

Sebrief 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.

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6 Single-Sided Reconstruction

In this tutorial, we will look at single-sided reconstruction. It's important to note that all analysis is done on tracks, and this involves both working with and analysing target tracks, including **grooming track data**, **grooming sensor data**, **generating**, and **merging tracks**. As such, you must know how to configure Debrief and how to load your data. So, before running through this tutorial, you should really have completed **Tutorial 3 - Controlling what you view**; if you haven't done this, please do so before attempting this tutorial. In this tutorial we will be looking at the following areas:

- Grooming Track Data
- Grooming Sensor Data
- Generating Track Target
- Merging Tracks

Now it's time to start building and grooming the target track.

6.1 Grooming Track Data

This section will lead you through grooming some dodgy track data. First though, we need to load and understand the track data itself.

Loading Data Files

To load the data files:

- 1. Open the **Navigator** view.
- 2. Expand the **S2R folder** and locate the file "dodgy_track.rep".

Debrief



3. Double-click on it to load this track as a new **Debrief** plot. The **Select track mode** dialog will display.

Select track mo	de 🗕 🗆 🗙
Debrief can plot tracks using one of two modes. Use this dialog to select how to import the track titled You can override your choice using the CMAP tab of V	Frigate. Vindows/Preferences
O Dead Reckoning (DR) - positions are calculated usin	ng recorded course and speed
Over The Ground (OTG) - where positions are plotted	ed according to the recorded location
Resample frequency (only for OTG):	
All	~
OK Cancel	

4. Select **Over The Ground (OTG)** as the track mode, and the plot and associated views will promptly update.





6.1.1 Main Track Data

As you can see, we have our blue ownship track called **Frigate**. The vessel is travelling from the North in a general South-East direction. There is a period of missing data on this track, as well as several jumps in the data itself (this will become obvious in the next step).

Note: Jumps often occur when an inertial navigation system receives an external update. We'll fix these first.

6.1.2 Understanding Data

Now we'll make the track and our data easier to understand by making the track data points visible:

- 1. Open the **Outline** view and you'll see **Track:Frigate**.
- 2. Click on the drop-down arrow (to view the contents of the track) and you will see **Positions (156 items)**. This is the data contained within the track.





- 3. Now, right-click on **Track:Frigate**, in the **Outline** view, and a popup menu will appear.
- 4. Click on **Frigate > Symbol frequency > All**.

	0	। • • • ≜ &�/□®Q/		00115		1 Secs
Outline	8	▶ 5 1 2 +2 □ 7 ⁻ □ ▶ *doday trac	c.rep	8		5 Secs
lame		Visibi	arep			10 Secs
Frac	JaErio	anto a				30 Secs
030	2	Make Secondary	1	Frigate 030134		1 Min
	+2	Add as Secondary				2 Min
		Frigate +		Color •		3 Min
		Export Shape	Γ	Line style 🕨 🕨		5 Mins
		Reset DTG Labels		Line thickness +		10 Mins
		Generate calculated Course and Speed		Name location +		15 Mins
	ot	Cut Frigate Ctrl+X		Snail symbol size		30 Mins
	Ð	Copy Frigate Ctrl+C		Snail symbol type		60 Mins
	×	Delete Frigate Delete		Track Coloring Mode		2 Hours
		Convert to lightweight track in		Interpolate points		6 Hours
Track To		Generate TUA Ellipse for this track		Arrow frequency		12 Hours
ttribute	2	Add new sensor		Custom Vector Stretch		24 Hours
ange	0	Trim track to Time Period (from Time Controller)		Label frequency		48 Hours
earing		Provide position data	-	Resample data at		/2 Hours
el Brg	-	resample position data		symbol frequency	-	None
TB	0	Insert new Sensor Arc	~	Start/End time labels		
peed		View XY plot	~	Link positions		
ourse		Export track to GPX	× ×	Name at start Name visible		
ime		Calculate track length (visible positions)		Plot array centre		
		Select all Children	-	Positions visible		

The track will now show a symbol at every data point. You can clearly see the track breaks that occur about 2/3rds of the way along the track, and soon after the track start (marked 1 and 2, respectively in the screenshot below).



🖢 *dodgy_track.rep 🛛	
Codgy_track.rep &	Frigate 030134 2 1
	030417

- To better see and understand what is happening here, we'll turn the time labels on. Click on Frigate > Label Frequency > All and you will then see the time labels for each point.
- 6. Now zoom in and have a look at the times around each block of missing data. The jumps around '1' (Shown in Fig a. below) have consecutive time steps, so they're clearly jumps. But the break around '2' (Shown in Fig b. below) shows a period of about 9 minutes of missing data we'll fill that missing period in with data from another source.





We will now fix those gaps.

6.1.3 Splitting and Fixing the First Gap

Zoom into the large gap about 2/3rds of the way along the track (where it looks like almost a 90° starboard turn is made. (**Fig a.** shown above).

Though this part of the track looks like 3 sharp turns were made, it's actually three jumps in the data, labeled with numbers in the following screenshot. We will now go through and fix these, and will start by clearing the last jump.

Here the vehicle is travelling in an ESE direction, so:



1. Right-click on the first valid point in the southernmost leg of data (at time 0337, point marked 1 in the above image) and a popup menu will display.



		Copy cursor location	
		0337	+
	-	Reset Color	
		Reset Label	
		Reset label location	
		Export Shape	
		Split track before 0337	
		Split track after 0337	
228	of	Cut 0337	Ctrl+X
0329		Copy 0337	Ctrl+C
2 0331	×	Delete 0337	Delete
³²³ 0324 0333 0324 03334	2	Frigate	٠
0325 05		Export Shape	
		Reset DTG Labels	
		Generate calculated Course and Speed	
N		Convert to lightweight track in	+
		Generate TUA Ellipse for this track	
0326	2	Add new sensor	
	0	Trim track to Time Period (from Time Controller)	
		Resample position data	•
	0	Insert new Sensor Arc	
		View XY plot	

2. Select **Split track before 0337** and the track will split into 2 pieces.





3. Look at the **Outline** view and you will see that **Track:Frigate** now contains **Positions (2 legs)**.

🔓 Outline 🛛 🛛 🖒 🔀 1 2 +2 [
Name	Visibi
🔺 🎢 Track:Frigate	1
Positions (2 legs)	

We now need to align the tracks. First, we'll hide the labels as they clutter the display. In the plot editor, right click on the **Frigate** track line then select **Frigate > Label Frequency > None**. The labels will be hidden.

6.1.4 Aligning the Tracks

To align the tracks, we need to drag one track segment to the other.

Click on the Drag Track Segment button on the main toolbar (or press Alt+1). The Bearing Residuals view will display to the right of the plot editor and, as we're now in drag mode, the mouse cursor will change to a brown hand. Don't worry about the Bearing Residuals View for now, it will be covered later when we get to Generate Target Track.





2. For this step, we need to drag the entire track segment. Click on the arrow next to the **Mouse Drag Mode** and then click **Translate.** in the **Bearing Residuals** view.



- 3. Now, move the mouse-cursor over the first point of the lower segment of track, labelled **030337.25**. It will turn green when it is in the correct position.
- 4. Start dragging the track upwards and leftwards over the dangling end of the other track segment.

As you drag the track, you will 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 next first point on the track.

6. Now fine-tune your drag operation to put the 'target' over the last point on the blue track, then release the mouse-button to drop the track.





6.1.5 Merging Track Segments

We will now merge the track segments:

1. In the **Outline** view, right-click on **Positions (2 Legs)**, a popup will appear.



2. Click on **Merge all track segments**. The tracks will combine and **Track:Frigate** will once again show **Positions (156 items)**.



6.1.6 Splitting and Fixing the Second Jump

We'll now correct the jump to the north of the one we just fixed.

- 1. Open the **Time Controller** view and move the time slider to **030326**, this is where it looks like the vessel is travelling west of north and then does a sharp turn to the south-east (marked as position 2 on the earlier image).
- 2. Right-click on the track data point and select **Split track before 0327** and the track will split into 2 again.



