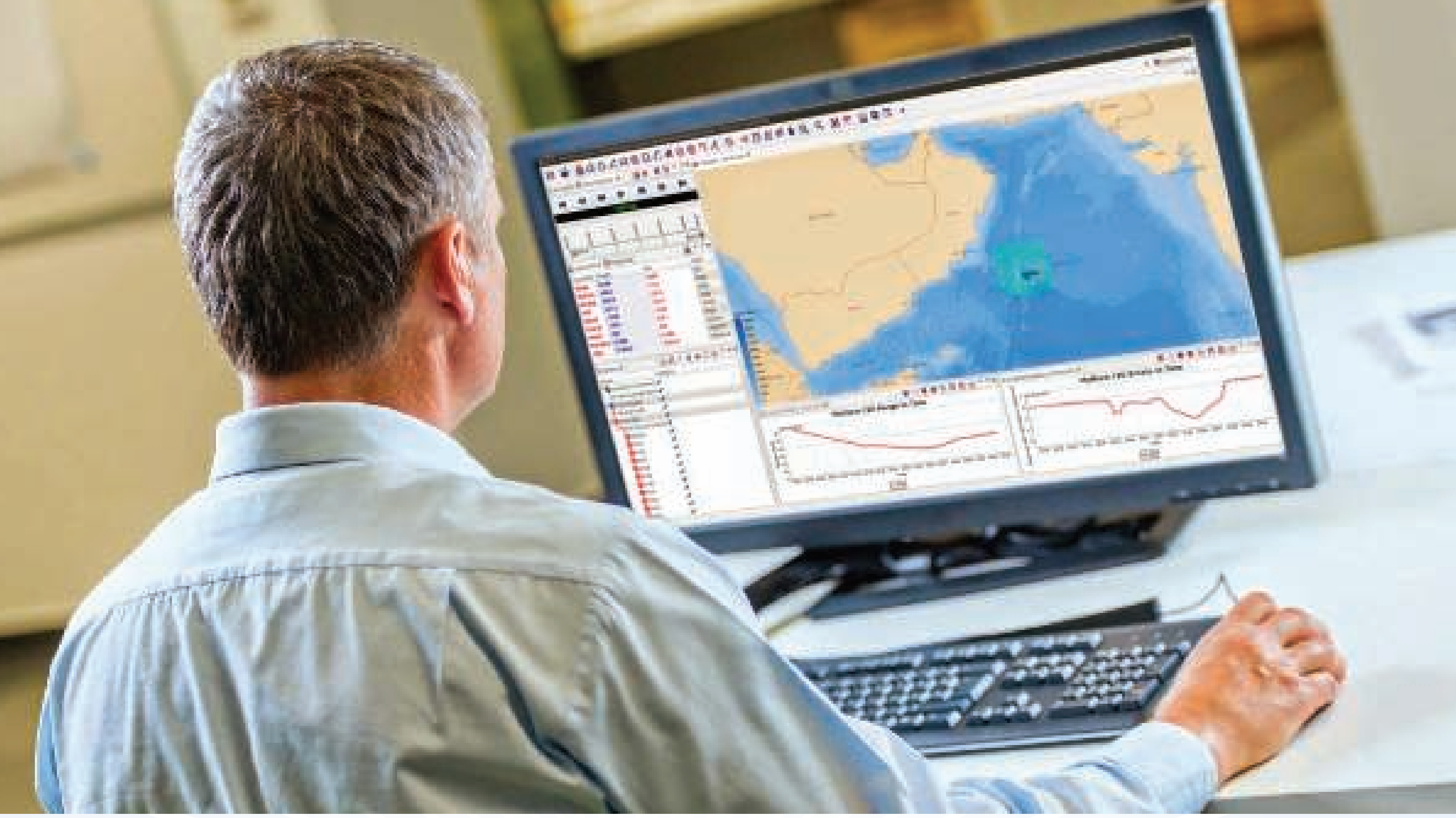

Debrief

TMA Skills

This set of tutorials covers the skills necessary for single-sided track reconstruction - useful if one of your trial participants hasn't provided track data but for which you have sonar data.

www.debrief.info

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Name: ______________ Date: ______________

Please forward feedback on this cheat-sheet to support@debrief.info

Single Sided Reconstruction in Debrief

Before running through this cheat-sheet, you should have already completed the **A Debrief walkthrough** cheatsheet, so you know how to configure Debrief and load your data. If you haven't done this, please do so before attempting this tutorial.

Working with target tracks

Now it's time to start building the target track

Grooming track data

This cheat-sheet will lead you through grooming some dodgy track data.

1. **Check Navigator is open**
   In the top left hand corner of Debrief you should find the Navigator window. If is isn't there, select "Navigator" from Debrief's Window/Show View menu (or click the link below). In the navigator, you should have a linked directory to sample data, either from a previous Debrief installation, or from within the 'Sample_data' folder in the installation directory of this fresh one.
2. **View sample data**
   In the Navigator, expand the folder that contains your existing Debrief files (either REP or XML). REP files are flagged with a Debrief icon.
3. **Check import mode**
   For this tutorial we need to ensure that the data track is imported in Over the Ground mode. To check the import mode, click on the Preferences item from the Window menu. The **Default track import mode** selector is in the **Maritime Analysis** preferences. Check that **Ask user** is selected - so that you can be confident of the mode in which the data is to be imported.
4. **Drag in sample data**
   In the sample data folder you linked to via the Navigator view, you'll find a **S2R** folder containing test data for this tutorial. Double-click on the dodgy_track.rep file from your the S2R folder of the Navigator view to load that track as a new Debrief plot. The plot and any associated views will promptly update. As the REP file is dragged in, you'll be asked whether you wish to import the data in Over The Ground (OTG) or Dead Reckoning (DR) mode. Select OTG for the track segments in this tutorial file

5. **Main track loaded**
   There you are, your track data is now on the plot. In this (fictional) example, you have your blue ownship track . Unfortunately this track has a period of missing data. There are also several jumps in the data - shown about 2/3 of the way along it. Note: jumps can occur when an inertial navigation system receives an external update. We'll fix these first.
6. **Getting a feel for the data**
   Right we've now got our first track section loaded. You can also see it in the Outline View view. If this isn't open, either select it from **Window/Show View/ Outline View** or click the shortcut immediately below. It would be useful to show symbols for all of the data points on the track. So, right-click on Track:Frigate. A large popup menu will appear - which shows the range of items we can edit for this track, and operations we can apply to this track. From the menu, select **Frigate** to see the list of editable items specific to this track. From the popup menu, open the **Symbol Freqency** menu, and select **All** . This will switch on a symbol at every data point.
7. **Zoom in on jump**
   If you look at the Blue track, you will see several instances where there is a large step (jump) in the data. We're going to fix those. Start off by zooming in on the jumps shown near the bottom of the blue track. The zoom in button is the magnifying glass with a plus sign inside it
8. **Make first split**
   There are actually three jumps in the data here. Let's start by clearing the last jump. The vehicle is travelling in a ESE direction, so right-click on the first valid point in the southernmost leg of data (it's the first point in the last leg of straight-line data). From the popup menu, select **Split track before 0337** .
9. **Check what just happened**
   Now you'll see that the track has been split into two. But, also observe that we've still just got the single track shown in the Outline View. But, if you expand the **Track:Frigate** track using the arrow to its left, you'll see that it has a child named **Track segments (2)** .
10. **Align last section**
    Next, select **Drag Track Segment** from the toolbar, it's an arrow cursor with a picture of a track-segment to it's top-right. When you select **Drag Track Segment**, the Bearing Residuals window opens. It isn't of relevance to our tidying of this single track - but we do need to switch to Translate mode from the Translate/Rotate/Stretch/Shear modes offered. Now, move the hand-cursor over first point of the lower segment of track - it will be labelled with **030337.25**. When it turns green, start dragging the track upwards and leftwards over the dangling end of the other track segment. Whilst the track is being dragged, you'll see that extension legs are plotted on each end of the track, with a marker circle plotted at the distance along the extension equal to the distance from the end point to the first point on the track. You can now fine-tune your drag operation to put the 'target' over the last point on the blue track.
11. **Rejoin tracks**
    Now we can recombine these two track sections. View the sections by opening up the **Track:Frigate** item in the **Outline View**. You'll see there's a single item, labelled **Track segments (2 items)** . Right click on this item and select **Merge all track segments**. You'll now see the tracks combined.

