 are exactly the same, given the different data sets it used?

R: In fact, the program does work with faults and slip lines without sense of movement. Nothing special has to be done for that. When you input your data, select type 1 (fault plane with slip pine) and type X for the sense of movement.

13. Working with fracture of unknown type (X)

Q: I have difficulties when I go from the Right Dihedron to the Rotation Optimization mode to include the fracture data (with X slip R.) sense and X Confidence level) and optimize the fault and fracture data together. The problem is that I sometimes don't have enough fault data for the Tensor calculation and need to combine it with fracture data. It was possible in the previous versions of the program.

R: This is a protection to avoid precisely using those data. A fracture of unknown type is not used in the optimization procedure because it is not possible to determine what function has to be minimized on it. In order to avoid giving a false impression, they are excluded from the procedure. Otherwise, the stereogram can be full of fractures of unknown type which are not used to constrain the tensor.

14. Optimum number of data per tensor

Q: How much data one can base a tensor on? We as a group feel that the more data you have, the better the tensor will be.

R: In my own work, for about 500 stress tensors determined, I used an average of 21 data per tensor and 41 data measured in the field (some sites are polyphase). I believe that you should measure at least 20 data per site, and if possible more than 40. It is no use to measure more than 100-150 data per site, because then the data become redundant and more data did not significantly change nor improve the result.

15. Discrimination between different subsets

Q: Is there an option to discriminate between different subsets which are both plotted in the same stereogram? By using different colours of the planes or different symbols of the poles for example?

R: This is now possible with version 1.4.12. See documentation on Subset Management.

16. Data filtering

Q.1: How does the filtering take place? What is the statistical method used. For example: An outcrop from which the data give a perfect clock while there are actually two tensors involved. The program will filter "the sides" of the clock, while these consist of data from both tensors

Q.2: Isn't a tensor built from data from differently orientated planes? Because when, for instance, filtering down from 300 data to 50 we noticed the orientation of the planes to be very important; the last 50 data consisted totally out of planes with the same orientation, instead of plane with all kinds of orientations, theoretically the best way to determine a tensor.

R: The best way to determine the tensor is not the statistical way. The populations should be first filtered according to field criteria. Then you can perform further separation carefully, but controlling what you do. You can always improve the fit of the tensor by reducing the number of data you use. However, this will decrease the quality of the results. This is why I

implemented the Quality Ranking system. Please refer to the documentation I gave with the program.

If you know that two different tensors exist, but with relatively small differences, you have to start with the data you can differentiate from field criteria. Then you progressively separate the rest. When you get two slightly different tensors, they might sometimes correspond to the same tectonic stage. This is often the case when there are some components of rotation during the deformation.

17. How the Automatic Regression works?

Q: Thanks again for your messages. Your explanation helps me a lot! As I followed your instructions on how to make subset indices in the data base, unfortunately, I got in some trouble again. It does not seem to work in the program (or I don't understand how it works!). When I try to make subsets using (Data > Transfer Subset Indexes > Input-->Working Indexes) I don't see the subsets in the Subset > Input-->Manager.

I have found a way to work around this problem, which is changing the 0,0 in the WOR (under Subsets in the data table) column into 0,1 (for example), this way I can select or deselect this subset. Is this the way to (manually) divide your data into subsets? It seems to work. Apart from this I have the feeling that I am just playing around with the Rotation Optimization without really understanding what I am doing (especially when I use the auto optimization option). What do the 1-3, 1-4, 2 (rotation+/-20°, R+/-0.20) etc exactly mean in the Tensor optimization & data separation section? The reason why I prefer to do this by hand is because in that case I understand and see every step I take and I seem to get lost in your program on this part, since I do not know exactly what it is calculating.

R : For the automatic optimization, the program performs a series of rotation, successively around the sigma 1 axis, sigma2 axis and sigma3 axis, computing the value of the function for a range of rotation angles (positive and negative) then finding the rotation angle which gives the best value of the function (minimum or maximum in function of the function selected). After rotation around the sigma 1 axis, it adjusts the tensor according to the latter rotation angle. Then the same is done around the sigma2 axis, then around the sigma 3 axis. The same principle is used for optimizing the R value, by checking a range of R values at both sides of the original R value. When the 4 parameters have been optimized successively, I call this a Rotation Run.

A Rotation Run can be performed with different precision: checking the values of the function for a rotation of max. 45°, 20°, 10°, 5°, positive and negative around a particular axis from the original tensor orientation. These are respectively Precision 1, 2, 3 & 4. When you select the mode for automatic optimization, for example 2-4 means performing successively a rotation run with precision 2, one with Precision 3 and a last one with Precision 4.

18. It is mandatory to use the Composite function F5?

Q: It is mandatory to use the Composite function (F5) or can I use anyone of the other 8 remaining functions?

You can use the function you want, but you have to know what you do. Function F5 is probably the best as it integrates different aspects. Function 1 and 2 only consider the deviation angle, and do not care whether the shear stress on the plane is large enough to allow the plane to slip. With function F5, you can combine different type of data: faults with slip line, tension fracture, shear fracture and compressional fractures and use them all together to constrain a tensor. With the other functions, you can use only F1 and F2 to constrain a tensor with slickenside data, F3 and F4 with shear fractures and slip planes, F8 for tension fractures and F9 for compressional fractures. The best is to try them individually on a sample data set.

19. Focal mechanisms inversion from p-t axis data

Q.

1. How to calculate the true nodal plane. I see this option but not activated. Which friction ?
2. How to perform the overall processing. Only after I went out of the program and tried again the same file it worked fine. What am I doing wrong?
3. How to separate a subset of selected nodal planes?
4. I note some filling problems in the beach balls when one of the nodal planes dips less than 15° or higher than 75° or 80° .