3. Now, click on the **Drag Track Segment** button again (or press **Alt+1**, if you like to learn the shortcut keys) and drag this end of the track down and to the left and position it on the dodgy point at the end of the good track section.





4. In the **Outline** view, right-click on **Positions (2 legs)** and then click **Merge all track segments** to combine the tracks.

The tracks will combine and in the **Outline** view, **Track:Frigate** will once again show **Positions (156** items).

6.1.7 Splitting and Fixing the Third Jump

We'll now do the same with the third jump:

1. Right-click on the data point at **0326** (if you hover your mouse cursor over the data point, a tooltip will appear giving details at that point, marked as position 3 on the earlier image) and select **Split track before 0326**.





2. As before, drag this track to the good section and merge the tracks into one track.



3. In the **Outline** view, right-click on **Positions (2 legs)** and then click **Merge all track segments** to combine the tracks.



The tracks will combine and in the **Outline** view, **Track:Frigate** will once again show **Positions (156 items)**.

6.1.8 Adding Third Party Data

We have now removed the jumps from the track. But, as we established earlier, there is still a missing period of data near the start of the track. Fortunately we have been able to obtain data for this period from a slightly less accurate typed log. We will now add this external data to fill the remaining gap.

1. In the **Navigator** view, locate the file **third_party_track.rep**.



2. Drag and drop the file into the plot editor and select **Over The Ground (OTG)** when the **Select track mode** dialog appears.

	Select track mode	-		×
Debrief can plot tracks Use this dialog to selec You can override your	using one of two modes. t how to import the track titled TP_Track. choice using the CMAP tab of Windows/Prefere	ences		
O Dead Reckoning (D	R) - positions are calculated using recorded cou	rse and sp	eed	
Over The Ground (OTG) - where positions are plotted according to	the record	led lo	cation
Resample frequency (only for OTG):			
All				~
Automatically use t	his mode next time			



 Click Ok and you will see the new track appear to the north of Track:Frigate in the plot editor and appear as Track:TP_Track in the Outline view.



🔓 Outline 🛛	P 23	1 2	2 +2	1			
Name					Vi	sibi	
 Frack:Frigate Frack:TP_Track 	k				1		

4. Click Fit to window button on the Main Toolbar, to view both the tracks.



Now we need to position and merge this track with the blue track.



6.1.9 Positioning New Data

To make it easier to merge the tracks, we need to move the new track closer to the Frigate track.

Click on the Drag whole feature toolbar button (Alt+3), move it over the Track:TP_Track until the mouse cursor changes green, and then drag and drop the track near the period of missing data, as shown below.



- 2. Zoom in on the gap in the **blue** track.
- Right-click on the data point to the north of the track, and select Split track after 0143. The blue track will split into two segments.





- 4. Click on the **Drag Whole Feature** button (**Alt+3**) and then drag and drop the top point of the green track onto the southern end of the blue track. Zoom in if need be.
- 5. Now, click on the **Drag Track Segment** button on the main toolbar (**Alt+1**), and drag and drop the southern end of the green track onto the northern end of the blue track.



Now that our tracks are lined up, we need to merge them.

6.1.10 Joining Track Segments

To join the track segments:

- 1. In the **Outline** view, press **Ctrl** and click on both the tracks to select them.
- 2. Right-click and then select **Group tracks into Frigate**. Now, only the **Track:Frigate** remains in the **Outline** view.



Coutline ⊠ Name	2 +2	Make Secondary Add as Secondary Multiple items Export Shape Reset DTG Labels Generate calculated Course and Speed
	∘ł ∎ ¥	Cut 2 selected items Copy 2 selected items Delete 2 selected items
		Group tracks into Frigate

3. If you click on the drop-down arrow next to **Track:Frigate** you will see **Positions (3 legs)**. However, we don't want a segmented track, we want a complete track.



4. Right-click and select Merge all track segments.



You will now see in the **Outline** view **Track:Frigate** which contains **Positions (164 items)**.



皆 Outline 🖾	№ № 1 2 +2	
Name		Visibi
A Mark:Friga	te	
Position	is (164 positions)	

Our track is now complete.



In this stage of the tutorial, you fixed some jumps in the ownship track, and filled in period of missing data using external data.

You can close the current plot now, as you won't need it for the next stage. No need to save changes.

6.2 Grooming Sensor Data

This tutorial is going to work through creating and preparing the ownship sensor data ready for production of **Target Motion Analysis (TMA) tracks**.

Load Data Files

For this tutorial we will be using a new set of datafiles. In the Navigator view:

1. Go to the **sample_data > S2R** folder.



a Navigator	83	(→ → @ 🖻 🔩 ▽ 🗖	
	0	Ambig_tracks3.dpf	^
		dodgy_track.rep	
	2	lengths.csv	
	0	mid_flow.dpf	
	0	midflow2.dpf	
	0	midflow2a.dpf	
		nonsuch_otg.rep	
		nonsuch.rep	
		Polyline_Measurement.rep	
	6	sensor.dsf	
		third_party_track.rep	
	2	turn_single_point.rep	
	0	turn.dpf	
	6	turn.dsf	
		turn.rep	
· 62	CA.	TC	~

2. Double-click on the "nonsuch.rep" file. The Select track mode dialog will display.

	Select track mode		х
Debrief can plot tra Use this dialog to s You can override ye	acks using one of two modes. elect how to import the track titled NONSUCH. our choice using the CMAP tab of Windows/Prefer	ences	
Dead Reckoning	g (DR) - positions are calculated using recorded cou	urse and speed	
Over The Groun	d (OTG) - where positions are plotted according to	the recorded loca	tion
Resample frequence	:y (only for OTG):		
All			Ŷ
Automatically u	ise this mode next time		
OK Cancel			

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 on the Main Toolbar.
- 5. Next, from the **Navigator** again, drag in the **"sensor.dsf"** file. The **Import Sensor Data** dialog will display.



D		
Import Senso Please provide	r data the name for this sensor	-IGHIMMAN &
Name: SENSO	A one-word title for this block Note: you can prevent this w the Debrief preference title 'Show the wizard when imp	c of sensor contacts (e.g. S2046) wizard from opening using ed: worting sensor data from REP'
?	< Back Next >	Finish Cancel

6. You can go through the tabs by clicking on the **Next** button; but for now, you can also click on **Finish** to select the default options.

Note: The plot area can quickly become cluttered when showing bearing lines. So, by default, sensor data is set to *not-visible* when loaded from .**REP** file..

6.2.1 Making Sensor Data Visible

Though that is the default option, we now wish to show that 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. Then click on Sensor:Sensor_A (52 cuts) to select it.



🔓 Outline 🖾	▶ 🔀 12 +2 [
Name		Visibi	
A 🏂 Track:NONS	SUCH		
> 220350.0	4 (826 positions)	✓	
🖌 🌆 Sensors (1 items)			
b is Sens	or:SENSOR_A (52 cuts)		

4. In the **Outline** view toolbar, click on the empty tick box for **SENSOR_A**, and all the sensor data will be revealed (a pattern of bearing lines is shown either side of the track, we call each of these a **bearing fan**).



6.2.2 Resolving Ambiguity

In our data you can see one bearing fan heading off to the WNW, and the other off towards the NE—this is typical of a towed sensor as they produce both a true bearing to the target, and a mirror-reflection, called an ambiguous bearing. But, we have to determine which side is *true* and which is *ambiguous*.

6.2.3 Dropping Ambiguous Data

Intelligence tells us that the actual contact is off to the NW, so we can dismiss (drop) the ambiguous data set of bearings that generally point NE. This set of bearings are to the Starboard of the vessel track:



 In the Outline view, right-click on SENSOR_A(52 cuts) and then select Select all Children.