12. **Fix other jump**
    There are two other jumps further up the track. We'll work our way backwards up through them, preserving the start of the blue track at each step. Start off by splitting the track at the north-end of the larger of the two jump (split track before 0327), drag it onto the dodgy point at the end of the good track section, and combine the track sections again. Lastly split the track after the remaining jump, (split track before 0326), move it onto the valid track data, and recombine them.
13. **Add third party data**
    Don't forget the period of data missing from the track. Cleverly, you've found this data from another source and stored it in the file named **third_party_track.rep**. Drag in this file of 3rd party data, again selecting OTG during the import. You'll see it appear quite a long way north of the main track, since it has been measured from a different datum.
14. **Get in the ballpark**
    We'll start off by moving the third party track segment down to the right region. To do this, click on the 'Drag whole feature' toolbar button: it's a cursor arrow with a rectangle to its top-right. Now move your hand-shaped cursor over the 'rogue' green track. You'll see your hand-shaped cursor turn green as it passes over something that can be dragged. When its green over the rogue track, click the mouse and drag it down near the start of the blue track (Hint, put it just below the 'g' of the blue track title. Trust me, I know where it's going to go...).
15. **Fit to window**
    Now click on the **Fit to Window** toolbar button, it's the green diagonal arrows. The plot will now zoom in and you'll see the data in more detail
16. **Zoom in on blue hole**
    Next we're going to zoom in on where the green segment is to be inserted. To do this, select **Zoom in** from the toolbar. Once the zoom button is clicked, drag a rectangle around the top 1/3 of the blue track. Once zoomed in, you'll clearly see the jump where our missing data is to go.
17. **Split the blue track**
    The 'jump' in the data where the ficticious recording went down should now be visible. Right-click on the point at the North-end of the jump (the earlier point), and select **Split track after 0143** .
18. **Move the third party track section into place.**
    Next, switch to **Drag whole feature**, then move the cursor over the top-left end of the green track, and when the cursor turns green start dragging the green track down so it' ready to drop on the end of the blue track segment.
19. **Position remaining blue track**
    We've now got to tidy the remaining section of blue track. So, zoom out so you can see both ends of the green track (the zoom out button is the magnifying glass with a minus symbol). Once you can see the green track and the lower blue track, select **Drag track segment** again and move the blue track onto the end of the green track.
20. **Join track segments**
    Now that our tracks are lined up, we can group them together into one. Do this by selecting both tracks (**Track:Frigate** and **Track:TP_track**) in the Outline View (use the control key to select multiple items). Then right-click on one of them and select **Group tracks into Frigate** . The segments will all now turn blue, and only the **Track:Frigate** will be shown in the Outline View. But, expanding this item shows **Track segments (3 items)** . Right-click on this and select **Merge all track segments** .

In that task, you fixed some jumps in the ownship track, and filled in a period of missing data. You won't need the current plot for the next stage of the tutorial, so you can close it (by clicking in the 'x' in its title tab) - and no, you won't need to save changes.

Groom sensor data

This cheat sheet guides you through creating and preparing the ownship sensor data for producing **Target Motion Analysis (TMA)** tracks.

1. **Load datafiles**
   For this tutorial we will be using a new set of datafiles.
   In the **Navigator**:
   1. Go to the **sample_data** > **S2R** folder.
   2. Double-click on the **nonsuch.rep** file to display the **Track Mode** dialog.
   3. Select **Dead Reckoning (DR)...** from the dialog and click on **OK**. The ownship track will load into the plot (**Track:NONSUCH** in the **Outline View**).
   4. Click on the **Fit to Window** button.
   5. Now drag in the **sensor.dsf** file from the **Navigator** view.
   6. The **Import Sensor Data** dialog will display.
   7. You can go through the tabs by clicking on the **Next** button this time round you can just click **Finish** to accept the default options.
   Note: as the plot area can quickly become cluttered, the data from the **sensor.dsf** file is not shown on the plot by default.

2. **Make sensor data visible**
   While this is the default option, we now wish to see the sensor data we've just imported.
   So, in the **Outline** view:
   1. Click on the down-arrow next to **Track:NONSUCH**
   2. Click on **Sensors (1 items)** to expand it.
   3. Click on **Sensor:Sensor_A (52 items)** to select it.
   4. In the **Outline** view toolbar, click on the tick button (**Reveal selected items**), and all the sensor data will appear (we call these bearing fans).

3. **Resolve ambiguity**
   In our data, you can see there are 2 bearing fans: 1 radiating out WNW, and the other NNE. Intelligence and experience tells us that our actual contact is off to the NW. Now we need to understand what is actually happening here.
   If we open the **Time Controller** view and drag the time slider back and forth, we'll see our current position highlight moving from top-right (the start point), to bottom left (the end point). As such, the NW block of sensor data is to the right, or starboard, of the Nonsuch track. .

4. **Remove ambiguous data**
   Now that we know which sensor data we do need, we can remove that which we don't:
   1. In the **Outline** view, expand the **SENSOR_A** dataset
   2. Select all of the child items by clicking on the top value, scroll to the bottom of the list and then press and hold the **Shift** key on your keyboard while clicking on the bottom value - this will select all 52 sensor items.
   3. Right-click on any of the entries and select **Keep starboard bearing**; the port bearings will disappear from view.
   Next, we need to edit the raw sensor data.

5. **Open grid editor**
   One way of editing the raw sensor data is by using the **Grid Editor**.
   1. Click on **Window** > **Show view** > **Grid Editor**.
   2. The **Grid Editor** view will appear, but it will be blank until we indicate the data to edit.

6. **Indicate data to edit**

   The grid editor reflects the current selection in the **Outline** view. However, if the selected items in the **Outline** view are not suitable for editing in the grid format, nothing will be seen; as we have just seen in this tutorial, after hiding the port bearings and opening the grid editor, the grid is actually empty.
   To populate the grid area: click on the Track Segment **220350.04 (826 items)**, just under the **Track:NONSUCH** in the **Outline** view. The grid edit view will now populate.
   Note: this behaviour can be cancelled by clicking on the lock icon in the grid editor toolbar. If you open the **Track:NONSUCH** item and select the positions, you'll see them appear in the grid editor.
   Now click on the sensor data for **Track:NONSUCH** > **Sensor:SENSOR_A(52 items)** — the data from this track will now populate the grid editor.

