GPS Newsletter – SKI-Pro

A Newsletter On System 500 GPS, Vol. 01, No. 22.

Point Classes and Triplets...

This is the first Newsletter in our new in-depth form. It will cover a topic, which you have certainly come across when working with SKI-Pro: Point Classes and Co-ordinate Triplets. They build one of the fundamental concepts of SKI-Pro.

In the SKI-Pro database there may exist more than one co-ordinate triplet for any point. They are called **co-ordinate triplet** simply because the co-ordinates typically comprise of three values (X, Y, Z or Latitude, Longitude, Height or Easting, Northing, Height). The hierarchical order of these co-ordinate triplets is represented by the so called **Point Class**.

Imagine you import GPS raw data for post-processing, then just the **navigated** co-ordinates for a point will be stored. After processing a baseline, additionally, the processed co-ordinates are stored using the Point Class **Measured**. If more than one baseline is stored the **averaged** co-ordinates are saved in addition to all the measured ones. If later the point is used in an adjustment, the **adjusted** co-ordinates are also added.

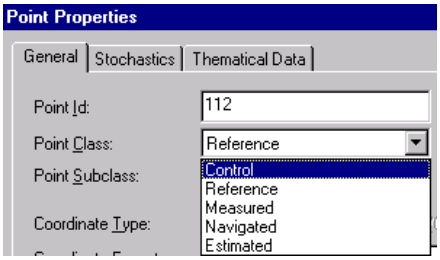
The following list gives an overview of all existing Point Classes in a **hierarchical order** (highest one on top):

- Control
- Adjusted
- Reference
- Averaged
- Measured
- Single Point Solution
- Navigated
- Estimated

The Point Class Measured is the only one, which can hold more than one co-ordinate triplet. All other Point Classes are unique. They only have one triplet.

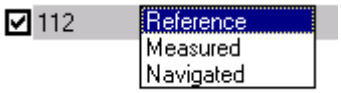
Adding new triplets (classes)

It is not possible to create some of the point classes manually. For example SKI-Pro establishes the measured co-ordinates, builds the average or calculates the adjusted co-ordinates. The only Point Classes, which you can add manually are the classes Control and Estimated. You can do this in the Point Properties page:



Note that from only the screen shot above, you cannot see which point classes actually already exist, because Control and Estimated will always show up in the drop-down box to allow adding new triplets of this type.

To find out which Point Classes are stored for that point double-click in the Point Class column of the Points view:

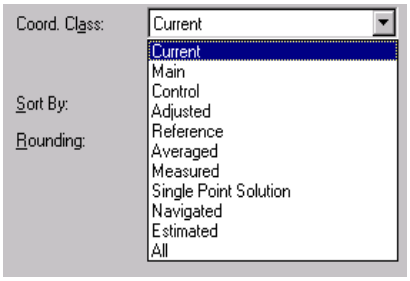


The Current and the Main Class

Always one of the existing point classes is currently active. This is the one, which is displayed in the Points view in the Points Properties page and for which the corresponding symbol is shown in the View/Edit screen.

According to the hierarchy, the **Main Class** is the highest class that exists for a point.

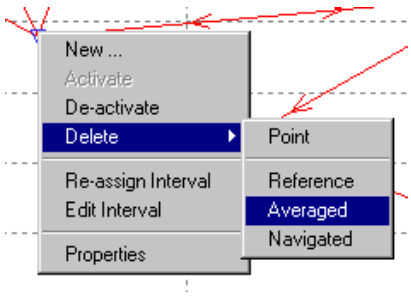
This class can be used in all kinds of ASCII exports where the point class to be exported can be selected.



Setting the class to **Main** will ensure you (typically) get the best co-ordinates during export. **Current** may be used, if you wish to get different point classes for individual points. Setting it to **All** will export all existing triplets for each point. Using one of the other classes will enforce that only the selected class is exported.

Deleting Triplets

You can **remove co-ordinate** triplets from the SKI-Pro database using the context menu in the View/Edit screen:



Note that deleting an averaged co-ordinate will also remove all measured co-ordinates and the corresponding baselines. Deleting a point of the point class Reference will remove all baselines derived from that point as well. This ensures that data integrity is maintained.

You can also remove triplets for more than one point at once. To achieve this you have to select the points in the View/Edit screen and then select **Edit / Delete / Triplets** from the main menu. This can be useful, if you want to remove, for example, all Control points or all adjusted solutions from your project.

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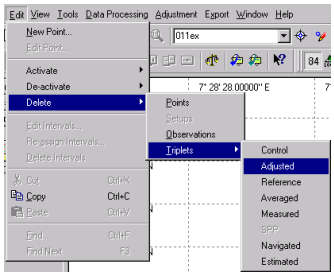


Note that the actual point is only removed from the database when deleting the last existing triplet. Only then the raw data for that point would be removed as well.

The next paragraphs explain the different point classes in more detail.