- 2. All the 52 sensor items will be selected.
- 3. Right-click on any of the entries and select Keep starboard bearing;



Name		Visibi. ^			
 Track:NONSUCH 220350.04 (826 positions) Sensors (1 items) Sensor:SENSOR_A (52 c 		Multiple items Reset Color Clear Origin			
<u> </u> 090722 041522		Keep port bearing			
090722 041645		Keep starboard bearing			
<u> </u>		heep starboard bearing			
<u> </u>	of	Cut 52 selected items			
<u> </u>		Copy 52 selected items			
		Delete 52 selected items			
	î	Generate TMA solution from selected cuts			
🔬 090722 042918					
<u> </u>		61 F			
1090722 043409		Shading			
<u> </u>		SemiAuto TMA			
<u> </u>	-				
🔬 090722 044000		✓ ✓			

The port bearings will disappear from view.



Next, we need to edit the raw sensor data.



Open Grid Editor

One method of editing the raw sensor data is by using the Grid Editor.

1. Click on Window > Show view > Grid Editor.

The **Grid Editor** view will display on the right side of the plot editor, but it will be blank until we indicate the data to edit.

6.2.4 Indicating Data to Edit

- 1. The **Grid Editor** 'listens out' for the current selection on 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, e.g. as we have just seen, after hiding the port bearings in this tutorial and opening the grid editor, the grid is empty.
- 2. To populate the **Grid Editor**: click on the Track Segment **220350.04 (826 items)**, which is just under the **Track:NONSUCH** in the **Outline** view.



The Grid Editor view will now populate.



💐 Grid Editor 🛛		0	🛛 🔳 🛛 🗖	3 🗸 🔒 — 🗆
Date Time	Label	Depth	Visible	Location ^
09/07/22 05:40:04	0540	22.3	true 🛛	04°55'30.04"
09/07/22 05:39:56	0539	22.42	true	04°55'29.45"
09/07/22 05:39:48	0539	22.42	true	04°55'28.84"
09/07/22 05:39:40	0539	22.3	true	04°55'28.23"
09/07/22 05:39:32	0539	21.94	true	04°55'27.60"
09/07/22 05:39:24	0539	23.03	true	04°55'26.98"
09/07/22 05:39:16	0539	21.94	true	04°55'26.36"
09/07/22 05:39:08	0539	21.94	true	04°55'25.73"
09/07/22 05:39:00	0539	21.7	true	04°55'25.10"
09/07/22 05:38:52	0538	21.94	true	04°55'24.46"
09/07/22 05:38:44	0538	22.3	true	04°55'23.83"
09/07/22 05:38:36	0538	22.78	true	04°55'23.20"
09/07/22 05:38:27	0538	21.7	true	04°55'22.51"
09/07/22 05:38:20	0538	21.22	true	04°55'21.98"
09/07/22 05:38:12	0538	21.7	true	04°55'21.39"
09/07/22 05:38:04	0538	22.3	true	04°55'20.82"
09/07/22 05:37:56	0537	22.42	true	04°55'20.25"
09/07/22 05:37:48	0537	23.03	true	04°55'19.70"
09/07/22 05:37:40	0537	21.82	true	04°55'19.18"
09/07/22 05:37:32	0537	21.46	true	04°55'18.68"
09/07/22 05:37:24	0537	21.46	true	04°55'18.22"
09/07/22 05:37:16	0537	21.7	true	04°55'17.80"
09/07/22 05:37:08	0537	21.94	true	04°55'17.41" ¥

Note: This behaviour can be cancelled by clicking on the **lock icon** button in the **Grid Editor** toolbar.

 Now in the Outline view, click on the sensor data for Track:NONSUCH > Sensor:SENSOR_A (52 items)



皆 Outline 🛛	<u>▶</u> %1:	2 +2 🗌 🗹 🕆 🗖
Name		Visibi
A 🏂 Track:NON	SUCH	
⊳ 🐴 220350.0	04 (826 positions)	
Sensors	(1 items)	
🕞 💿 Sens	sor:SENSOR_A (52	2 cuts) 🗹

The data from this track will populate the grid editor.

Date Time	Label	Visible	Frequency	Bearing	^
09/07/22 05:25:49	0525	true	50.2	300.0	•
09/07/22 05:25:05	0525	true	<mark>50.2</mark>	299.5	
09/07/22 05:24:17	0524	true	50.2	299.0	
09/07/22 05:23:18	0523	true	50.2	298.3	
09/07/22 05:22:22	0522	true	50.2	297.8	
09/07/22 05:21:30	0521	true	50.09	297.5	
09/07/22 05:20:30	0520	true	49.99	296.5	
09/07/22 05:19:11	0519	true	49.96	296.5	
09/07/22 05:18:11	0518	true	49.99	295.8	
09/07/22 05:16:39	0516	true	49.99	295.8	
09/07/22 05:15:35	0515	true	49.99	295.8	
09/07/22 05:14:04	0514	true	<mark>49.99</mark>	294.8	
09/07/22 05:13:20	0513	true	49.99	294.8	
09/07/22 05:12:00	0512	true	49.99	294.8	
09/07/22 05:10:44	0510	true	49.99	294.3	
09/07/22 05:09:13	0509	true	49.99	294.0	
09/07/22 05:07:57	0507	true	49.99	293.5	
09/07/22 05:06:02	0506	true	49.96	293.0	
09/07/22 05:04:34	0504	true	49.96	292.3	
09/07/22 05:03:26	0503	true	49.99	292.3	
09/07/22 05:02:11	0502	true	49.99	291.5	
09/07/22 05:00:43	0500	true	49.99	291.0	
09/07/22 04:59:19	0459	true	49.96	289.8	~



6.2.5 Tidying your Interface

As mentioned previously, the interface can become easily cluttered. However, if you have a dual monitor and need all the windows and views open, then 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.

6.2.6 Viewing Grid Data

The scrollbar on the right-hand side lets you move forward and backward through the data (the newest items are shown at the top). Most cells in the grid are editable, including the date, and blue and red buttons are provided 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 to manually entering data.

6.2.7 Working 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 the 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.



6.2.8 Fixing Dodgy Frequency Observation

If you zoom out to look at all the frequency data you'll see that whilst 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).



As such, we're going to 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 quite a lot lower than its neighbours.
- 2. Move this data point by clicking inside the square data point and dragging the symbol to align it with its neighbours. Remember, you can zoom in multiple times for greater precision. After aligning the data point, the graph looks as shown below:



6.2.9 Smoothing a Period of Data

To smooth a block of data, we will switch to bearing data:



1. Click on the **Bearing** column, the graph of bearing data will appear.



2. Around the period **05:10** to **05:20** 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 inform **Debrief** which points we intend to keep:



- 1. In the **Grid Editor**, select the row with **Date Time** value **09/07/22 05:10:44** by clicking on the empty cell to the left of the row. In the grid (the top half of the editor) click on the empty space to the left of row **05:10:44**.
- Now, hold down the Ctrl key and click on the row with Date Time value 09/07/22
 05:21:30. We have now selected the valid points at either end of the period we wish



to correct. As soon as you do this, the **Interpolate Bearing** (**calculator**) button in the **Grid Editor** toolbar will be enabled.

🛿 Grid Editor 🖾 🛛 🕞 🔂 🐨 🗖					
Date Time	Label	Visible	Frequency	Bearing	Ambiguous be ^
09/07/22 05:22:22	0522	true	50.2	297.8	62.3
09/07/22 05:21:30	0521	true	50.09	297.5	62.5
09/07/22 05:20:30	0520	true	49.99	297.2027	63.5
09/07/22 05:19:11	0519	true	<mark>49.96</mark>	296.8114	63.5
09/07/22 05:18:11	0518	true	49.99	296.5142	64.3
09/07/22 05:16:39	0516	true	<mark>49.99</mark>	296.0585	64.3
09/07/22 05:15:35	0515	true	49.99	295.7414	64.3
09/07/22 05:14:04	0514	true	<mark>49.99</mark>	295.2907	65.3
09/07/22 05:13:20	0513	true	49.99	295.0727	65.3
09/07/22 05:12:00	0512	true	<mark>49.99</mark>	294.6764	65.3
09/07/22 05:10:44	0510	true	49.99	294.3	65.8

3. Click on the **Interpolate Bearing** button and the bearings for the selected data points will be smoothed along a straight line.