7. **Tidy your interface**

   As mentioned previously, the interface can become easily cluttered. However, if you have a dual monitor and want all the windows and views open, you can drag-and-drop views onto your other screen by clicking and holding the individual view tabs, and then moving them or resizing them as required.

8. **View the data**

   he scrollbar on the right-hand side lets you move forwards and backwards through the data (the newest items are shown at the top). Most cells in the grid are editable, including the date; blue and red buttons are available in the toolbar to add or remove rows.
   Clicking on the blue **Add** button will insert a duplicate of the currently selected row immediately beneath it - a major time-saver compared with manually entering data.

9. **Work on an attribute**

   In addition to straight-forward text-editing of data, selecting an attribute offers further editing capabilities. For example:
   1. In the **Frequency** column, click on the header cell itself (where it says 'Frequency'): you'll see a graph appear in the bottom half of the view. This graph is a 'waterfall' display of frequency, with the most recent value at the top.
   2. Zoom in on data by dragging your mouse on the graph using a top-left to bottom-right motion.
   3. Zoom out by dragging bottom-right to top-left.

10. **Fix dodgy frequency observation**

    Fix dodgy frequency observation If you zoom out to look at all the frequency data, you'll see that while this data seems fairly constant near the top of the dataset (along the 49.99 frequency value), there are occasions where the data value seems too low (when viewed in the context of a steady ownship track).
    We can fix an errant data point by dragging it into a better position.
    1. Zoom in on the data around the time **05:20**. You will see that the data-point at **05:19:11** is signifocantly lower than its neighbours.
    2. Move this data point by clicking inside the square data point and dragging the symbol to align with it's neighbours. Remember, you can zoom in multiple times for greater precision.
    Note: if the neighbours were in a steady drift, you could align them by sight far more accurately.

11. **Smooth period of data**

To smooth a block of data, we need to switch to bearing data:
1. Click on the **Bearing** column, the graph of bearing data will appear.
1. Around the **05:10** to **05:20** period on the graph, you will see three step-ups in the data, zoom in on these three steps.
It appears that the last smooth data point before the steps is at **05:10:44**, and the first after the steps is at **05:21:30**. We're going to interpolate the data points between these two values.
To do so, we must tell Debrief which points we intend to keep:
1. In the grid, the top half of the editor, click on the empty space to the left of row **05:10:44**.
2. Now, hold down the **Ctrl** key and click on row **05:21:30**. As soon as you do this, the **Interpolate** (**calculator**) button in the grid editor toolbar will be enabled.
3. Click on the **Interpolate** button and the bearings for the selected data points will be smoothed along that curve.
Note: you can select **Undo** from the edit menu or press **Ctrl+Z** on your keyboard to undo an interpolation operation.

☐

12. **Getting clever with interpolation**

In the previous step, we only selected a single point at each end of what could be considered poor data. However, there are two other, more advanced ways of doing an interpolation.
1. If we had selected multiple points at the ends of the dodgy data, Debrief would have fit the interpolated values to a cubic spline passing through the selected points.
2. If we had selected one or more points in the middle of the dodgy data (in addition to point(s) at the ends) then Debrief would have fitted a curve through the end and midpoints of the dataset.
Now that we've tidied the sensor data, we can move on.

☐ (optional)

13. **Set array offset**

As you will see, the sensor data is ambiguous; this can happen when the data has been produced by a towed array.
In this current scenario, Debrief is plotting the sensor cuts against the attack datum of the platform, but we need to apply an offset of 451 m in this particular example for this sensor (this is -451m). To do this:
1. Select **Sensor:SENSOR_A** in the **Outline** view
2. Open the **Properties** view and you will see the **SensorOffset** attribute. Enter -451 in this field, then press enter. As you do so, the bearings on the plot will adjust to reflect this change.
3. To see where the current array centre is, in the **Outline** view, click on **Track:NONSUCH**
4. In the **Properties** view under **Format**, you will see **PlotArrayCentre**, change it to **Yes**. A cross will appear astern of the current submarine location.
Note: we will use the track and sensor data from this tutorial in the next tutorial, so ensure you save it if you're going to take a break and move onto something else.

☐

14. **Reduce data density**
    Though it isn't necessary for this particular scenario, Debrief does allow you to reduce the density of sensor data:
    1. In the **Outline** view, right-click on **Sensor:SENSOR_A**
    2. In the drop-down menu, click on **SENSOR_A** > **Visible Frequency**, then select the filter required.
    Adjusting these options will filter out sensor data and hide sensor observations between the specified frequency. The sensor cuts are not deleted, they are just hidden; they can be made visible again by selecting a smaller, visible frequency. **Note:** another way of doing this is to right-click the parent track, **Track:NONSUCH**, select **Resample data at**, and select the required period.
    We've now got a track with lovely smooth sensor data.

    (optional)

15. **Save your data**
    As mentioned earlier, this sensor data and track will be required for the next tutorial; if you don't intend to jump straight onto it, be sure to save this file:
    1. Click on **File** > **Save**
    2. You have to save the file with the dpf extension, so select the folder where you will save the fil
    3. Enter the filename and click **OK**

We've now got a track with lovely smooth sensor data. Hmm.

Generate a target track

This cheat sheet guides you through creating a target track segment from bearing data to represent a period of straight-line motion; and can be interpreted as a **Manual Target Motion Analysis (TMA) Solution**.
We will be using the track and sensor data from the previous example, so if you closed it, reopen it now.
In this tutorial, we will be concentrating on the plot, so you can close the **Grid Editor** window.

1. **Deciding the contact period**
   A capable analyst will be able to recognise a couple of periods of steady bearing rate that lend themselves to being the basis of TMA solutions.
   The first period of cuts we're going to use here are the first 15 or so sensor cuts.
   We can see that at the end of this period, there are 2 bearing lines very close together and then a gap, a small group of 3 bearing lines, and then another gap.
   After this second gap, there is a period of about 10 unsteady cuts, and then another steady period; we'll be using that for a solution a little later also.

2. **Highlight contacts**
   Let's change the color of the contacts to make our first solution easier to see and work on:
   1. Identify the last bearing line you will use for the first period of steady bearing data.
   2. Double-click somewhere on that bearing line and it will be highlighted in the **Outline** view (I selected the data point named **090722 044319**).
   3. Click on that item in the **Outline** view to select it.
   4. Now, scroll back up to the start of the sensor data, hold down the **Shift** key, and then click on the first entry - this period of sensor data is now selected.
   5. To change the colour, right-click anywhere on the selected group and select **Multiple items** > **Color** > **Orange**.
   The bearing lines in the plot area, and the selected items in the **Outline** view will turn orange.

3. **Generate the TMA segment**

   Now we're going to create a solution from this selected (orange) data. When we generate a TMA segment based on sensor data, Debrief creates a track segment of steady course/speed data points, with one data-point at the time of each sensor cut used to generate the segment. Debrief has a **Generate TMA Wizard** to help you with this.

   With the set of data still selected in the **Outline** view (or reselect it if you've lost the selection):

   1. Right-click on the selected sensor data and select **Generate TMA solution from selected cuts**. The **Generate TMA Segment** dialog will show, asking you to **specify the offset to the track start**.

   2. Enter a range of **1 nautical mile (nm)** and you can leave the bearing of **300.8** (it's using the bearing from our first sensor cut).