R. First go to Right Dihedron. In the table, all data should have a subset index 1.0. If not, reset them to 1.0 (Menu/Data/Reset Subset Indexes)

Optimize the Tensor and separate the data using button next. Press it until in the Results frame, the values for Nbr and CV for Sigma 1 and sigma 3 become blue or green. The excluded data will go to subset 1.9.

Then go to the Rotational Optimization panel and select preferably optimization function F5. Perform automatic optimization by clicking on AutoOptim button until the result become stable. When this is done, use option Menu/Data/Define Focal Plane. The program will separate the focal planes according to the value of function F5. The lowest the value, the better chance is that this is actually the focal plane. This function is minimising the deviation between observed and theoretical slip direction on the plane, but also minimise the normal stress and maximise the shear stress magnitude on the plane in order to favour the slip on that plane. The focal planes selected as movement plane are put in subset 1.1 and the auxiliary plane, subset 2.

The theory and examples for this is given in Delvaux and Sperner (2003), posted on the website.

20. Separate data for focal mechanisms (Dos-Tensor program)

Q: How to work separate focal mechanism using F4 and option M? (By Alan Lopez)

R: Working with focal mechanisms, you should use the minimisation function F5. It allows simultaneously to minimise the angular deviation between the observed and theoretical slip directions (angle alpha) and to maximise the shear stress magnitude on the focal planes. The values of this function are generally close to that of the mean deviation angle alpha. When you start the separation of the focal plane, you might want not to be too strict right from the beginning. You can then separate auxiliary from movement plane for focal mechanisms, only if the difference between the values of this function for the two planes is greater than a given value (e.g. 5). When applying the tensor to the data, the program calculates the values of the minimisation function for both focal planes of each mechanism. If the difference is greater than 5 (in this example), the plane for which the value of the function is the lowest will be considered as the potential movement plane (provided that the slip deviation alpha is lower than 30° or lower than the value fixed by the user). The other plane will be considered as the auxiliary plane. If the difference between the two values is smaller than 5° (in the present case), then both planes will still be considered as potential movement planes.

In the resulting table, the data are presented by pairs of focal planes for the same focal mechanism. The index column is the data number (reference to the data table when you select the data for processing). The Function column is the value of the minimisation function (F5 or others). The Function difference is the difference between the two focal planes for the same focal mechanism. If the database contains only focal mechanisms (as it should do), the first plane of a mechanism has always an odd index, and the second, the next even index.

The data in green (label = 4) are considered compatible, but with a function difference lower than the threshold. The data in Violet (label = 1) are considered as movement planes, the data in Blue (label = 2), as auxiliary planes and the data in red (label = 4) are not compatible (deviation alpha too high).

To terminate the separation, the program classifies the data into four classes according to the labels defined above, for which you can attribute separate indexes. The data with label = 3 have to be excluded: they belong to non-compatible focal mechanism (each of them a pair of focal planes). The data with label = 1 and 2 are pairs of planes from compatible mechanisms (one is the movement plane and the other is the auxiliary plane). The data with label 4 have still to be separated into movement and auxiliary plane.

After performing a first separation with a non-zero threshold, you have to further optimize the tensor on the remaining data, and then perform the separation again, with a smaller difference, until the difference is set to 0 (maximum one plane per each focal mechanism is kept as a potential movement plane).

21. Plots as in Tensor for Dos

Q: While saving all created images I would like create one single plot which contains: the stereoplot, the histogram, symbols of stress axis orientations + R value and the amount of used data (n=x) in one image (e.g. all plots in Delvaux et al. 1995). But the latter two are not shown in the layout of the program and its exports.

R: This is now possible with version 1.4.12

22. How to deduce the Stress Regime Index R' from the Stress Ratio R ? (in French)

Comment expliquer la déduction du Stress Regime Index R' à partir du Stress Ratio R pour le régime de contrainte, sachant que R varie de 0 à 1.

R . La définition de R' est une astuce pour présenter en une seule valeur le régime de contrainte tenant compte du facteur R et du type de contrainte (Extensif, décrochant ou compressif).

En allant du plus extensif (radial extension) au plus compressif (constriction) en passant par le décrochement, on a une évolution progressive qui s'exprime par le rapport R de la manière suivante :

- R va de 0 à 1 pour le régime extensif (d'extension radiale à extension avec composante décrochante)
- R va de 1 à 0 pour le régime décrochant (de décrochement avec composante en extension à décrochement avec composante en compression)
- R va de 0 à 1 pour le régime extensif (de compression avec composante décrochante à compression radiale ou constriction)

Ce va-et-vient n'est pas très pratique pour exprimer le facteur R sous forme de diagrammes. Soit les auteurs utilisent un diagramme triangulaire, soit ils présentent les valeurs de R dans 3 diagrammes différents en fonction du régime de contrainte.

Dans ce dernier cas, le problème se situe lorsque l'on a une population de tenseurs qui se situent à cheval sur la limite entre deux régimes. Tu dois savoir que par exemple pour la transition entre extension et décrochement, un tenseur extensif avec une valeur de R élevée est très similaire à un tenseur décrochant avec une valeur de R très élevée. A la limite, un tenseur extensif avec une valeur de $R = 1$ est identique à un tenseur décrochant avec une valeur de 1. Il en va de même pour la transition décrochement – compression. Un tenseur décrochant avec une valeur de $R = 0$ est identique à un tenseur compressif avec une valeur de $R = 0$. Tu peux tester cela aisément avec le programme WinTensor, en changeant la valeur de R' dans le panneau Rotational Optimization et en regardant l'effet que cela fait sur le cercle de Mohr.