Note: You can select **Undo** from the **Edit** menu, or press **Ctrl+Z** on your keyboard, to undo an interpolation operation.

6.2.10 Getting Clever with Interpolation

Remember, 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 then **Debrief** would have made the interpolated values fit through a cubic spline that passed 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.

6.2.11 Setting Array Offset

As you saw in the earlier step of the tutorial, sensor data can be ambiguous; this can happen when the data has been produced by a sensor that is towed on a cable, behind the vessel. In order to plot the bearing lines from the correct origin, we need to tell Debrief how far back the centre of the sensor is..

In the current scenario, **Debrief** is plotting the sensor cuts against the attack datum of the platform. In truth the centre of towed array sonar is 451m behind the datum of the platform. So, we need to apply an offset of 451m in this particular example for this sensor (since it's behind, we use -451m). To do this:

1. Select **Sensor:SENSOR_A** in the **Outline** view.





2. Open the **Properties** view and you will see the **Sensor offset** attribute. Enter **-451** in this field, then press **Enter**. As you do so, the bearings on the plot will adjust to reflect this change.



<mark>ម្លៃ</mark> Outline 🔀 🛛 🕅	X 1 2 +2 □ ∀ [∨] [□]
Name	Visibi
 Track:NONSUCH 220350.04 (820) Sensors (1 iter Sensor:SEI 	6 positions) ms) VSOR_A (52 cuts)
🔳 Properties 🛛	en → En → En → En =
Sensor:SENSOR_A (52 cuts	;)
Property	Value
⊿ Misc	and a construction of the
Default color	(R:255 G:0 B:0)
Line tickness	1 pixels
Name	SENSOR_A
Sensor offset	-451.0 m
Start/Finish DTG	22/Jul/09 04:15:22 - 22/Jul/09 05:2
Visible	Yes
Visible frequency	All
Optional	
Base frequency	220.0
▲ Spatial	
Array Centre Mo	Worm in hole
▲ Time-Related	
Resample data at	All

- 3. To see where the current array centre is, we can direct **Debrief** to show a marker at the array centre. In the **Outline** view, click on **Track:NONSUCH**.
- 4. Then, in the **Properties** view, under **Visibility**, you will see **Plot array centre**, change it to **Yes**.



🔳 Properties 🛛	🛃 🗄 🔅 🔼 🗸 🗖	
Track:NONSUCH		
Property	Value	^
Spatial		
Interpolate point	No	
▲ Time-Related		
Arrow frequency	None	
Custom Snail Tra		
Custom Vector S	0 - reset	
Label frequency	None	D
Resample data at	All	
Symbol frequenc	None	
 Visibility 		
Link positions	Yes	
Name at start	Yes	
Name visible	Yes	
Plot array centre	Yes 🗸	
Positions visible	Yes	1
Start/End time la	Yes	
Visible	Yes	¥
<	>	

A cross will appear astern of the current submarine location, in the **Plot Editor**.





6.2.12 OPTIONAL - Reducing 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.
- In the drop-down menu, click on SENSOR_A > Visible Frequency, then select 5 Mins.



Adjusting these options will filter out sensor data and hide sensor observations between the specified frequency. The sensor cuts are not deleted, just hidden; and can be made visible again by selecting a smaller, visible frequency.

Note: A more permanent way of doing this is to use the alternate option shown above to **Resample position data at**, and select the required period.

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



Saving Your Data

As mentioned earlier, this sensor data and track will be required for the next tutorial; so, if you don't intend to jump straight onto it, ensure you save this file:

- 1. Click on **File > Save**.
- 2. You have to save the file with the **dpf** extension, and also **select the folder** where you will save the file.
- 3. Enter the filename, e.g. nonsuch_plus_data.dpf.
- 4. Click on Ok.

6.3 Generating Target Track

This tutorial guides you through creating a target track segment from bearing data to represent a period of straight-line motion; this can be interpreted as a **Manual Target Motion Analysis (TMA) Solution**.

- 1. We will be using the track and sensor data from the previous example, so if you closed it, reopen it now.
- 2. In this tutorial, we will be concentrating on the plot, so you can close the **Grid Editor** view.

6.3.1 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.

If you earlier filtered the sensor data, you should reveal it all again before continuing, since we want to use all available data when generating this TMA track.

The first period of cuts we're going to be using here are the first 15 or so sensor cuts (marked 1 in the below screenshot). We can see that at the end of this period, there are 2 bearing lines very close together and then a gap (marked 2 in the screenshot below), followed by a small group of 3 bearing lines, and then another gap (marked 3 in the screenshot below). After this second gap, there is then a period of about 10 unsteady cuts, and then another steady period; we'll be using that for a solution a little later. Experience shows us that, since Ownship is steady throughout this period, these bearing patterns indicate that the subject vessel was first on a straight course, then it manoeuvred, then it assumed a second straight course.



皆 Navigator 👸 Time Controller 🖁 Outline 🔀		😓 *nonsuch.rep 🛛	
Name	St 1 2 +2 □ ✓ ▼ Visibi		
▲ 090722 041522 ▲ 090722 041645 ▲ 090722 042036 ▲ 090722 042036 ▲ 090722 042036 ▲ 090722 042036 ▲ 090722 042036 ▲ 090722 042313 ▲ 090722 042918 ▲ 090722 042918 ▲ 090722 043134 ▲ 090722 043577 ▲ 090722 043577 ▲ 090722 043577 ▲ 090722 043577 ▲ 090722 043577 ▲ 090722 044177	X K K K K K K K K K K K K K K K K K K K		NONSUCH 220350
100/122 044/54 100/0722 044312 100/0722 044319 100/0722 044319 100/0722 044319 100/0722 044319 100/0722 044544 100/0722 044544 100/0722 044544 100/0722 044518 100/0722 044517 100/0722 045313 100/0722 045313 100/0722 045313 100/0722 045313 100/0722 045313 100/0722 045356 100/0722 045556 100/0722 045515 100/0722 045515 100/0722 045519	A K K K K K K K K K K K K K K K K K K K	220540	

6.3.2 Highlighting Contacts

We will 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 then be highlighted in the **Outline** view (I selected the data point named **090722 044127**).
- 3. Alternatively, you can click on that item in the **Outline** view to select it.



법 Outline 🛛	№ % 1 2	+2 🗌 🗹 ▽	
Name		Visibi	^
▲ O Sensor:SENSOR	(_A (52 cuts)	✓	
090722 0415 090722 0415	522	✓	
<u> </u>	545	✓	
<u> </u>	325	1	
<u> </u>	036	✓	
<u> </u>	312	✓	
<u> </u>	535	1	
<u> </u>	711	1	
<u> </u>	918	✓	
<u> </u>	134	✓	
<u> </u>	409	✓	
<u> </u>	557	1	
<u> </u>	756	✓	
<u> </u>	000	1	-
<u> </u>	127	1	
<u> </u>	232	1	
O90722 0443 O90722 0443 O	312	1	
	319		*

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.

皆 Outline 🔀	N 🔀 1	2 +2 🗆 🗹	
Name		Visibi	^
⊿ 🔘 S	ensor:SENSOR_A (52 cuts)		
4	090722 041522	1	
4	090722 041645	✓	
4	090722 041825	V	
	090722 042036		
4	090722 042312	√	
4	090722 042535	1	
4	090722 042711	V	
4	090722 042918	✓	
	090722 043134	✓	
4	090722 043409	✓	
4	090722 043557	V	
4	090722 043756	✓	
4	090722 044000		
4	090722 044127	√	
4	090722 044232	~	
4	090722 044312		
-	090722 044319		*



 To change the colour, right-click anywhere on the selected group and select Multiple items > Color > Orange.