   3. Click **Next** and you will see the **initial solution** dialog.

   4. Based on our understanding and analysis of the sensor fan in the plot area, enter **220** for the initial estimate of the course and **6 knots** for the speed estimate.

   5. Click on **Finish**. A red track will appear on the plot, labelled with the TMA solution and the time of the first cut used (**TMA_220415.22** on my plot — all solutions have times in their name to make it easier to manage).

4. **Recognise track data**

   We will now look at the track data for this TMA solution in the **Outline** view. First, expand the new track (mine is called **Track:TMA_220415.22**) in the **Outline** view and you will see the **Positions (17 items)** child item.

   If you look at the icon for this particular item, you will see that it shows a straight-line section of data with a tiny red compass rose on it. However, if you also look at the equivalent object for **Track:NONSUCH** , you can see that it shows a non-straight-line set of positions (with 2 turns).

   (optional)

   Also, note that on the plot, the name of the **Track:NONSUCH** TMA segment is shown in italics, to denote that it's not based on actual position recordings.

5. **Put the tracks on the tote**

   To view residuals, we must tell Debrief which is the ownship and which is the target. Debrief can hold many more than two tracks, but we must tell it which two tracks we want to compare.

   1. In the **Outline** view, select **Track:NONSUCH**

   2. In the **Outline** view toolbar, click on the **1 (primary)** button.

   3. Now, click on the **Track_xxxx** item (mine is **Track:TMA_220415.22**)

   4. Click on the **2 (secondary)** button on the toolbar.

   5. Now, switch to the **Track Tote** view (**Window** > **Show View** > **Track Tote** if it is not open) and you'll see it contains both our primary and our secondary tracks.

   Debrief now knows which tracks we wish to compare.

6. **Manipulate the track segment**

We will now manipulate the track segment to minimise bearing and frequency residuals.
1. Click on the **Drag Track Segment** button on the Debrief toolbar or press **ALt +1** to display the **Bearing Residuals** view.
Note: you can resize or move views by moving your mouse over the sides of a view and, when the cursor changes to a multi-directional arrow, you can drag in either of the directions indicated; or you can click on the view tab and drag the view to another part of the display, or even to another connected monitor. .
2. In the **Bearing Residuals** view are the four drag operation buttons that control how you drag the track. The labelled functions are:
Translate - you can drag either end of the track: this changes range and bearing from the source, but maintains target course and speed.
#**Rotate -** you can drag either end or from the middle of the track: doing so maintains the target speed but changes the target course.
#**Stretch -** you can also drag either end or the middle of the track: stretch allows you to maintain the target course but change the target speed. If the centre-point of the track is dragged, the track moves in and out, adjusting as necessary to adhere to the start/end points on the host platform bearing fan.
#**Shear -** you can drag either end or the middle of the track: this option allows you to change both target course and speed.
Note: only the **Translate** and **Rotate** operations are available for all track sections. Only the **Stretch** and **Shear** operations are suitable for application to **straight-line TMA Segments**. To help you, the hand cursor will only turn green over straight-line TMA Segment hot-spots.
Even though you select the above drag options in the **Bearing Residuals** view, these selections are used in conjunction with the drag buttons from the main toolbar: **Drag Track Segment**, **Drag Component**, and **Drag Whole Feature**, and all drag functions are carried out on tracks within the plot area. This gives you a huge array of options and capabilities.
By default, the cursor hand is brown. When it is this colour, you cannot modify the track from this particular point because it isn't a hot-spot. If you move the cursor over a point on the track which is a hot-spot and does allow you to manipulate (or move) that point, the cursor will become green. As mentioned above, this will either be at the end, and/or in the middle of a track.
2. Now, select **Shear mode** and **Drag Track Segment** (**Alt+1**) and practice dragging the ends of the track to optimise the bearing errors in the **Bearing Residuals** windowview.
Note: remember, here you are trying to reduce the distance between the calculated bearing and the measured bearing.

7. **Generate second TMA segment**

Looking at the sensor data, it would appear that the turn is represented by about 13 cuts before a further straight line section of data.
As you look at the fan of sensor data, you can see there's an early block of bearing lines that are roughly parallel. Then, towards the end of the track, the bearing lines appear to converge steadily around a single point. In between these two periods of steady data, the lines jump around a little, and this represents the period where the target vessel is changing course and/or speed.
Now, let's work with the plot again…
1. Click on the first sensor cut of the second steady set of bearings - that cut will be highlighted in the **Outline** view (I selected **090722 050326**).
2. Now scroll down to the end of the data and **Shift-click** the last sensor cut. We've now selected the cuts to be used for the second track segment.
3. Right-click on one of the selected items and select **Multiple items** > **Color** > **Green**. The cuts will turn green.
4. Right-click again on the selected cuts and select **Generate TMA solution from selected cuts**, and complete the wizard once again:
i. Enter a range of **1 nautical mile** (**nm**) and you can leave the bearing of **292.3** as is (it's using the bearing from our first sensor cut in this selection).
ii. Click **Next** and you will see the **initial solution** dialog.
iii. Based on our understanding and analysis of the sensor fan in the plot area, enter **220** for the initial estimate of the course (but it won't be, because the earlier spacing in the bearing fan shows us that the vessel has turned) and **6 knots** for the speed estimate.
iv. Click on **Finish** and the second track will be plotted.
As already mentioned, the new track is probably wrong due to the earlier turn, but we can manipulate the track and see what solution we can arrive at.

8. **Refine second solution**

Now, locate this new solution in the **Outline** view:
1. Click on the track to select it (mine is called **Track:TMA_220503.26**)
2. Then click on the **2** (**secondary**) button on the toolbar to designate it as the secondary track. As soon as you mark it as secondary, you will see it listed in the **Track Tote** view.
3. Now, start manipulating and refining this solution.

We now have a pair of target track sections.

Merging one or more tracks

In the previous tutorial, we generated two track sections and, though they are separate tracks on our plot, we know that they belong to the same vessel; we will now combine them into a single track.
1. Using the **Outline** view, use press the **Ctrl** key and click to select both tracks.
2. Right-click on one of the selected tracks and select **Group tracks into TMA_xyz** (it doesn't matter which one you select).
3. The tracks will merge into one (the other track will disappear). However, there is still that large 'turn gap' remaining. We will use Debrief to infill, or bridge, that gap.

1. **Provide infill positions**

   Debrief is able to link the two track sections by filling the gap between them.
   1. Click to expand **Track:TMA_xyz** and you will see it contains T**rack Segments** (**2 items**).
   2. Expand this, and you will see two tracks with different numbers of items (in mine, I have **220415.22** (**17 items**) and **220503.26** (**20 items**)).
   3. Select both tracks (**Ctrl+click**)
   4. Right-click on either one and select **Generate infill segment**.
   5. You'll see a new segment appear both in the **Outline** view and in the plot.
   Notice that the infill segment is shown as a dotted line. This indicates that this track segment is not based on any real bearing data, it has just been calculated to join both tracks.
   Also, if you look in the **Outline** view at the **Track Segments**, you will see the three individual tracks listed. Take note of the icons: two are straight-line tracks, and the other shows multiple turns.

2. **Merge tracks**

   You can continue to keep your target track represented as three or more track segments for as long as you like. But, when you need to export the data for presentation or subsequent analysis then you must merge them:
   1. Select the parent item for the track segments (**Track segments (3 items**)
   2. Right-click on it and select **Merge all track segments** to merge the tracks.

