This note will delve further into 3D-GPR data interpretation and touch on the theme of quality control of the resulting exports.

Condor's development goal was to create 3D GPR processing software that was much easier to use while still being effective. When considering the different elements of a 3D-GPR project, e.g., data volume, target complexity, positioning systems, varying soils, applications, etc. etc., keeping the processing software efficient and user-friendly seems conflicting and complicated in itself. However, we have a growing and experienced user-base, helping us refine this process to suit typical workflows.

On that note, we introduce a feature called 'ribbon-box', which allows the user to define a volume on the top-view with a few simple clicks (as with the 'cut-lines' discussed previously). Figure 1 below, demonstrates the concept; where the ribbon-box's outline, shown in red, is defined when the user clicks the centre line shown. In this case, we define the box with nine vertexes, and the software creates the red dots for smoothing.
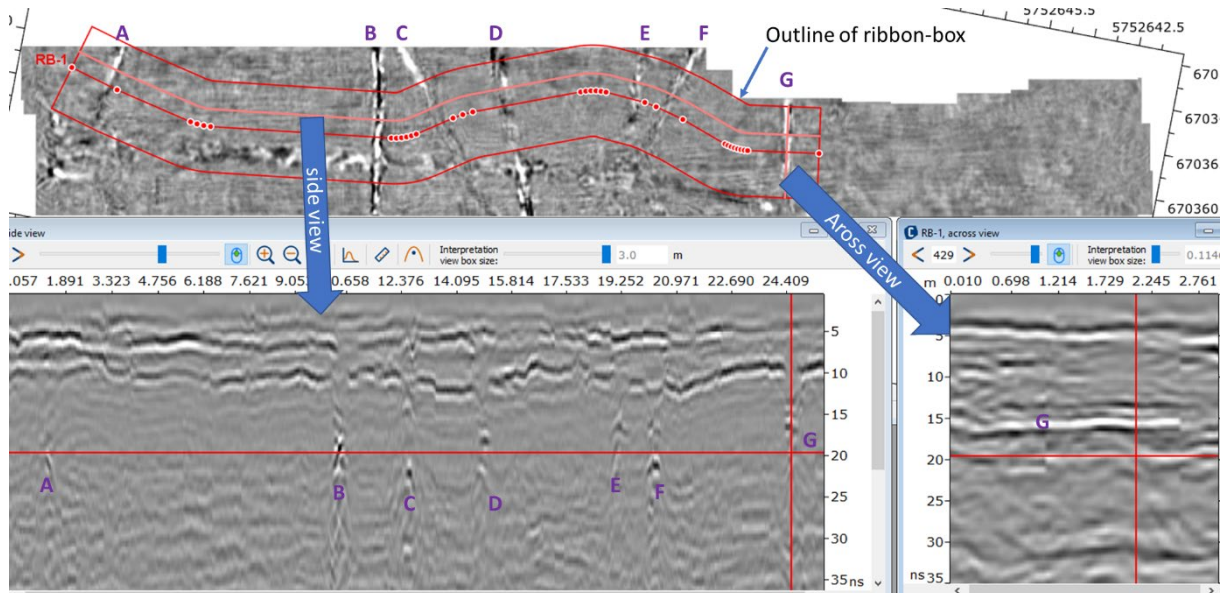

Figure 1, Top, layout of ribbon-box with marked utilities, bottom; side-and across views with the same utilities labled

Once the last vertex of the box is clicked, the two bottom views appear, showing a side-view and an across-view. The side- view can be moved freely in the box but is always parallel to the centre line, and the same is true for the across-view, which is perpendicular to the centre line. Both cuts are shown in a brighter colour in the top-view.

In Figure 1, the side-view shows the marking of seven utilities, A to G, which are also clearly visible in the top-view. The outline of the ribbon-box is created so that it crosses the marked utilities at approximately 90 degrees. This placement means that the across-view will be parallel to the utilities when moved to intersect them, an advantage when working with precise target picking, shown below.