Name		Visibi. ^					
Track:NONSUCH							
Positions (826 positions)							
Sensors (1 items)							
Sensor:SENSOR_A (52 cuts)							
<u> </u>							
						-	100.000
<u> </u>		Madain la itema			Calar		Red
<u> </u>		Multiple items			Color		Blue
🔬 090722 042711		Reset Color			Label visible		Course
🔬 090722 042918		Clear Origin		4	Visible		Green
🔬 090722 043134		Keep port bearing		-			Yellow
		Keen starboard bearing			Has ambiguous bearing		Magenta
		Reep starboard bearing		~	Has bearing		Purple
	of	Cut 14 selected items	Ctrl+X	4	Has frequency		Orange
	P	Copy 14 selected items	Ctrl+C				Bassinge
		Delete 14 celected items	Delete		Label location	<u>*</u>	Brown
M 090722 044232	*	Delete 14 selected items	Delete		Line style	•	Cyan
1 090722 044312		Generate TMA solution from selected	d cuts		Put label at	+	Light Green
A 000722 044210							

The bearing lines in the plot area and the selected items in the **Outline** view will turn orange.



6.3.3 Generating the TMA segment

Next, 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**.

😫 Outline 🛛 🛛 🔉 🔀 1 2 +2 [🔽 🗖 🗖 🎦 🔯 *nonsuch_plus_data.dpf 🛛
Name		Visibi. ^
 Track:NONSUCH Positions (826 positions) Sensors (1 items) 		
Sensor:SENSOR_A (52 cuts)		
A 090722 041522	-	
090722 041645		Multiple items
090722 041825	1	Reset Color
090722 042036		Clear Origin
090722 042312		
090722 042535		Keep port bearing
090722 042711		Keep starboard bearing
090722 042918	at	Cut 14 selected items
090722 043134	3	Cut 14 selected items
090722 043409		Copy 14 selected items
090722 043557	×	Delete 14 selected items
090722 043756	-	C
090722 044000	L	Generate TMA solution from selected cuts
090722 044127		Shading
090722 044232		
3 090722 044312		SemiAuto TMA

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** as is (it's using the bearing from our first sensor cut).



D				_ 0	×
Genera Now sp	te TMA s	segment fset to the track	: start		4
Range: Bearing:	1.0 300.8	nm	 range from ownship to start of tra bearing from ownship to start of t 	ick track	
?		< <u>B</u> ack	<u>N</u> ext > <u>F</u> inish	Cance	4

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

200 F 7	,,.		
ourse:	220.0		the initial estimate of course
peed:	6.0	kts 🗸	the initial estimate of speed

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 kts for the speed estimate. Click Next and you will be prompted to select a color.



D				-		×
Generate T Format the s	FMA segment sensor cuts used for this le	eg				4
Color:	The colour to shade	the selected sense	or cuts (or leave un	change	d)	

5. Select **Orange** and Click on **Finish**.

A red track will appear on the plot. Note that the **Orange** value provided in the last tab of the wizard was to select what color to shade the sensor cuts - the TMA legs are always painted red. The track is 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 them easier to manage).





6.3.4 Recognising Track Data

We will now look at the track data for this TMA solution in the **Outline** view.

1. In the Outline view, click on the arrow next to the new track

Track:TMA_220415.22) and you will see the Positions (14 positions) child item.



 If you look at the icon for this particular child item, you will see that it shows a straight-line section of data with a tiny red compass rose on it (to indicate that this a forecasted straight leg of track). 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 - to indicate that this is a series of absolute measured positions). 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.

6.3.5 Put the Tracks on the Tote

We are going to use a statistical graph to improve the accuracy of the TMA leg we created. To do this, we need to tell Debrief which is the **primary** track (the one carrying the sensor), and which is the **secondary** track (the TMA track we're developing). As we've been generating the TMA track, **Debrief** has automatically assigned the **secondary** track as the new TMA track, and the **primary** track as the platform hosting the sensors used to produce the TMA track.

Note: if you wish to change the secondary track used in single-sided reconstruction, just select the track in the **Outline View** then click on the **2** icon in the Outline toolbar, to mark it as secondary.

1. Verify we have the correct tracks assigned by viewing the Track Tote

Propert	ies 🔽 T	rack Tote 🖾		¢ X	-	
Attribute	NONSUG	СН	TMA_220	415.22		
Range Bearing Rel Brg Brg Rate ATB						
Speed	08.83					
Course	259.3					
Depth	031					
Time	0350.04					

Debrief now knows what tracks we wish to compare, so we will manipulate the track segment to minimise bearing and frequency residuals. But first, let's look at the **Bearing Residuals** view.

6.3.6 The Bearing Residuals View

To open the **Bearing Residuals** view, click on the **Drag Track Segment** () button on the Debrief toolbar. The **Bearing Residuals** view will display to the right of the **Plot Editor**.

Note: if the **Bearing Residuals** view is small, make it bigger for this next exercise. As with all views, you can resize or move them by moving your mouse over the sides of a view and, when the cursor changes to a multi-directional arrow, drag in any of the directions indicated; or, if required, by clicking on the view's tab, you can then either drag the view to another part of the display or to another connected monitor.



Looking at the **Bearing Residuals** view, you will see that the central graph is titled **Error**. The aim with this view is for the analyst to reduce the residual error—the error between the measured and the calculated bearing—by manipulating the track **manually in the plot editor**. As this is carried out, a real-time view of the track manipulation is displayed in the **Bearing Residuals** view.

		0	1 2	eed (Kt 3 4	s) 5 (
)	Error (*)		C	ourse (*)
3000	20 40	0	45 9	0 135	180 22
			_		
			-		
					-
		_	-		-
- 1			-		-
					-
					-
			-		-
	_		-		-
		-			
	-				
1		-	-		
1	-		-		
-	-		-		-

This manipulation is carried out using one of the **translate**, **rotate**, **stretch**, and **shear** modes, which are located on the **Bearing Residual** view toolbar, in conjunction with Debrief's **Drag Track** functions, which are located on the **main toolbar**.

When you have selected your drag mode and started to manipulate the active track in the plot editor, the resultant effects will be seen in both panes in the **Bearing Residuals** view: **Absolute (degs)** and **Error (degs)**. The aim here is to drag/position the active track to reduce the calculated error to a minimum, i.e. the **Error (degs)** central pane shows an error of **0 degrees**.

This in conjunction with the analyst's knowledge, experience, and other available data (such as narratives), which will enable them to perform an accurate track reconstruction. Let's do this now.



6.3.7 Manipulating Track Segment

 In the Bearing Residuals view, Absolute (degs) pane, you can see 2 lines: Measured (the bearing recorded by the sonar), and Calculated (the calculated bearing between each ownship position and each position of the hypothetical subject vessel).

Note: if you don't see any lines here, click the ship's wheel toolbar icon twice in the **Bearing Residuals** view to switch the plotting of **Ownship Course** off then back on. **The Bearing Residuals** view will now update to show the measured/calculated data.

The **Error (degs)** pane of the **Bearing Residuals** view at the start time of 04:15:22 (obtained from the grid editor data), shows a residual error of just under 10° (you can zoom in by clicking and dragging top-left to bottom-right in the pane). We need to reduce this as much as possible, so must select the drag operation most suitable.

2. There are 4 drag mode buttons in the **Bearing Residuals** view, these control how you drag the

track. Click on the **Drag Track Segment** button on the Bearing Residuals View toolbar and the 4 drag modes will display.



They are labelled, and have functions, as follows:

- **Translate** you can drag either end of the track: this changes range and bearing from the source, but maintains target course and speed.
- **Rotate** here you can drag either end of the track: doing so maintains the target speed but changes the target course.

You can also drag the track from the middle in this mode, but when **rotate**, **stretch**, or **shear** mode is selected, a **Translate** operation is performed (the button in the **Bearing Residuals** view doesn't switch to Translate though).