You have now completed the **Single-sided reconstruction** using Debrief tutorial. I hope you can see how easy it is to use Debrief, as well as appreciate the power and potential it offers for working with your data. The next tutorial takes us to the next step and walks us through a **Semi-automatic Target Motion Analysis** scenario.

Signed: ______________ Date: ______________

Name: ______________ Date: ______________

Please forward feedback on this cheat-sheet to support@debrief.info

Semi Automatic TMA Walkthrough

Introduction
This collection of cheat sheets will teach you how to use Debrief's Semi Automated Track Construction (SATC) capabilities.

Single Leg Solution

Introduction The first tutorial in this set will involve an engagement with just a single leg of target data.

Generating a project for your data

Debrief NG stores data in a local folder called **Project**. You place analysis files and links to existing data folders on your machine/network into this folder. This tutorial will lead you through creating a new, blank project.

1. **Check Navigator is open**
   In the top left hand corner of Debrief you should find the **Navigator** view. If it is open, close it; if it isn't there these next steps will show you how to open it:
   1. click on **Window** on the menu bar
   2. mouseover or click on **Show View**
   3. click on **Navigator**
   The **Navigator** view will then appear. A much faster (old school) alternative is to use key stroke sequences on your keyboard to perform specific actions.
2. **Shortcut key combinations**
   If you're an old school type who, like me, prefers to use the keyboard where possible, then you can use what are called keyboard combinations. Keyboard combinations consist of a sequence of keys which perform a certain action in the program. For example, a common keyboard combination/shortcut in any program is **Ctrl+S** to quickly save your current document. Similarly, the **Navigator** can be quickly opened via a keyboard combination:
   1. Press **Ctrl+3** on your keyboard, and the **Quick Access** popup dialog will show.
   2. Start typing ‘navigator' in the dialog box and, before you've finished typing the word, you will see **Views - Navigator - General**; click on it and the **Navigator** dialog will appear in the top left of your window.
   The next time you need to do this, press **Ctrl+3** and you'll see **Previous Choices** right under the field where you type - just click on it.

   (optional)

3. **Other key combinations**

   Throughout these cheat sheets, you will see other combinations like:
   •**Alt+[key]** means **press and hold** the **Alt** key and, while it is still pressed, press the other key (or keys).
   •**Alt, [key]** means you press and release the **Alt** key and then press the next key(s).
   Note: sometimes, both variations will work (mainly for common Windows-type tasks), but all programs have their differences.

   (optional)

4. **How to find out what the shortcut keys are**

   To find out what other shortcut keys work:
   1. Press the **Alt** key and observe how the letters of each meno item is underlined.
   2. By pressing any one of those underlined letters on your keyboard, the common commands in the corresponding menu will appear.
   In these drop-down sub-menus, you will see pre-programmed keyboard combinations next to the more popular commands, e.g., in the **File** menu (**Alt, F** or **ALt+F**) you will see that the shortcut key to **Print** is **Ctrl+P -** this is the same in the vast majority of Windows applications. Try and remember these, as they can speed up your work in Debrief.

   (optional)

5. **Learn about the show view menu**

   If the Navigator view was already open, you may have missed an important feature in Debrief, the **Show View** menu. Views are supplemental panels that provide additional information (or control) to the conventional 2D Debrief plot, and there are a number of views available.

   (optional)

6. **Opening a view**

   To open a view:
   1. Click on the **Window** menu item
   2. Select **Show view** and a list of Debrief-specific views open.
   3. Click on the view you require to open in it the Debrief window.
   So, in the future, when you're directed to a view and you can't find it on your screen, just remember you can open any view from this menu.

   (optional)

7. **Closing a view**

   Views can be closed by clicking on the X icon on their name tab.

   (optional)

8. **Moving a view**

   Views can also be dragged around, both within Debrief to reposition them, or to a separate external window. When you close Debrief, it remembers the views that were previously open.

   (optional)

9. **Learn about the Quick Access panel**

   Alternatively, wherever you are in Debrief, you can open the quick access panel. Just **press and hold** the **Ctrl key**, and then press **3** and a yellow post-it like menu will appear. As you start typing 'Navigator' the list of available commands will reduce until your required view is open. If you prefer to use the mouse, click on **Window > Navigation > Quick Access**.
   When you see '**menu > sub-menu item > item**' in this document, it means click on the first item, then on the second, and so on. I'm sure you've seen this before; it's a much tidier than writing:
   1. Click on **Window**
   2. Then click on **Navigation**
   3. and so on...
   I think you'll agree that the second method is far more cumbersome. We will still use the second approach for step-by-step procedures, however.

10. Check you need a project

If you have to create a project please move on to the next step. If the **Navigator** view is empty, then you will need to create a new project. If the window already contains a folder-icon (possibly containing sample data) then you're ready to go, and can move on to the next cheat sheet.

11. Create a general project

To create a 'general' project:
1. Right-click anywhere in the **Navigator** view, the **New** sub-menu will display
2. Select **Project...**
3. The **New Project wizard** will open
4. Click on **General** > **Project**
5. Click on the **Next** button; you will now **Create a new project resource**
6. Enter a name for your project (perhaps the name of the current exercise, or another meaningful name).
If you're in a workplace where users are unable to create folders in their home directory, clear the **Use default location** checkbox, and **Browse** to a folder in your personal working directories
Note: you can ignore 'Working Sets' for now
7. Click on the **Finish** button
You will see the new project in your workspace.

You now have a Debrief **Project** , to contain your tutorial data.
There are two ways in which we can load sample data. We will be modifying the sample data, so ensure you're not working on data that is shared with other users (the master data). The first thing we need to know is whether your Debrief installation folder is on your local machine or on a Network Shared Folder.
• If it's on a **local machine** go to **Sample Data if Debrief is on a Local Machine**
• If it's on a **Network Shared Folder**, go to **Sample Data if Debrief is on a Network Shared Folder**.

Sample Data if Debrief is on a Local Machine

Debrief NG stores it's data in a local folder called a Project. While these are frequently created afresh to store new analysis data, it's also possible to denote your existing data directories as sub-folders (via links).
This tutorial leads you through generating links to your existing data folders. But, if the "Create Project" form opened at application startup, you provided a project name, and indicated that you would like sample data to be imported, then you can skip the following steps and move on to the next cheat sheet.
You should also skip this set of tasks if you can see a **Sample Data** folder in your Navigator, since you must have already created the necessary link(s).
Lastly, you should skip this set of tasks if you run Debrief from a network share. The next set of tasks (for **shared folder**) are the correct set for your situation.

1. Open Navigator if it is closed

Open **Navigator** if it is closed by using the **Ctrl+3** shortcut and then either clicking on the option in **Previous Choices** or typing 'navigator' in the search field and clicking on it when it appears.

(optional)

2. Check you have a workspace

Before you can link existing data, you need to define a project for your work: a 'project' is a parent folder which stores your links. If your **Navigator** view is empty, you must first complete the **Generating a project for your data** cheat-sheet (above).