Navigated, SPP and Estimated

When GPS raw data is imported, the points will be assigned the point class of **Navigated**. This is the navigated, uncorrected code solution from the field and is typically accurate to a few meters.

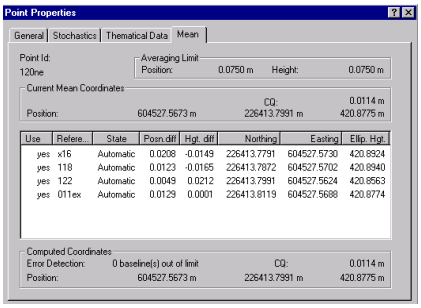
When a **Single Point Solution** is processed and stored, the point class SPP is added using the resulting co-ordinates.

The point class **Estimated** is not needed for pure GPS processing networks. It is only required to support the Adjustment component with initial provisional co-ordinates, when a point is only observed with terrestrial observations.

Measured and Averaged

Measured co-ordinate triplets are stored in the database either after the import of real-time measurements or when storing post-processed results. It is worthwhile knowing that RTK and post-processed solutions can be distinguished by the additional **Point Subclass**. RTK results have subclass **Phase** whereas post-processed results have subclass **Phase Fixed**. Measured triplets cannot be edited.

When more than one measured triplet exists for any point, the **Averaged** triplet is automatically created. You can then access the different solutions on the Mean tab of the Points Properties page. This is also where you can include or exclude solutions from the Mean:



Reference

The **Reference** triplet is the guarantee that in SKI-Pro always the same co-ordinates are used to construct the baselines from. Whenever a point becomes reference for the first time, the co-ordinates of the highest point class are copied and the point is awarded the new class Reference. Whenever another baseline is to be processed and stored, the vector will be added to the already existing reference triplet. Reference triplets are automatically created by SKI-Pro (and not by the user) either after importing RTK results into your project or when storing post-processed results.

To keep the consistency of a complex network, the reference triplet will always be passed to the processing kernel, if it already exists. This principle is kept even if you later add a Control triplet to your point. This approach makes sure you do not use different reference co-ordinates for the same point!

Note that reference triplets are always stored in the WGS84 co-ordinate system. This makes sure, that the WGS84 reference co-ordinates do not change because of a change in the attached co-ordinate system. It is also important to know that Control co-ordinates given in Local Grid will therefore only be used to build the Reference triplet, if the attached co-ordinate system allows the conversion to WGS84.

Changing reference triplets

An example: You are combining RTK and post-processed work in the same project. With RTK you were using a 'HERE' position in the field, because you wanted to find the best co-ordinates for your reference station later as a result of your post-processing.

You should first import the post-processing data, find your best co-ordinates and store these results. If now the point you used as a reference in your RTK job also was reference during your post-processing, then a reference triplet will already exist in your project. This is likely to be different to the HERE position. When you then import the RTK job, SKI-Pro will create a new point ID *"Reference (2)"* for that point, as the reference triplet has to be unique. However since version 2.0 you are able to change the reference triplet without deleting the baselines. SKI-Pro will then apply the corresponding shift to all rover points, which are connected to that reference.

Adjusted and Control

After performing an adjustment an additional triplet of class **Adjusted** is added to the database. Note, that only one adjusted co-ordinate can exist, which means that adjusted co-ordinates will be overwritten by another adjustment run.

Control is the highest class and is used to hold points fixed in a constrained adjustment. Points can be fixed in either position, height, or position and height.

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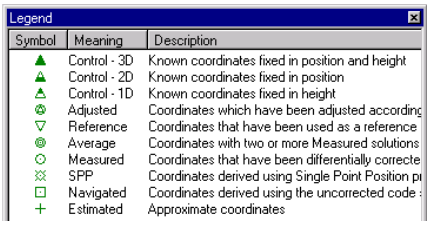
Note, that also for points which have a Control triplet stored, an Adjusted triplet is created after storing the adjustment results. This is important for example if you are holding points fixed in position only. The Adjusted triplet will then inherit the fixed position, but will have the adjusted height.

It is therefore recommended that after an adjustment involving points fixed in 'position only' or 'height only' the Adjusted class is chosen when exporting to obtain the 'best' co-ordinates.

More information...

To read more about Point classes, subclasses or co-ordinate triplets you may check the **Online Help**. Just type Point Classes in the Index...

Also note that you can switch on the **legend** in the View/Edit screen, which gives a short explanation what the symbols mean...



Remember…

- Any point in SKI-Pro can have more than one co-ordinate triplet. Co-ordinate triplets are organised in the hierarchy of Point Classes.
- Only the point class Measured can comprise of more than one co-ordinate triplet. All other point classes are unique.
- If a co-ordinate triplet of the point class Reference already exists for a point, it will be used again for subsequent baselines to be processed or stored. If it does not exist yet, the highest class is used to create a new reference triplet.
- Control triplets are used to hold points fixed in an Adjustment.

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