In figure 1, the across-view is right on top of target G, which is shown as a straight non-dipping anomaly, and easy to pick. However, scrolling the across-view over target E shows it
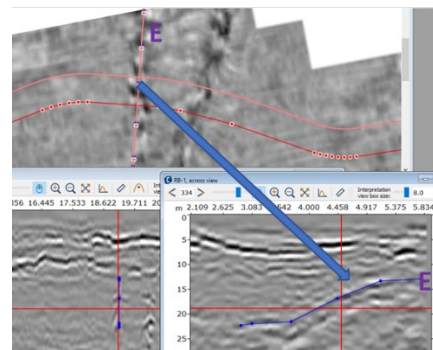

Figure 2, Target E highlighted by moving the across view to its location.

dipping strongly, as shown in Figure 2. It is now equally easy to pick this target in the across-view while checking the alignment and/or adjusting it in the other views.

By selecting a suitable outline and width of the ribbon-box, one can move through the data set and conveniently pick all the targets observed. This approach is faster and more precise than the use of simple cut-lines, as previously described. Regardless, cut-lines have a place and can still be highly useful.

A common problem when interpreting 3D-GPR data is that the number of targets can clutter the view, making it hard to know on which one you are working. To reduce clutter, you can toggle features on or off, but that means many repetitive mouse-clicks. However, when using the ribbon-box, you can
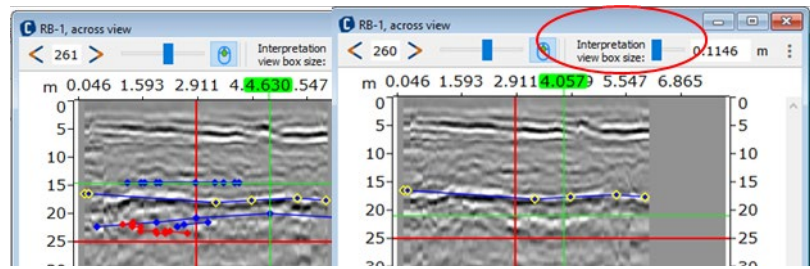

Figure 3, To reduce the visible picks shown on the radargrams we use a defined/variable volume, 'Interpretation view box size', left: large window, right: narrowed to the active pick.

adjust the depth of the interpretation view to mask picks outside of the working area, which easily declutters the data view, as shown in Figure 3.

Consequently, the ribbon-box tool is convenient and straightforward to use. Furthermore, it simplifies managing large data volumes, since it puts far fewer demands on the processing PC than a 3D-cube approach.

Once the interpretation process is complete, you can export the interpretations for further use to create deliverable reports. The most common format is DXF, as these files are compatible with CAD software typically used for this purpose. However, how these files where made, is something a user may have to explain to the end client. Of particular interest is the velocity used for calculating the depth to marked targets, since this crucial parameter determines the depth of interpretations.

As previously presented, Condor is constant velocity software that manages only one velocity at a time. However, it's essential to understand Condor's characteristics, which allow it to handle any number of velocities at different times, as shown in Figure 4.

Figure 4, Condor manage different velocities, in this example it would be 3, if the operator does not intervene

Understanding the implementation:

- A project velocity is defined in preferences, and if left unchanged is the value used for all data instances up to the first instance of migrated data.
- Each instance of migrated data and any subordinate-instances are assigned the same velocity to which it was migrated.
- Every picked target is assigned the velocity used during picking, and that velocity is used when the depth of that target is written to the dxf-file.
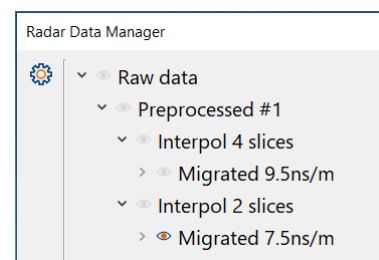
Moreover, a log file for every picked feature, including the vertexes and velocity used while exporting it, may also be saved. The operator always has control and can overrule any pre-set velocity.

Ultimately, data interpretation depends on the user's skill and experience, but Condor dramatically aids the operator to make this process easier.

With access to the right tools, processing and interpreting 3D-GPR data does not have to be complicated nor tedious. With the advancement of modern 3D-GPR solutions such as Raptor, this technology becomes more accessible and therefore, the demands on interpretation tools increase. You should not need to be a geophysicist to do 3D-GPR work, and with the combination of Raptor and Condor, you need not.