(optional)

3. **Add a new Folder**
   To add a new folder:
   1. Right-click on your current project in the **Navigator** view, the **New** sub-menu will show.
   2. Select **Folder** and the **New Folder** wizard will open.
   Here though, instead of creating a fresh child folder to store our data, we're going to link to an existing folder.
   3. In the **New Folder** wizard, click on the **Advanced** button and the **Advanced** options will show.
   4. Select **Link to alternate location (Linked folder)**.
   5. Click on the **Browse...** button and navigate to an existing data folder on your machine or network location.
   6. Once complete, click on **Finish** to close the wizard and link to your existing data.
   Note: if you don't have your own data, use either of the following:
   • For a deployed Debrief, use the **sample_data** folder installed in your Debrief installation folder.
   • If you are running a development version of Debrief, use **org.mwc.cmap.combined.feature/root_installs**.
   If you followed these steps, you will have created a link to the sample data, however, if you need to load data from other data directories, repeat this process as often as is required, but use a shared working folder.

   (optional)

Ok, you've found the Debrief **Sample Data**. You're ready for the tutorial now.

Sample Data if Debrief is on a Network Shared Folder

Here we are going to copy in an existing set of sample data. We aren't going to link to the original set, since we don't want to modify it, or we don't have modify access.
The steps presume that the Debrief **Sample data** is in the **Debrief\DebriefNG** folder that is probably in a **Programs** network share.
If you already have a **Sample data** folder in your Navigator you can skip this set of steps

1. **Check Navigator is open**
   In the top left hand corner of Debrief you should find the Navigator view. If it isn't there, select **Navigator** from Debrief's Window/Show View menu.
2. **Check you have a workspace**
   Before you can import the existing data, you need to define a project for your work. This is a parent folder within which your data (or links to your data) is stored. If your Navigator view is empty, you must follow the **Generating a project** cheat-sheet accessed from the Help/Cheat Sheets menu.
3. **Prepare to drag in data**
   The sample data is going to be dragged in. In order to do this, the relevant views both need to be visible at the same time.
   So, open Windows Explorer and then arrange your on-screen views so that Debrief is also visible. Then, navigate in Windows Explorer so that you can see the **sample_data** folder. It's in the **Debrief/DebriefNG** folder.
4. **Drag in sample data**
   Now that you are ready to import, pick up the **sample_data** folder using your mouse, and drop it into a project in the **Navigator** view of Debrief. A dialog will open asking you if you wish to **Copy files and folders** or **Link to files and folders**. Select the **Copy** option.

Great, that's your data now copied in. Now we can move onto the tutorial. Go to **Loading a simple scenario**.

Loading a simple scenario

To produce target solutions, we must load some ownship data. We'll do that now.

1. **Find SATC subfolder and Load Ownship Track**
   In the **Navigator** view:
   1. Open the **SATC** sub-folder and either drag the **L1_OwnshipTrack.rep** file into the Debrief plot area or right click and select **Open With** > **Debrief Plot Editor**.
   2. Select **Over the Ground** mode. You will now see the blue ownship track in your window.
2. **Load ownship sensor data**
   Next, we will load the ownship sensor data (this is the sonar data):
   1. Drag and drop the **L1_OwnshipSensor.dsf** file onto the plot, the **Import Sensor Wizard** will appear.
   2. You can leave this **sensor contact name** as **plain** and click on **Next**
   3. Choose a **color** for the sensor data, then click **Next**.
   4. Select the **value** check box so that the sensor data will be visible, then click **Next**.
   5. In the **Rainbow shades** dialog, select the check box to show the sensor cuts and click on **Finish**.
   The dialog box will close and the fan of ownship bearing data (sonar data) will be seen radiating north-west and north from the ownship track. If you don't see this, repeat the above steps making sure you've loaded the correct files.
   Now we've loaded our data, we can create a scenario.

Ok, now you have ownship track loaded, and you can see the fan of ownship bearing data.

Create scenario

Debrief uses the term **scenario** to describe the collection of data that is collated in order for SATC to produce an optimal solution. Let's create our first scenario now.

1. **Browse to the sensor data**
   We will use all of the ownship sensor data to create our scenario:
   1. Open the **Outline** view
   2. Open **Track:OWNSHIP**.
   3. The ownship track has a **Sensors (1 items)** object; open this and you will see the single block of sensor data called **Sensor:Plain (11 items)**.
   4. Right-click on it and select **SemiAuto TMA** > **Create new scenario from these bearings**.
2. **Create scenario based upon cuts**
   A new item with the name **121213.14** is created in the **Outline** view (the item name is auto-selected from the Date-Time-Group (DTG) of the first item in the bearing data).
   You will also see that the **Maintain Contributions** view has opened. This view is used to create and manage your scenario data. If you haven't read about the SATC user interface via the help page earlier on, please read it now.
3. **Change scenario name**
   As nice as it is to try and remember a new set of telephone numbers every time you create a new scenario, it makes sense to rename the scenario to something more meaningful:
   1. Select this scenario in the **Outline** view
   2. In the **Properties** view (**Windows** > **Show View** > **Properties**, if it isn't visible) change the **Name** value to **Single Leg**.
4. **Understand the contributions window**
   In the **Maintain Contributions** view, you can see a single **Bearing Measurement - Bearing Data** item listed in the **Analyst Contributions** section. This is the bearing data that will be used to inform all of the subsequent contributions.

5. **Viewing the bearing measurement contributions**

   The **Bearing Measurement Contribution** is the set of bearings that represent the unknown target track. You can see that the contribution has an estimated **error** value of **+/- 3 degs**, so the algorithm will only offer solutions that are within 3 degrees of these bearing measurements.
   To view these measurements:
   1. Select the track **Single Leg** in the **Outline** view.
   2. In the **Properties** view, select the **ShowLocationConstraints** item.
   3. In the **Maintain Contributions** view, click on the **Calculate Solution** button. A set of "pie-slices" will now appear on the plot showing the allowable 3-degree error on each bearing measurement.
   4. Still in the **Maintain Contributions** view, expand the **Bearing Measurement - Bearing Data** contribution and you will see that it is possible to change the error value on this bearing data by moving the slider. As you move and release the slider you will see the pie slices expand and contract (you may need to click on the **Auto-Recalc of Constraints** button in the **Preferences** area to initiate this).
   Note: The **Auto-Recalc of Constraints** is a two-state button that is normally depressed. But, if you have a complex scenario that takes some time to update, you may wish to uncheck this button so the screen doesn't refresh while you are interactively adjusting any contributions.

6. **Get ready to specify a target leg**

   Note: in this sample data, the imported bearings have a maximum range of 12,000 yards (yds). In the absence of a range estimate, SATC will restrict them to 30k yds to stop your PC doing the 'Ferranti Reset'.
   Also, before we continue, Debrief must be reset to a predictable state:
   1. Restore the **Analyst Contribution** to 3 degrees In the **Properties** view, deselect the **ShowLocationConstraints** (so it shows **No**).

7. **Specify a target leg**

   It is possible that your deep analysis skills have led you to believe that all of these cuts relate to a single leg of target data where the target maintains course and speed through the period of interest - this is useful information to the TMA algorithms.
   1. In the **Outline** view, select **Track:Ownship** > **Sensors (1 items)**, and then right-click on **Sensor:Plain (11 items)**
   2. From the drop-down menu, select **Semi Auto TMA** > **Add to Single Leg** > **New Straight Leg for period covered by [sensor cuts]**. When the **New contribution** dialog opens, name this contribution 'Leg limits'.
   3. Click on **Ok**.
   4. In the **Outline** view, you will see **Single Leg (1 item)** has changed to **Single Leg (2 items)**.