 Stretch - here 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: whilst the **Translate** and **Rotate** operations are available for all types of track segments, only the **Stretch** and **Shear** operations are suitable for application to **straight-line TMA Segments** (the sums just get too complex when applying these operations to real track data). To help you, the hand cursor will only turn green over straight-line TMA Segment hot-spots.

As mentioned earlier, though you select the above drag options in the **Bearing Residuals** view, these selections are used in conjunction with the following drag buttons from the main toolbar:

- Stretch, Shear, and Rotate are only used with the Drag Track Segment function.
- Translate can be used with Drag Track Segment, Drag Component, or Drag Whole Feature.

By default, the mouse cursor hand is brown. When it is this colour, you cannot modify the track from this particular point—it isn't a *hot-spot*. However, if you move the cursor over a point on the track which does allow you to manipulate (or move) that point—a *hot-spot*—the cursor will change colour to green. As mentioned in the bullet points above, this will either be at the end, and/or in the middle of a track.

- 3. Now, select **Shear** mode and then click on **Drag Track Segment** on the main toolbar and move your cursor to the start point of **TMA_220415.22**.
- 4. When you are in the position to drag the track point, the mouse cursor will turn green, you can now drag.

Bear in mind, the data points we have must correspond to the bearing fans, so the objective here is to both reduce the residual AND position the start of the track on the bearing line. You will probably need to zoom in on the track and in the **Error (degs)** pane.

5. In the bigger picture, you will try to minimise errors by moving the start *AND* end points of the track leg. But, since this leg starts at a bearing of 300.8 from the primary track (to match the first bearing), the initial error at the start of the leg should already be zero - as in the following screenshot. Note: there's a good chance it's at the wrong range though - so you may have to come back and manipulate it further..





 Do the same with the end of the track. As you can see from the image below, it is possible to reduce the error to 0.4 degrees either side. Also note that the background to the error plot has gone green, to indicate "acceptable". The cut-off value used to indicate an acceptable solution is defined in Debrief Properties, under TMA Operations..



Now we'll look at expanding on this with another TMA segment.

6.3.8 Generating Second TMA Segment



Looking at the sensor data, it would appear that the turn is represented by about 14 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 (marked 1 in the below screenshot). Then, towards the end of the track, the bearing lines appear to converge steadily around a single point (marked 2 in the below screenshot). In between these two periods of steady data, the lines jump around a little (marked 3 in the below screenshot), 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 hold **Shift** and then click the last sensor cut. We've now selected the cuts to be used for the second track segment.
- Right-click on one of the selected items and select Multiple items > Color > Green. The cuts will turn green.



 090722 05021 Multiple items Red 090722 050326 Multiple items Rest Color Rest Color Rest Color Label visible Blue 090722 050757 Osoma (Clear Origin Clear Origin Clear Origin Green Has ambiguous bearing Magenta 090722 051044 Cu 20 selected items Ctrl+X Has bearing Magenta 090722 051344 Cu 20 selected items Ctrl+X Has frequency Orange 090722 051355 Cu 20 selected items Cut 20 selected items Cut 20 selected items Cut 20 selected items Cut 20 selected items Light Green 090722 051351 SemiAutor TMA	ame		^					
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Light Grey 0 090722 052318 0 090722 052417 0 090722 052505 0 090722 052549 ► Additional data (Empty)	A 000722 052730		SemiAuto TMA	•				Pink
▲ 090722 052417 Grey ▲ 090722 052505 Dark Grey ▲ 090722 052549 White	090722 052318	-						Light Grey
▲ 090722 052505 Dark Grey ▲ 090722 052549 White	090722 052417							Grey
O90722 052549 White Additional data (Empty)	090722 052505							Dark Grey
Additional data (Empty)	090722 052549							White
	Additional data	Empt	0					ou i
			>					Medium BI

The plot and the **Outline** view will update to show the color change.





4. Right-click again on the selected cuts and select **Generate TMA solution from** selected cuts,



The Generate TMA segment dialog will display.

D							x
Genera Now spe	te TMA s	segment fset to the track st	art				
Range: Bearing:	1.0	nm v	range from ownsł bearing from own	nip to start of track Iship to start of trac	:k		
0		e Daek	Nexts	Finish		Cancel	

- a. 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, which represents as good a start point as any).
- b. Click **Next** and the initial solution dialog will display.



D							×
Genera This pag	a te TMA ge lets you	segment u enter an ini	itia <mark>l s</mark> o	lution			
Course: Speed:	220.0 6.0	kts	the v the	initial estimate of o	ourse peed		
?		< <u>B</u> a	ck	Next >	<u>F</u> inish	Cance	ļ

- c. 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 kts for the speed estimate.
- d. Click Next and the dialog to select the color will display.

ienerate	TMA segment				
i offide the		-9			
olor	T I I	2011/2012/01/01	101123100100		
	The colour to shade	the selected sens	or cuts (or leave un	changed)	
	The colour to shade	the selected sens	or cuts (or leave un	changed)	
	The colour to shade	the selected sens	or cuts (or leave un	changed)	
	The colour to shade	the selected sens	or cuts (or leave un	changed)	

e. Click on **Finish** and the second track will be plotted.

The new track will display in the plot and the **Outline** view.





As mentioned, due to the earlier turn, the new track is probably wrong; but we can manipulate the track and see what solution we can arrive at.

6.3.9 Refining 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. Note that Debrief has *automagically* assigned this track as the secondary track in the Track Tote.
- Now, let us start manipulating and refining this solution. Click on Drag Track Segment on the main toolbar (or press Alt+1) and move your cursor to the start point of TMA_220503.26.
- 4. When you are in the position to drag the track point, the mouse cursor will turn green. Click and start dragging the track.



5. Again try to minimise the errors for this new leg of TMA. I was able to reduce the error down to around 0.5 degrees either side.



6.4 Merging Tracks

6.4.1 Selecting and Merge 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; so, we will now combine them into a single track.

1. Using the **Outline** view, **Ctrl+click** to select both tracks.





- Right-click on one of the selected tracks and select Group tracks into TMA_220415.22 (it doesn't matter which one you select).
- 3. The tracks will merge into 1 (the 'other' track will disappear). However, there is still that large 'turn gap' remaining. We will now use **Debrief** to *infill*, or bridge, that gap.



6.4.2 Providing Infill Positions

Debrief is capable of linking track sections by infilling the gap between them. Instead of just creating a straight leg of data between the two legs, Debrief fits a curve to the end of the first leg and the start of the second one - to allow on leg to *flow* into the other.

- 1. Click to expand Track:TMA_220415.22 and you will see it contains Positions (2 legs).
- 2. Expand this and you will see 2 tracks with different numbers of items (in mine, I have 220415.22 (14 positions) and 220503.26 (20 positions)).









3. Select both tracks. (Ctrl+click)

4. Right-click on either one and select **Generate infill segment**.



Note that a second **Generate infll segment** command is provided. Use this if your two legs are very close together in time, and it will give Debrief permission to delete enough points from the second leg in order to allow for a dynamic infill to be inserted.

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's just been calculated to join both tracks.

Also, if you look in the **Outline** view at the **Track Segments**, you will see the 3 individual tracks listed. Take note of the icons: 2 are straight line tracks, and the other shows a turn.



6.4.3 Merging Tracks

You can continue to keep your target track represented as 3 or more track segments for as long as you like. If you try dragging either of the TMA track segments you created, you'll see the the infill adjusts itself to optimally fit those legs. If you view a Speed-Time (or Heading-Time) plot of the combined TMA track, you'll see that Debrief attempts to smooth speed and course, in addition to position. 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 (Positions (3 legs)).