Pour éviter cela, on peut transposer cette valeur de R en un index composite R' allant de 0 à 3 exprimant cette évolution du plus extensif au plus compressif de manière continue et calculé comme suit :

- $R' = R$ pour le régime extensif (donc pas de changement)
- $R' = 2 - R$ pour le régime décrochant (R' reste croissant du plus extensif au plus compressif, alors que R est décroissant)
- $R' = 2 + R$ pour le régime compressif (juste une translation)

23. How to compute a stress tensor from focal mechanisms?

First of all, the focal mechanism data has to be defined, as Type 5, 6 or 7 according to way the focal mechanism is recorded. In particular, Type 1 (fault with slip line) has not to be confused

with Type 6 (focal mechanism defined as slip plane, slip direction and sense of one of the auxiliary planes). It may look similar, but in the case of the focal mechanism, a second plane (the auxiliary plane) will be generated during data compilation. The difference will appear in the processing part of the program.

Computing stress tensors from focal mechanisms is quite straightforward. Within the Processing Sheet, select first all data (both focal planes for all FM) and compute a preliminary tensor using Dieder. In Dieder, click on button “Next” in order to exclude one FM (two focal planes) apparently not compatible. Move then to the Optimization pane. First optimize the tensor by clicking on button “Optimize” until the tensor stabilized. Like this, you are still working using both focal planes for each FM. Now I used the option Data/Separate Focal Mechanisms. In this, the system compares the values of the misfit function for each pairs of focal planes in order to separate actual movement planes from the auxiliary plane. We consider here that the movement plane best fit to the general tensor (has the lowest misfit value) and the auxiliary plan has the highest value of the misfit function). The decimal par of the subset index is set according to the values indicated in the drop-down box next to the labels “Movement plane” and “Auxiliary plane” in the frame “Focal plane discrimination”. If the misfit function of both focal plane from the same FM have values above the specified value in the frame “Focal mechanism exclusion”, they will be excluded by giving them the minor index specified. When you validate it, you remain in the subset index 1.1 with only the best-fit focal plane for every FM and some additional FM are excluded.

The next step is to optimize the tensor using this selection (index 1.1). To finish the procedure, in is necessary to re-check the excluded FM (normally within subset index 1.9) without changing the tensor for testing if by chance, after the last optimization, some of the focal planes did not became compatible with the computed stress tensor. If not, then the process ends here. If yes, you have to re-incorporate it to the data base, re-optimize the stress tensor and check again the rejected data.

24. What are the correct steps for the Rotational Optimization procedure?

After finishing the Right Dieder, I go to the Rotational Optimization (RO).

I start with the last number of data used in Right Dieder.

Choose the Auto-optimization mode 1 then click ‘optimize’

Choose mode 2 then click ‘optimize’

Choose mode 3 then click ‘optimize’

Choose mode 4 then click ‘optimize’

Repeat clicking ‘optimize’ with mode 4 until the tensor stops rotating (I guess this is what means “until the tensor is stable”)

Question: When should I click “reject” during RO procedure? Which button should I click when working with RO? Optimize with reject or just button next? Should I go through this order when using auto-optimization: 1,2,3,4? Can I skip any of them for example 1 then jump to 4? What if I choose mode 1-4 then repeating mode 4 until the tensor stops rotating?

Reply: The way you are using the RO procedure sounds correct. What is important is to get a stable solution, but which also gives the minimum possible value of the misfit function. It is correct to end in mode 4, but it is also good to check after that in mode 2-3 or even 4 in order to be sure that no other minima exist in the 4D space (orientation of σ_{1-3} and value of R).

Mode 1 is good for starting as it checks the whole range of possible rotation angles around the stress axes and of R values. As first the stress axes are adjusted and then the R value, a R value of 0.5 is used for finding the optimal rotation angle around the 3 stress axes (which gives the minimal value for the function). Effectively, it is when $R = 0.5$ that the stress axes are best defined, the magnitude difference between σ_{1-2} and σ_{2-3} being equal. R is fixed to 0.5 as a starting condition only in mode 1. For the other modes, the R value determined at the end of the preceding cycle is used.

[More on that in FAQ 34: 34. Data separation and optimization in R.Optim](#)

25. What is the most effective way to merge the datasets of two different files?

Use command File/Append. This will place the data of the append file at the bottom of an existing file. Note that the header of the existing file will not be affected and that the ID of fault-slip data has to be all different.

You can also insert the appropriate number of blank lines at the bottom of the existing data (Edit/Insert/Rows at bottom), select all the lines you want copy from a second open worksheet, copy them (Edit/Copy), position the cursor to the upper left free field in the first worksheet and paste the data (Edit/Paste).

26. Data validation

When you work with the database, the program validates every data lines while typing it. It may happen that when you import data, too many data lines are invalid and updating them becomes difficult. The solution is to deactivate the validation process by pressing button "Validate" on the command bar on top of the Data worksheet.

27. Data separation into subset, is it appropriate?

Q. In some optimizations, I got a number of *non compatible* data although the tensor quality is B or even A and the same time all the faults are well above the friction line in the Mohr circle. When I try to remove-delete them (1 by 1) of course the database complicates and the new data to be deleted becomes sometimes larger, as usual. I wonder whether I am doing it well or bad. Isn't it better not to have even 1 non compatible data ???

R. With focal mechanisms, we can suppose reasonably that they are all related to a similar stress field (if we have not in the aftershock sequence of a large event). Therefore, we can choose to keep all data and to use the average misfit factor as a measurement of the crustal stress heterogeneity. This is what we did in paper Delvaux et al. (2010).