8. **Understanding the contributions**

   So, now there are two contributions for this scenario:
   1. a set of bearings through which a solution must travel
   2. an indication that the target will have travelled on a single course and speed throughout the entire engagement.
   An observant analyst will have noticed that our two ownship turns have provided a valuable change in bearing rate - exactly what a TMA algorithm needs.
   So, now that we've provided the TMA algorithm with some viable data, let's see it calculate a solution.

We've provided the TMA algortihm with some data, let's see it calculate a solution

Generate a solution

Now that we have provided background data to SATC, we can generate a solution.

1. **Calculate the solution**
   Now we're going to generate the solution for this scenario. Before we do this:
   1. Click on the **Fit to Window** button to ensure you can see the ownship track and the rough area where the target should be.
   2. Click on the **Calculate Solution** button.
   By default, the SATC is set to **Low** precision and uses relaxed constraints.
   The rather sparse bearing data and ownship maneuvers used in this scenario means that there aren't very many candidate solutions, and an answer will be generated within a second or so. When it has completed its calculations, a new track will appear on the plot.
   As you can see, the track is the color you specified for the bearing data in the **Bearing Import Wizard**.
   My computer returned a solution of **9.0 kts** on **269 degrees**. You can alter the precision setting as you require (to medium or high), but you must click on **Calculate Solution** each time you do.
   It is unlikely that you will get a better solution with this set of data, but you will notice that the **Performance** graph (below the **Maintain Contributions** view) processes more slowly as SATC homes in on a particular solution. You will see that the x-axis shows more cycles have been computed, and that each one moves more slowly.
2. **Marking your own homework**
   The data we are using here is from a simulation tool, which means we have the actual target track to compare against:
   1. Drag the **L1_SubjectTrack.rep** file into the plot area
   2. Select **Over the ground** as the import mode.
   The track will now appear on the plot as a solid red line.
   Now, compare the SATC solution with the actual target track. You will see that SATC is actually quite close, with a greater error near the start to the East because of the low bearing rate there; however, both tracks appear to be on a roughly parallel course.
   We now have an SATC-generated solution which is very close to the actual target track.

We now have a target solution, very close to the truth track, generated by SATC.

Importing solution

Debrief has a range of analysis and export capabilities we can use on Track objects; however, as our current suggested solution isn't a track yet, we need to import it.

1. **Select scenario**
   If you've followed the instructions in the previous tutorial correctly, then you will have a scenario named **Single Leg (2 items)** in your **Outline** View. Click on it to select it.
2. **Convert to Composite Track**
   To convert the current solution to a Composite Track:
   1. Right-click on **Single Leg (2 items)**
   2. Select **Convert to Composite Track (legs)**.
   You will see a new track appear on the plot and you will see a new item in the **Outline** view marked as a Track followed by the same name of this scenario (mine is named **Track:Single Leg_0**).
3. **Rename to avoid confusion**
   To prevent potential problems, we will now rename the imported track:
   1. In the **Outline** view, click on **Track:Single Leg_0** to select it.
   2. In the **Properties** view, change its name to **Single Leg TMA**.
   3. Click away from the **Properties** view to change the name.

4. **Tidy the plot**
   It's very easy for the plot to become cluttered, so we will now use the **Outline** view to hide the red SUBJECT track:
   1. Click on **Track:Subject** to select it.
   2. Right-click and select **Hide Item**. The track will disappear from view so only the **OWNSHIP** and **Single Leg TMA** tracks remain visible.
5. **Manually tune the TMA solution**
   Now we will adjust this solution in the same way we did for the **Single-Sided Reconstruction**:
   1. Click on the **Drag Track Segment** arrow button in the Debrief toolbar and the **Bearing Residuals** view will open.
   2. Mark the **OWNSHIP** track as the **primary track**, and the **Single Leg TMA** track as the **secondary track** (using the mini-toolbar above the **Outline** view).
   Now you can drag the **Single Leg TMA** track and see the error residuals move.
   Note: the **Absolute (degs)** values graph is easier to read in this instance if you select the **Use +/- 180 scale for absolute data** button in the **Bearing Residuals** toolbar, second from the left.
6. **Import as standalone track**
   The manual-track fine-tuning process steps you have just completed are more suited to complex scenarios where, because of dissatisfaction with the system-produced SATC solution, the analyst decides it is better to merge the TMA solutions into a formal track.
   However, as the raw SATC produced a perfectly acceptable solution, we can discard the manual track and import the original TMA solution:
   1. In the **Outline** view, right-click on **Track:Single Leg TMA** and select **Delete Single Leg TMA**.
   Then, to import our original TMA solution:
   2. Right-click on **Single Leg (2 items)** and select **Convert to Standalone Track**.
   You will now see the track has appeared in the **Outline** view as **Track:Single Leg**.
7. **Mark our homework**
   Debrief now has our imported TMA Solution (**Track:Single Leg_0**), and our Truth Track (**Track:SUBJECT**) loaded; we can now use the application to calculate the distance between these two tracks.
   1. Select **Track:Single Leg_0** and **Track:Subject** in the **Outline** view (**Ctrl +click** to multi-select).
   2. Right click on either track, select **View XY Plot** and the **View time-variable** plot dialog box will open.
   3. Select **Range**, click on **Ok** and the **Select Primary** dialog will open.
   4. Select **Track:Subject** as the primary track, and click on **Ok**. The **Subject Range vs Time Plot** graph will appear.
   This graph shows an intial error of approximately 130 yds, which reduces to 60 towards the end of the track. This is quite satisfactory considering the target ranges vary from 8000 to 3000 yards from ownship.

That's the single leg solution complete, so you can now close this Debrief plot. In the next tutorial, we will look at multi-leg solutions.

Multi Leg Solution

In this more advanced multi leg solution, the scenario has several target zigs, and a number of contributions are required to obtain an optimal solution.

Loading the data

We've got a Debrief plot file pre-prepared to let you avoid some of the steps in the single-leg tutorial, called **L2_Scenario.dpf**.
For this file we have a good set of ownship data for the ownship track, but we didn't get GPS data for the other participant - though the exercise observer did record the platform speed during the trial.

1. **Find the data file**
   The data-file for this tutorial is contained in the SATC sub-folder, as were the files used in the previous tutorial.

2. **Drag in the file**
   Before you load the data-file, close any existing Debrief plots, then drag in the **L2_Scenario.dpf** data-file from the SATC folder we used in the previous tutorial.
   You will see a Blue Ownship track, with a dark green bearing fan.

Grooming the data

Let's understand the data we've got, before we start manipulating it.