😫 Outline 🛛		Tonsuch_plus_data.dpf
№ X 1 2	+2 🗌	
Name	V	isibility
a 🚜 Track:TMA_220415.22	-	
Positions (3 legs) 220415.22 (14 position	Po	sitions
infill_0744_1 (20 positi	Me	erge all track segments
220503.26 (20 position and Track NONSUCH	Rev	veal all positions
 Positions (826 positions) Sensors (1 items) Sensor: SENSOR_A (52) 	Cut Position Copy Position	t Positions py Positions lete Positions
	Me	erge track segments - into new track (single shade): TMA_220415.22 (Merged) erge track segments - into new track (highlight infills): TMA_220415.22 (Merged)
	Sel	ect all Children
	7 Sel	ect infills segments in this track

2. Right-click on it and select **Merge all track segments**. The tracks will merge and in the **Outline** view you will see **Positions (54 positions)**.

6.5 Conclusion

That's the Single-sided reconstruction tutorial using **Debrief** finished. I hope you can see how easy it is to do this using **Debrief**, as well as appreciate the power and potential 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: _____



7 Semi-Automatic TMA Walkthrough

Semi Automatic Track Construction (SATC) was developed in response to the challenges of handling and solving multi-leg target tracks using **Debrief**'s manual TMA algorithms. SATC provides an automated means of obtaining an optimal solution based upon disparate "packages" of analyst knowledge, measured data, and logical/geometric deductions (collectively these are called "contributions"). This tutorial looks at:

- Single Leg TMA Solution
- <u>Multi Leg TMA Solution</u>

7.1 Single Leg TMA Solution

The first tutorial in this set will involve an engagement where there is just a single leg of target data. Here we follow 5 steps:

- Loading a Simple Scenario
- Creating a Scenario
- <u>Generating a Solution</u>
- Converting the Solution to a Track

7.1.1 Loading a Simple Scenario

Note:Before you begin this section, you should know how to <u>generate a project</u> and <u>generate links to</u> <u>existing data</u>.

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

Find SATC Subfolder and Load Ownship Track

In the Navigator view:

 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.





🔓 Navigator 🛛	Ģ	⇔ @ 🖪 🕏 ▽ 🗖			
	BlueTrack.rep CompositeStraigh Deb_North_Low_E FreqTracks.dpf FreqTracksQuanti L1_OwnshipSenso	tTest.dpf Bearing_Rate_s_turns.dpf zed.dpf vr.dsf ren			
24 10 10	L1_SubjectT L2_Scenario MDA_Test.d	New Open Open With	•		Debrief Plot Editor
	RedTrack.re	Сору		D	Text Editor

2. In the Select track mode dialog, select Over the Ground (OTG) mode.

You will now see the blue ownship track in your Plot Editor. Click **Fit to window** button to view the entire plot.

🛃 *L1_OwnshipTrack.rep 🛛	
121230	
	121213 OWNSHIP

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 display.



2. You can leave this sensor contact name as Plain. Click Next.



3. Choose a **color** for the sensor data, then click **Next**.



Ø	
Import Sensor data Please specify if this sensor should be displayed once loaded	- Channes -
Value: 🗹 yes/no	
? Sack Next >	Finish Cancel

4. Select the value check box so that the sensor data will be visible, then click Next.

Ø	
Import Sensor data Should Debrief apply Rainbow Shades to these sensor cuts?	
Value: 🗹 yes/no	
? < Back Next >	Finish Cancel

5. In the **Rainbow shades** dialog, select the check box to shade the sensor cuts in a range of colors. Click **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, then repeat the above steps (making sure you've loaded the correct files).

Now we've loaded our data and we can now create a scenario.

7.1.2 Creating a Scenario

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

7.1.2.1 Creating a Scenario Based on Cuts

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, titled **Sensor:Plain (11 cuts)**.



 Right-click on it and select SemiAuto TMA > Create new scenario from these bearings.





7.1.2.2 Creating Scenario Based upon Cuts

A new item with the name **121213.14 (1 items)** has been 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). Notice the use of the calculator symbol to indicate this computer-generated track solution.



You will also see that the **Maintain Contributions** view has opened. A contribution is a piece of information that is used in the development of target solutions. This information can be in the form of a measurement (range, bearing or frequency); an analyst forecast (i.e. speed or range), or one of a hidden set of analysis contributions that deduce further constraints based on other contributions. This view is used to create and manage your scenario data.

Auto-Ke	calc of Const	raints	Calculate So	lution	V 3	u
<						>
Analyst Co	ntributions					
	Active	Hard	Estimate	Weighting	Delete	
Bearing	Measuremen	it - Bearir	ng data			~
	-		+/- 3 degs	11 Mea	surement	



7.1.2.3 Changing the 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. To rename the scenario

- 1. In the **Outline** view, click on the scenario name **121213.14** to select it.
- 2. In the **Properties** view, (**Windows > Show View > Properties**, if it isn't visible) change the **Name** value to **Single Leg**.

7		
_	_	

🔳 Properties 🛛	
121213.14 (1 items)	
Property	Value
Format	101000
Color	(R:0 G:255 B:0)
Name	Single Leg
Only plot leg ends	
Show alteration states	
Show location constraints	
Show solutions	
 Visibility 	
Visible	OK Cancel
	Cancer

3. Click OK.

7.1.2.4 Understanding the Maintain Contributions View

Main Contributions View



Auto-Recal	c of Constraints Cal	culate Solution	Suppress Cuts Plot O/S Course	Precision: Low
nalyst Conti	ributions			
	Active	Hard constraints	Estimate	Weighting Delete
Bearing Me	easurement - Bearing o	lata		
	•	+/- 3 degs	11 Measurements	5 🖨 💥

In the **Maintain Contributions** view you can see that, in the **Analyst Contributions** section, there is a single **Bearing Measurement - Bearing data** item listed.

This is the bearing data that will be used to inform all of the subsequent contributions.

7.1.2.5 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**, which means the algorithm will only consider 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, set the attribute value **Show location constraints** to **Yes**.


🔳 Properties 🔀	2	in.	幕				1
Single Leg (1 items)							1
Property	Value	e					
Format							
Color	I) I	R:0 0	6:255	5 B:0)		
Name	Singl	e Le	g				
Only plot leg ends	No						
Show alteration states	No						
Show location constraints	Yes					Ý	4
Show solutions	Yes						
Visibility							
Visible	Yes						
<						>	ŝ

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 3 degree allowable 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 toggle the Auto-Recalc of Constraints button in the Preferences area to initiate this).

Auto-Recalc	of Constraints	Calculat	te Solution	Suppress Cuts	✓ Plot O/S Course	
<						>
Analyst Contri	butions Active	Hard co	onstraints	Estimate	Weighting Delete	
Adjust Name:	Bearing o	lata				^
Dates:	12/01/20)1(🔲 12	:13:14 PM 🌲	- 12/01/201(12:2	9:59 PM 🗘	
Error:	√ +/-3 c	legs			1 1 1	
MDA:	1. Slice O	/S leas	2. Slice Tat leas	Auto-detect target ma	noeuvres	

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 un-check this button - then the screen will no longer be refreshed as you are interactively adjusting any contributions.

7.1.2.6 Specifying 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 30kyds, to keep things manageable, and to avoid your PC requiring the *Ferranti Reset*.

Also, before we continue, **Debrief** must be reset to a *predictable state*, so:

- 1. Restore the **Analyst Contribution** to **3 degrees**.
- 2. In the **Properties** view, set the attribute value of **Show Location Constraints** to **No**.

It's 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 of great value to the TMA algorithms, since it means the contact must travel through those pie slices in a straight line.



- In the Outline view, select Track:Ownship > Sensors (1 items), and then right-click on Sensor:Plain (11 cuts).
- From the drop-down menu, select Semi Auto TMA > Add to Single Leg > New Straight Leg for period covered by [sensor cuts].



3. When the **New contribution** dialog opens up, name this contribution **Leg limits**.

D	New contribution	×
What is the nam	of this contribution	
Leg limits		

4. Click Ok.

In the Outline view, you will see Single Leg (1 item) has changed to Single Leg (2 items).