For geological fault-slip data, the situation is different as the measured faults might belong to different periods, in relation to different stress fields. Even during a single tectonic stage, the stress field can change during deformation or the rock mass rotate progressively relatively to the stress direction. Therefore, the fault population is generally much more heterogeneous. In this case, it seems meaningless to measure this heterogeneity using the average misfit angle for the entire fault population. Conversely, the paleostress method offers this nice (and rare) possibility to filter out and separate the structures that have been produced during different tectonic sub-events and to reconstruct the stress tensors that generated them. This is in my opinion one of the great advantage of this method. Of course, such data filtering has to be performed in an intelligent way using as much field criteria as possible. Win-Tensor offers a large variety of tools for doing that while constantly keeping an eye on the field descriptions. Such separation has to be performed in a reasonable way, without over separation. I consider in general that a maximum of 3 different tensors and related structures can be isolated from a data set. First of all, the original data set has to be large enough to allow for a sufficiently numerous data in the extracted subsets. Ideally, we should try to have 15-20 data in each separated subset for ensuring a good constrain of the stress tensor. Therefore the original data set should contain at least 30-40 data for separating it into 2 subsets and in. 50-60 for separating it into 3 subsets.

28. Working with Win-tensor on 64 bit computers

Win-Tensor has been programmed using Microsoft Visual Basic 6, which is running under 32 bits. This is already an old technology but still widely used. It is the former programming language which was used in XP and former Office version. I had recent reports of users failing to run Win-Tensor on a 64 bit computer with Windows 7. Windows 7 should not be the problem as it runs perfectly on 32 bit machine installed with Windows 7.

Information from Windows Help: [Most programs written for Windows Vista also work in this version of Windows, but some older programs might run poorly or not at all. If a program written for an earlier version of Windows doesn't run correctly, you can try changing the compatibility settings for the program, either manually or by using the Program Compatibility troubleshooter. Changing the compatibility mode allows to run the program using settings from a previous version of Windows.](#)

Try changing the compatibility settings for the program by right-clicking the Win-Tensor program' icon or shortcut, choosing Properties and going to Compatibility. There, you should be able to define its compatibility mode. On my computer (Windows 7, 32 bit), it is set to run for Windows XP (Service Pack 3).

29. How to export data after their rotation?

An automatic procedure for this has still to be implemented for a user-friendly solving of this question. It is possible however to export the rotate data, using copy-paste. This will necessitate the creation of a new blank file as the copied rotated data from the Processing sheet will have to be pasted on the Datasheet of the new file.

When in the Rotation Tab, the data table show the rotated data in columns Plane-1, Line-1 and Slip-1. The data format is dip/dip-direction for planes and plunge/azimuth for lines and the Slip direction is presented with both the dip-slip component (I or.S), and the strike-slip component (S/D). Before to export the data, it is better to hide the data which are not selected (in the data table of the Processing sheet. To perform this, go to Menu / View and uncheck option "Show un-selected subsets".

The data to be copied have to be selected with the mouse (Columns Plane-1, Line-1, Slip-1 of Rotated Data). Selecting multiple entire columns by clicking on the column head is not an option as it will not work properly because when selecting several columns, the column with the Working index is also selected. Once selected, copy the data to the clipboard using by pressing a right click over the data table. In the floating menu, select Copy to Clipboard (also in Menu / Data). If activated (via the General Options), this will prompt a small window Copy Data to Clipboard, in which Apply to Selected Data and Apply to Selected Subsets are checked. Modify if necessary, then apply to OK. Otherwise, the visible data selected on the database will be copied.

Then create a new data worksheet (File/New). Eventually, on the tool bar on top of the sheet, deactivate the Row Validation by pressing the Validation button to avoid automatic checking of data integrity. Click on the first (empty) line of the data sheet (default values will appear) then create the necessary number of blank lines to store the copied data (Menu / Edit / Insert / Rows). Now the data sheet is ready to receive the copied data. Note that the data Format should be 11 as this is then one displayed in the Results table.

Position the cursor on the upper left cell of the data to be filled (column Fracture plane dip) the paste the data (Menu / Edit / Paste or Shift+Ins). The two components of the data group (dip/dip-direction for planes and plunge/azimuth for lines) are put into separate columns as the "/" separator is interpreted as a column separator. Now, correct the Type cells with the appropriate data type if necessary, when the data type is a fracture plane (type 4) instead of a fault with slip line (type 1).

After all the data have been copied, un-press button Validation on the tool bar on top of the Datasheet and validate the data (Menu / Data / Validate data). The lower small stereonet should display the validated data. If some data are still invalid, they will appear in with a red background. In this case, correct the data or accept the value proposed and revalidate the data.

30. Exporting tensor solutions

From the option "display/save results" in the tensor package, I assume that there is a possibility of exporting the tensor solution to Google Earth, as in the World stress map. How can I do so ?"

With the "Edit/Display/Save results", you display the data on the screen and generate a corresponding text file. Using "Edit/Copy results to clipboard", the data are copied in such a way that they can be pasted on an open Excel sheet to generate easily a database. From that excel sheet, it should be easy to export to other applications, but no particular interface is provided.

31. How to input focal mechanism solutions?

Q. I'm using focal mechanism solutions from NEIC (National Earthquake Information Center, USGS) and Harvard websites. What changes I should make in this data set to use in TENSOR ???

R. For working with focal mechanisms as input, you have to define the fault-slip data Type as focal mechanism (type 5 to 7, depending on the information you have):

- Type 5: Focal mechanism defined by two focal plane, with indication of the type (normal/reverse faulting)
- Type 6: Focal mechanism defined by one of the two slip plane (fault plane, slip line, slip sense)
- Type 7: Focal mechanism defined by its P and T kinematic axes.