1. **Understanding our data**
   To understand what is occurring here, use the Debrief **Time Controller** and the **Track Tote** to familiarise yourself with the general motion of the **OWNSHIP** track. As you do, you will see that the vessel starts in the North-East of the plot, then travels quite slowly at 2.5 knots, with two straight legs.
2. **Create the scenario**
   The most significant block of information in generating a solution is the bearing data itself—we need to mark this information as such.
   In this scenario, we will use all of the Ownship sensor data:
   1. Left-click on the drop-down arrow next to **Track:Ownship**
   2. Left-click on **Sensors** to expand it.
   3. Select **Sensor:Plain (145 items)**, right-click and select **Semi Auto TMA** > **Create new scenario from these bearings**.
   As with the previous tutorial, you will see the new scenario (called **121200.00**) appear in the **Outline** view, and the **Maintain Contributions** view will open with just one contribution.
3. **Intro to Zig Detection**
   Though **SATC's Manoeuvre Detection Aid** is capable of detecting target zigs, the algorithm can only reliably detect target zigs during an ownship straight leg (the geometry is just too chaotic during an ownship turn), so the actual process involves two steps:
   1. Detecting ownship legs
   2. Detecting target zigs during those straight legs. Despite this, the algorithm does attempt to determine if there is a target zig somewhere during an ownship turn by forecasting the bearing rate in the second leg. If the post-turn bearing rate does not match that produced in a passive ranging calculation, then a turn is assumed. However, as the algorithm won't know when the target turn occured during the ownship turn, it interprets the whole ownship turn as the period of the target turn.

4. **Generate the target legs**
   As mentioned in the previous step, the process begins with determining the ownship legs. The main information source for target zig detection is the bearing data.
   1. In the **Maintain Contributions** view, expand the **Bearing Measurement - Bearing data** section. Near the bottom of the controls, you will find the **MDA** (Manoeuvre Detection Algorithm) section.
   2. Click on **1. Slice O/S legs** to slice the ownship legs.
   3. Now, take a look at the **Ownship & Target Legs** graph at the bottom of the screen to judge the effectiveness of the slices.
   When SATC slices the legs, it shades each leg in blue, with transparent gaps between the legs. Ownship legs are labelled with text labels at the top of the chart.
   For this dataset, when run with **Low** precision, the algorithm thinks there is just one ownship leg.
   However, based on the displayed graph of ownship course and speed against time, this is clearly incorrect; it's just that the ownship turns and speed changes are too subtle for the turn detector.
   4. So, change the **SATC precision** value to **Medium** or **High** using the drop-down list at the top of the **Maintain Contributions** view.
   5. Click on **1. Slice O/S legs** again. You will probably find that **Medium** precision gives the best result.
   Once you are happy with the ownship legs:
   6. Click on **2. Slice Tgt legs** and the MDA algorithm will produce a series of legs for you.
   On my machine, the algorithm produces four target legs. The algorithm-spotted target turns part-way through ownship legs 1 and 2, and it also assumes a target turn somewhere during the ownship turn from leg 1 to leg 2.
5. **Groom the target legs**
   Let's look at what the algorithm produces from these target legs:
   1. Click on **Calculate Solution**; after a few seconds, the algorithm produces a target track shown on the plot.
   Looking at the target track, you should see that the very short target leg 3 is quite similar to leg 2. Switching back to the **Ownship & Target Legs** graph, you should see that legs 2 and 3 are split by the suspected target zig during the ownship turn. We can guess that the target zig early in ownship leg 2 has mistakenly caused the algorithm to predict a target turn during the ownship turn.
   We must therefore merge target legs 2 and 3:
   2. Open **Scenario (121200.00)** in the **Outline** view and you will see the **bearing data** listed, followed by our four target legs (**Tgt-x**).
   3. Ctrl-click on legs **Tgt-2** and **Tgt-3** to select them
   4. Right-click on either one and select **Merge Straight Leg Forecasts**.
   As soon as you do this, the target legs will merge, the **Maintain Contributions** view will update, and the calculated solution will disappear from the plot because it is no longer valid.
   5. Click on the **Calculate Solutions** button to rerun the solution. You will see that the new solution looks quite good.

Playing with legs

Once we're confident in the set of target legs we can move on to capture more of the analyst's knowledge and refine the target track.

1. **Introduce speed constraint**
   We did not have target track data for this hypothetical engagement, but we did have a record of the target's speed. We will now add it to our scenario.

2. **Add Speed constraint**

   There are a number of ways to add a speed constraint:
   1. At the per-leg level, we can expand a **Straight Leg Forecast** and enter min/max/estimate values for course or speed for each leg.
   2. We can apply a speed constraint to the whole engagement.
   To do the latter:
   1. In the **Outline** view, right-click on the **Bearing Data** item and select **Add speed forecast for period covered by [Selected Legs]**.
   2. When the **New contribution** dialog box opens, enter **Overall speed** as the name of this contribution.
   3. Click on **Ok** and the new contribution will appear in the listing in the **Maintain Contributions** view.

3. **Specify speed constraint**

   The exercise observer recorded that the target was doing around 9 knots during the whole exercise, so we must enter this constraint to allow for speed keeping errors:
   1. In the **Maintain Contributions** view, expand the **Speed Forecast** control
   2. Enter a **minimum speed** of **8 knots**
   3. Enter a **maximum speed** of **10 knots**
   4. Enter an **(optional) estimate** of **9 knots**
   5. Click on the **Calculate Solution** button.
   In the **Performance** tab, you will see the effectiveness of both the **Bearing Data** and the **Overall speed** estimates. The bars are shaded according to the respective color-coded constraint.

4. **Generate manual TMA solution**

   We will now use this information to develop a manual TMA solution.
   1. In the **Outline** view, right-click on the **TMA solution** and select **Convert to Composite Track (legs)**.
   A manual solution (**Track:121200.00_0**) will now appear in the **Outline** view, and the auto TMA solution will be hidden.
   Mark the new solution as a secondary track by:
   2. Left-clicking to select it in the **Outline** view
   3. Click on the **2** in the **Outline** view toolbar. We are now ready to manually adjust the solution.

5. **Tune manual TMA solution**

   To manually tune the TMA solution:
   1. In the **Outline** vView, ensure the track is selected
   2. Click on the **Drag Track Segment** button on the main application toolbar and the Bearing Residuals window will open.
   Note: if the **Bearing Residuals** window is empty, open the **Track Tote View** and check that your primary track is **Ownship** and your secondary track is **121200.00_0**. If they are not, assign these accordingly in the **Outline** view. Alternatively, if the ownship sensor cuts are not visible, you will need to clear the **Only draw dots for visible sensor points** button in the **Bearing Residuals** view toolbar.
   3. In the **Bearing Residuals** view, click on the **Shear** button.
   4. In the plot area, begin dragging track segments to minimise the bearing errors.
   Don't worry if your track segment dragging results in a mangled solution, you can delete the manual track from the **Outline** view and generate a new one from your existing solution.

6. Merge track segments

When you are happy with your solution, you can merge the separate track segments into a formal track.

1. In the **Outline** view, expand your manual TMA solution

2. Right-click on the **Track Segments (5 items)** and select **Merge all track segments from the popup list**.

You now have a track for the subject vessel that can be used for further analysis.

7. Mark your answers

To check how well you did:

1. In the **Outline** view, select **Track:Subject**

2. Click on **Reveal Selected Items** (make visible)

This is the actual **Truth Track**; so, how does it compare with your track?

If you prefer a more quantitative score, produce an **XY Plot** of the range between your solution and the truth track:

1. Ctrl-click on both tracks to select them.

2. Right-click and select **View XY Plot**

3. In the **View time-variable plot** dialog, select **Range**

4. Click on **Ok**.

You can now see a plot of how well you did.

Ideally, you should be able to achieve an accuracy of around 200 yds, which is not bad when you are using sensor data at around 20000 yds.

And that concludes Debrief's Semi-Automatic Track Construction and the end of this tutorial. Don't forget that we have a comprehensive user manual to help you.

Good luck!

Signed: ____________ Date: ____________