You need further to define the Format for the orientation data. If you use seismological notation (as for the Harvard CMTS catalog), you have to define it as strike, dip, rake. The format is therefore 44. The first digit (4) tells that the slip plane has to be introduced as oriented strike and dip angle (the dip direction is at $+90^\circ$ from the strike direction). The second digit (4) is tells that the slip vector is defined as the rake (from 0 to 180° , starting from the strike direction, and positive for a reverse faulting component and negative for normal faulting component).

32. How to visualize EPS and DXF graphics?

EPS graphics can be viewed by graphical interfaces such as GSview and IrfanView, provided that a PostsScript interpreter such as Ghostscript, is installed before.

Ghostscript and GSview are available at: <http://www.ghostscript.com/>.

IrfanView (<http://www.irfanview.com/>) is fast, small, compact and innovative graphic viewer for Windows 9x, ME, NT, 2000, XP, 2003, 2008, Vista, Windows 7, Windows 8. It is a freeware for non-commercial use. Download the IrfanView and the plugins

It is not advisable to import directly the EPS files into Microsoft Word or Powerpoint documents. The raster restitution is rather poor and it will generate errors when printing them into PDF document.

Using these graphical interfaces, the EPS files can be converted into raster images such as GIF files and then imported into Word or Powerpoint files. This provides a much better quality than by incorporating directly from screen shots or BMP files as illustrated below.

Procedure to follow for viewing the EPS graphics and convert them into a raster file

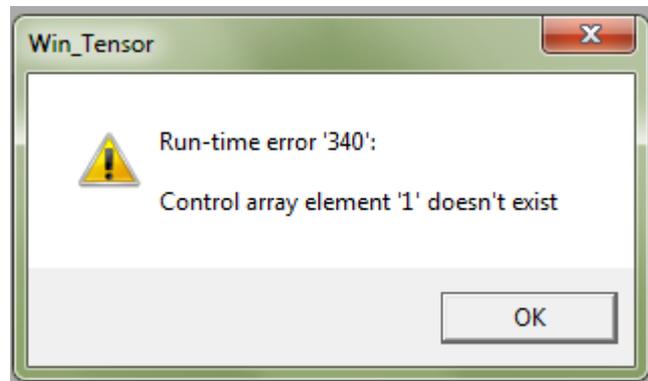
- 1: Install Ghostscript (available at: <http://www.ghostscript.com/>)
- 2: Install IrfanView (available at: <http://www.irfanview.com/>)
- 3: Close IrfanView if open
- 4: Install the IrfanView plugins (available at: <http://www.irfanview.com/>)
- 5: Open the EPS file with IrfanView
- 6: Save it in the desired format (I recommend .png).

For the DXF file, I open them in Surfer. It tested the opening of the DXF files with Surfer, but it seems that it does not work properly with other DXF readers. I am working on that.

33. Runtime Error 340

Posted 2 July 2013

Two users of Win-Tensor reported me at about the same time (25-27 June 2013) reported to have encountered a problem while starting Win-Tensor. They received a Run-time error 340 Control array element doesn't exist (example on the left). Both re-installed Win-Tensor using the .MSI file but the problem continues.



One user described how this problem appeared and how he solved it:

“I cannot exactly tell you under which condition it occurred, as I have done a series of changes, installations and maintenance in my Windows 7 Pro. This problem also happened last year, but it was solved just by a simple system restore to an earlier date. However, I have some ideas. Sometimes, when I run a program (maybe I could make a note and tell you later which programs exactly), it launches Win Tensor installer and causes it to stop working! Another issue that causes the program to stop working is running some cleaners such as the registry cleaner of CCleaner (by Piriform) or Wise Registry Cleaner. Anyway, when this problem occurs, it is not possible to solve it by a simple uninstalling and reinstalling. The only ways are either a system restore or something I did yesterday, is that after uninstallation, I removed manually whatever belonged to Win Tensor in C: drive, as well as within the registry through regedit. So, it means I have it running now. But, for normal users with lesser experience in computer it would be impossible to solve it in case they face such a problem.”

From what is described, this is not a problem caused by a bug inside Win-Tensor itself. It seems to be related to changes in the program installation caused by maintenance or automatic updates of Windows by Microsoft.

A similar problem happened to me several times after such an automatic update. I could no longer run my Visual Basic tool and I had to apply a corrective patch. I used the corrective MS12_060 security Patch: mscomctlcx2010-kb2687503-fullfile-x86-glb.exe which solved the problem. But this was for the Visual Basic programming tool, not for Win-Tensor itself. This problem was recognized by Windows itself which issued immediately this corrective patch. Just type Runtime Error 340 in Google and you will get a lot of links relative to such an error caused by programming bugs, but also links with Windows Runtime Error repair tools.

On web sites proposing repair tool kits, this cause for this error is described as follows:

“Windows Runtime Error usually happens when the computer overloads with too much data, or **when certain system files become missing or broken**. This is a critical sign of an unstable system that is typically caused by improper maintenance of the computer”.

I do not mean that your system is not properly managed, but this problem seem to originate from a registry problem and can well be caused by an improper system maintenance of update.

34. Data separation and optimization in R.Optim

[Read first FAQ 24: Correct steps for the Rotational Optimization procedure](#)

Q: In data separation & tensor optimization part in the Rotational Optimization procedure which button should I click when working with RO? Next button until mode4 appears and then click Optimize until the tensor stops rotating?

The **Next** button is first separating data then optimizing the stress tensor.

To optimize a stress tensor without separating data, use the button **Optimize** and click on it several times until the stress tensor stabilizes.

To separate data by removing those which have a too high misfit, use button **Reject**.

Note that after rejecting some data, you will need to re-adjust the stress tensor on the new data selection. This can be done by pressing **Optimize** again. Another possibility is to use button **Next** which performs successively the **Reject** and **Optimize** functions, so the stress tensor is re-adjusted automatically after data rejection.

After using the button **Next**, the button **Previous** will become active. It allows to go back to the preceding situation, before pressing **Next** button. It is a kind of Undo. Combining **Next** and **Previous** commands allows to find the best data selection by trial and error. The quality of the final solution depends not only on the homogeneity of the data set, but also of the total number of data. Both factors are opposed to each other. Removing the outliers enhance the homogeneity of the data set but decreases the number of data on which the stress tensor is adjusted. Therefore the ratio of the number of data selected relative to the total number of data in the initial set (n/nt) is decreasing. As both this ratio and the misfit function are included in the Quality ranking, decreasing the number of selected data will in general first enhance the Quality Rank as it lowers the misfit value which is initially the critical factor in the Quality ranking, but going too far in the separation will cause the n/nt ratio to become the critical factor in the Quality ranking.

35. QRw / QRt quality rank E: are the data reliable or not?

Q: What does CLw, DTw, QRwsm, Plen, Slen. QRt stand for? I know QR is Quality Ranking. Most of the time, QRw and QRt indicate E in the data I used. are they reliable or not?

The detail on these parameters for quality ranking are in the two papers with link below, which are also available through my web site.

http://www.africamuseum.be/publication_docs/2003_Delvaux-Sperner_Tensor%20Program.pdf
http://www.africamuseum.be/publication_docs/2003_Sperner_et_al_WorldStressMap.pdf

If both QRw and QRt indicate E quality, this means that the results you obtained on these data is not reliable. It does not mean that your data are not reliable, but that the data set do not meet the requirement expressed by these parameters. It can be that the number of data used is too small, that they have a poor spatial dispersion or that you have only fracture data without slip lines, or that your sense of movement is not defined.

There is a frequent confusion or misunderstanding regarding the number of data and the data dispersion. First, it is necessary to remember that the reduced stress tensor has 4 unknown. Mathematically, to determine 4 unknown, at least 4 data that are significantly different from each other are needed. So if the database contains only 4 data, a E grade is obtained because experience shows that we need a certain degree of redundancy in order to provide a statistically sufficient control on the reduced stress tensor. It has to be noted that families of data which display close orientations have to be considered in this respect as a single data. By extension, the database should contain at least 4 differently oriented families of data. Measuring several times the same fault plane or sub-parallel fault planes with sub-parallel slip lines will provide only one single family. Another option is when sub-parallel planes bear slip lines with a variety of pitch angle. These generally were generated by different tectonic events rather than by a single event as the direction of slip on a plane is ideally controlled only by the orientation of the (reactivated) slip plane and the stress tensor that generated the slip movement. The distribution of the poles of planes is expressed by the Plen, the length of the summation of unit vectors representing the poles. Slen similarly represents the distribution of the slip lines.

36. Data correction during input

Q: when I imported my data to your program and after I checked it, I found some different values between the user format (left screen) and my original data, I don't know the problem.

This happens when the format for data input is such that the planes and lines have introduced as separate entities (e.g. Dip-direction/Dip-angle for plane and Azimuth/Plunge angle for lines). In this case, there is some redundancy in the orientation data definition as the slip line is physically expressed on the slip plane and, by definition, it should be strictly parallel to it. When both elements are measured independently, a correction need to be made because of the inherent measurement error. In Win-Tensor, the correction is done by projecting the slip one on the slip plane using the smallest possible rotation angle. We prefer correct the line rather than the plane because it is generally more difficult to measure a line in the field than a plane. Due to the architecture of the database, the correction is applied directly during the data input and therefore the line orientation is slightly changed. This projection is done automatically for rotation angles less than 10° . For angles between 10 and 20° , a warning message is presented with together with the proposed now orientation of the line. The user can then choose to accept the proposed correction or to retype the data. If the angle is larger than 20° , the only possibility is to retype the data as there is obviously a problem either in the measurement itself. It can be a wrong measurement in the field, a compass reading mistake of just a typing mistake. When the slip line is defined by its pitch of rake angle in the slip plane, this problem is avoided.

37. Different results obtained using several programs

Q? I used several Paleostress programs (ex. MIM, T-Tecto, FP...et) to analysis the same data but the results were widely different, I don't understand what is the problem.

First of all, be sure that you are using exactly the same selection of data in each program. Win-Tensor has the possibility to select part of the database on which you perform the processing. Others programs generally do not. My experience is that using the same selection of data in different programs is giving similar results. See the following papers (on focal mechanisms):

Delvaux D., Barth, A. (2010). African Stress Pattern from formal inversion of focal mechanism data. Implications for rifting dynamics. *Tectonophysics* 482, 105-128.
http://www.africamuseum.be/publication_docs/2010_Delvaux-Barth_AfricanStressPattern-l.pdf

Petit, C., Deverchère, J., Houdry-Lémont, F., Sankov, V.A., Melnikova, V.I. and **Delvaux, D.** (1996) Present-day stress field changes along the Baikal rift and tectonic implications. *Tectonics*, 15(6), 1171-1191. http://www.africamuseum.be/publication_docs/1996_Petit_et_al_Baikal-stress-changes.pdf

38. Angle between P axis and fault plane: 30 or 45°?

Q.: I also got PBT axes which apart a bit from the reported ones, i.e CMT solutions. It is required to change the angle between P and the fault plane to 45 degrees instead of 30 used for faults when analyzing focal mechanism ?

Following the Coulomb fracture criteria, the angle between the maximum principal stress and the shear plane is generally close to 30°. This implies that the dihedral angle between two conjugated faults formed during the same event often approximate 60°.

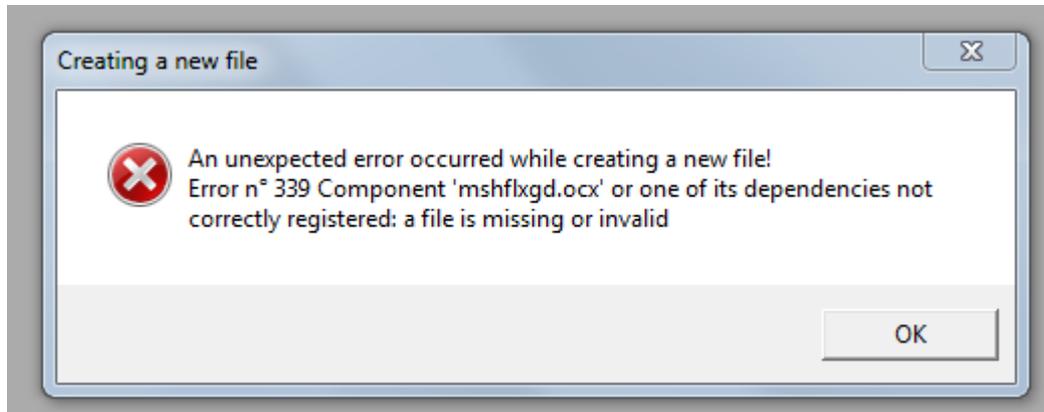
With fault-slip data, the P, B and T kinematic axes are geometrically derived and therefore refer to strain, so the P axis is an approximation of the maximum principal stress. With earthquake focal mechanisms, however, there is an ambiguity between the actual fault plane and the auxiliary (virtual) plane. In order to avoid a-priori selection of a focal plane, the P axis is set at 45° to the focal planes. This is geometrically more efficient in terms of strain (it provides the maximum shortening), but it is not the most efficient in mechanical terms where the best combination of normal and shear stress in order to generate failure is obtained with an angle of 30°.

Therefore, the default angle for the geometrical definition of the P axis is set to 30°. It can be changed in the General options, and this will modify the compiled data.

It is interesting to check the effect that a modification of this angle might have on the results. It can be well seen with a data base containing only one family of plane (not the ideal one for stress tensor calculation). When submitting this data set to the PTB method and then to the Right Dihedron, the sigma 1 will show a difference of approximately 15° if the angle between the P axis and the sera plane is set to 30°. After changing in to 45°, the results should be similar.

39. Error N°339 on component 'mshflxgd.ocx'

This error happened to a regular user of Win-Tensor after a Windows automatic update and the program could not run anymore.



This component contains the definition of the grid used to display the data in both the data and the processing sheets. It is installed by the .msi installer. It may happen that it was not properly recorded in the registry. In this case, uninstalling then re-installing the program using the .msi installer file might help.

However, in the present case this was unsuccessful. But after the update, the computer asked, as part of an increased security measure, whether the user would really want to launch the software despite the fact that it was downloaded from the net. Answering yes was not enough. But he was also offered the option (seen at the end) to decrease the security level. By taking that down to 0, the problem was solved and the program worked again fine. This happened with a Windows 7.

40. Separation of raw data into subsets

Q: Each data subset has its own stress regime which may be completely different from the other subsets. Before the separation of the raw data into several subsets, the program determines a stress regime for all data (100%). Is this stress regime the latest or recent one among all stress regimes within the raw data? or what?

R: This is the case when data from a single site formed during two different stress stages, with two different stress regimes. When treated together, the inversion will provide a mixed stress tensor which does not image a real stress regime. It is therefore not an ancient nor a recent one. It is a starting point for the separation of data into subsets. This can be used if one subset is dominant over the other one. In this case, by repeatedly removing outlier and re-adjusting the stress tensor, the program will converge to the solution which explains the dominant subset. The fault-slip data of the minor subset will be rejected progressively and these rejected data will form the second subset on which a new tensor can be adjusted.

When both subsets are of equal importance numerically, this way of separating the data is not appropriate and a a-priori separation is needed. This can be done in function of field observations if they allow to recognise the data from different subsets, using a kinematic

separation (option Menu/Data/Change-Assess Subset Index/Kinematics) or using a dynamic separation as the one implemented in the PBT method.

41. Separation of raw data into subsets

Q. I specify the half dieder angle for kinematic p axis calculation in data worksheet (angle between fault plane and p axis) 30. But I don't know what is the best value that I should use? and why?

This angle of 30° corresponds to the average angle between the p axis and the plane of fracture for neoformed fractures. In the Mohr circle, it corresponds to the optimal combination of shear and normal resolved stress on the plane, requested for initial failure. For reactivated faults, it can diverge significantly from this angle. In the Right Diehtron method, the use of right dihedrons makes the implicit assumption that this angle is 45°.

In the PBT method, we generally assume an angle of 30° and by assuming this, we assume that the faults we are using are neoformed faults. The PBT method is therefore more suitable for neoformed faults and the Right Dihedron, for any kind of faults (neoformed and reactivated).

42. Working with fracture data

Q.: I did fieldwork in the Spanish Pyrenees and collected structural data at an km scale anticline. We would like to analyse the palaeostress field during the fold development based on the different fracture patterns we measured. The data consists mostly of fracture data like joints and veins but also styloliths and shear fractures with lineations. I don't have any major faults in this area.

Is this dataset suitable to be analysed with your software? And is it easy to handle with your software? We have hundreds of measurements.

R.

The Win-Tensor programme has been designed for working, beside slickensided faults, also with different types of fractures. Each type of fracture has its proper kinematic meaning. It is clear also that a shear fracture contains less information on the stress field than faults with slip lines, but the presence of a shear fracture indicates favourable stress conditions for its development.

Fracture data can be used in Win-Tensor in a same way as for fault data. They have just to be entered and defined properly in the data base. After that, the use of the PBT and Right Dihedron methods will be limited to fracture data that can be handled by these methods.

Also, be aware that with such database of fractures, the solution obtained with then Rotational Optimization might be non-unique. You will probably impose some starting stress models in order to get realistic results.

The large number of measurements is not a problem, but an asset. As fracture data contain less information on the stress field than fault data, this can be partly compensated by adding more fracture data.

43. Copy paste data from an Excel sheet

Q. Is it possible to copy paste data from an excel Sheet or is there a way to easy import data so that I don't have to type any value manually?

R. There is indeed several ways to fill the data sheet and one of the most convenient is effectively copy-paste from an Excel sheet.

For this, follow the following steps:

- Create an empty file, fill the header data and enter the first line of data in the appropriate format
- Using Menu/Edit/Inert Rows, add the necessary number of lines (your number of data minus one because you already entered the first line)
- Deactivate the data validation process during the input by pressing the button Validation on the Option bar at the top of the Datasheet (it should be pressed)
- Copy your data by columns (multiple columns possible) and past them at the correct place (upper left cell where the data has to be pasted)
- Use the field Comments to label and describe your data
- If you have a unique Id for your data, transfer them to the column Id
- Eventually modify the ID by adding a prefix using Menu/Data/Reset ID
- Eventually modify also the other columns (confidence level, Weight factor, Activation type, Striae Intensity)
- Adapt eventually the Subset Input to group your data into different subsets
- When all the data are in place, press again the Validation button (it should be now unpressed)
- Validate the data using Menu/Data/Validate Data. This will first check of the data are in the correct format, then, if they are, it will also compile them fill the columns Compiled data and display them on the stereonets

44. Choosing the fault plane between the two nodal planes

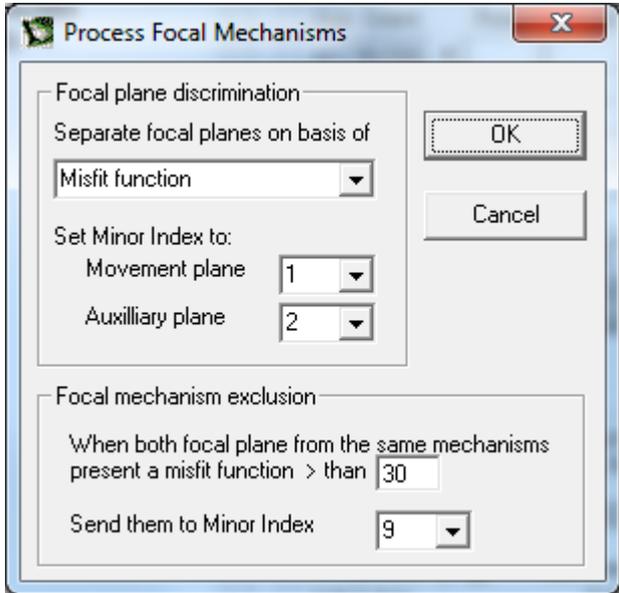
Q. How to discriminate between the fault plane and auxiliary plane between the two nodal planes of focal mechanisms?

R. Each focal mechanism is entered in the Data Sheet as a single data for which the two focal planes are deduced. In the Processing Worksheet, both focal planes for each mechanism appear in the data table as separate entries.

When processing focal mechanisms, it is advised to use first the Right Dihedron method as it has been developed specifically for the focal mechanisms and is makes no discrimination between the focal planes. In a next step, go directly to the Rotational Optimisation panel and the result of the Right Dihedron will appear as a starting point for the optimisation. Click several times on the button Optimize until the stress tensor stabilizes. Now, the result obtained

represent the best solution for all focal planes (both fault and auxiliary planes). The next step is to discriminate between the two. If no independent criteria exist, a solution is to consider as the fault plane for each focal mechanism, the focal plane which is the mechanically the most compatible with the stress tensor obtained. This can be easily done by comparing the value of the standard function F5, which is lower for the most compatible focal plane and higher for the least compatible one. This function combines the minimisation of the angular deviation between the observed slip on the focal planes and the resolved slip obtained by applying the tested stress tensor on the focal planes, with the minimisation of the resolved normal stress and maximisation of the resolved shear stress which promotes slip on the plane. This comparison can be done manually, by examining the F5 results in the data table and changing the working index to separate the fault planes from the auxiliary planes.

It can be done also automatically using the Process Focal Mechanisms dialog box which can be obtained from the menu bar by choosing Data/Process & Separate focal mechanisms (F7) when working with a database with only focal mechanisms, in the Rotational Optimisation panel.



In the dialog box, define the minor index for separating the Movement (fault) plane from the Auxilliary one. Define also the value of the misfit function for excluding mechanism for further processing, when both focal plane present misfit values above this threshold, and define the minor index for rejecting it.

Typically, when starting the separation process, it is advised to set the minor index to 0 for all data. After the automatic separation and using the pre-defined parameters, the actual movement planes will be with a minor index 1, the auxiliary planes with a minor index 2 and the rejected focal mechanisms, with a minor index 9.