Name		Visibi
A M Track:OWNS	SHIP	-
> 121213.1	4 (69 positions)	✓
🖌 🌆 Sensors ((1 items)	1
b (in the second sec	or:Plain (11 cuts)	1
Single Leg (2)	2 items)	✓

7.1.2.7 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.

7.1.3 Generating a Solution

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

7.1.3.1 Calculating 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 quite 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 will be the same color as you specified for the bearing data in the **Bearing Import Wizard**.

My computer returned a solution of 9.0 kts on 269°.

You can alter the **Precision** setting as you require (to medium or high), but you must click on **Calculate Solution** each time to generate it.

Maintain Contributions - 1212	13.14 🕱			? [<u></u>
Auto-Recalc of Constraints	Calculate Solution	Suppress Cuts Plot O/S Course	Precision:	Low	~
< Analyst Contributions				Medium High	

As you can see from the image below, which superimposes all 3 precision solutions—Low (red), Middle (yellow), and High (blue)—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

Debrief

have been run through, and that each one moves more slowly. The bars shown in the performance graph represent the sum of the contribution errors at each contact position (state).



7.1.3.2 Marking your Own Homework

The data we're using here is from a simulation tool; and this means we have the actual target track to compare against.

1. Drag the file "L1_SubjectTrack.rep" into the plot area.



2. In the **Select track mode** dialog, select **Over the Ground (OTG)** as the import mode.

The track will now display 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 to the East, near the start. This is because of the low bearing rate near the start; 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.

7.1.4 Importing a Solution

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

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.





🔓 Outline 🔀	P R .	12	+2	
Name				Visibi
A Mark:OWN	ISHIP			
▶ _ 121213.	14 (69 positio	ns)		
Sensors	(1 items)			
Sense Single Leg	() items)	uts)		
Track:SUBI	ECT			

7.1.4.1 Converting to Composite Track

To convert the current solution to a **Composite Track**:

- 1. Right-click on Single Leg (2 items).
- 2. Select Convert to manual TMA track.

	1 2 +2	Make Primary Make Secondary Add as Secondary Single Leg Convert to manual TMA track	•
		Convert to merged track Recalculate solutions	
<mark>៥ទួ</mark> Outline 🙁 ∑ Track To	≪ ■ ×	Cut Single Leg Copy Single Leg Delete Single Leg	Ctrl+X Ctrl+C Delete
Name		View XY plot Select all Children	
▲ 777777777777777777777777777777777777	1 1 1 1	Add Speed Forecast for period covered by [selected legs] Add Course Forecast for period covered by [selected legs] Add Straight Leg for period covered by [selected legs]	
Single Leg (2 items) Track:SUBJECT	_		

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**).





7.1.4.2 Renaming 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**.

🔳 Properties 🔀	1 日 李 國	
Track:Single Leg_0		
Property	Value	^
Snail symbol type	Submarine	
Track Coloring Mode	Per-fix Shades	
Track font	Arial, 12	
▲ Misc		
Name	Single Leg TMA	
Spatial		
Interpolate points		
Time-Related		
Arrow frequency		
Custom Snail Trail		
Custom Vector Stretch	[OK Cancel
Label frequency		Cancer
Recample data at	All	



3. Click OK.

7.1.4.3 Tidying 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 SUBJECT and then untick Visible.



The track will disappear from view and only the OWNSHIP and Single Leg TMA tracks are visible.





7.1.4.4 Tuning the TMA solution Manually

Now we will adjust this solution in the same way we did for the Single-Sided Reconstruction:

- 1. Click on the **Drag Track Segment** button in the Main Toolbar and the **Bearing Residuals** view will display in the right side.
- 2. Mark the **OWNSHIP** track as the **primary track**, and the **Single Leg TMA track** as the **secondary track** (using the mini-toolbar in 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 Centre bearing

axis on North button



7.1.4.5 Importing as Standalone Track

Note: The manual-track fine-tuning process steps you have just carried out are more suited to complex scenarios where, because of the lack of contributions available for the system-produced SATC solution, the analyst decides to use the manual TMA tools to groom the track by hand.

However, in this scenario, as the raw SATC did produce 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 Merge to Track.



0	Comp	oositeStraightTest.dpf	1
	1 2 +2	Make Primary Make Secondary Add as Secondary	
		Single Leg Convert To Manual TMA	×
Properties		Merge To Track Recalculate Solutions	
Single Leg (2 i	ot	Cut Single Leg	Ctrl+X
Property		Copy Single Leg	Ctrl+C
Show s	×	Delete Single Leg	Delete
Visible		View XY plot Select all Children	
Contline 2	۵	Add Speed Forecast for period covered by [selected legs]	
Name	-	Add Course Forecast for period covered by [selected legs]	
D 77 Track:	1	Add Straight Leg for period covered by [selected legs]	
Dingle	SUBJE	CT	

You will now see the track has appeared in the **Outline** view as **Track:Single Leg_0**.





7.1.4.6 Marking your Own Homework

Currently loaded into **Debrief** we have both our imported **TMA Solution (Track:Single Leg_0)**, and our **Truth Track (Track:SUBJECT)**; 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.**



ង Outline 🛛 🛛 除 🔀 🕇		Merge track segments - into new track (single shade): SUBJECT (Merged)
Name		Merge track segments - into new track (highlight infills): SUBJECT (Merged)
A March: OWNSHIP	0	Trim tracks to Time Period (from Time Controller)
 121213.14 (69 positions) Sensors (1 items) 	Ð	Copy tracks to clipboard as offsets from OWNSHIP
Sensor:Plain (11 cuts)		View XY plot
Single Leg (2 items)		
Track:SUBJECT		Export tracks to GPX
Frack:Single Leg_0		

The View time-variable plot dialog box will display.

D	View time-va	ariable plot	
Please sel	Please select the attribute to view		
		Depth Course Speed	
		Range Bearing Bearing rate o Doppler Rel Brg ATB	alculation
		ОК	Cancel

3. Select Range, click Ok and the Select Primary dialog will open.

D	Select p	orimary	/
Which is the p	rimary track	Track:S	UBJECT
		Track:S	UBJECT
		Track:Single	ingle Leg_0
	0	к	Cancel

4. Select **Track:SUBJECT** as the primary track, and click on **Ok**. The **Subject Range vs Time Plot** graph will display.



SUBJEC	CT Range vs T	Time plot 8	3									×	<□	🕚 🖤	h 🖸 [≣ ¢	
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	12	214.00	1216	.00	121	8.00	122	0.00	1222 Time	2.00	1224.0	10 12	26.00	122	8.00	123	0.0

This graph shows the start of the track has an error of approximately 130 yds, reducing to 60 near the end. This seems quite good considering the target ranges vary from 8000 to 3000 yards from ownship.

7.1.5 Conclusion

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.

7.2 Multi Leg Solution

In this, the more advanced multi leg solution, the scenario has several target zigs, and a number of contributions are required to obtain an optimal solution. Similar to the single leg solution, we need to load the data, then groom it before we can play with the multi-legs.

Loading the data

Load "L2_Scenario.dpf" by dragging it from the Navigator view into the plot area.

As soon as the plot opens, you will see a blue **Ownship** track, with a dark green bearing fan.





7.2.1 Grooming the Data

Now we've loaded the data, we now need to groom it. First, we need to understand what our data shows, then we create the scenario, before moving onto zig detection and generating and grooming target legs.

7.2.1.1 Understanding Data

To understand what is happening 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.

7.2.1.2 Creating Scenario

The most significant block of information that **Debrief** requires to generate a solution is the bearing data - we need to mark this information as such.

In this scenario, we will use all of the **Ownship** sensor data:

- 1. In the **Outline** view, click the drop-down arrow next to **Track:Ownship**.
- 2. Click Sensors (1 items) to expand it.



 Select Sensor: Plain (145 cuts), 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 (1 items)**) appear in the **Outline** view, and the **Maintain Contributions** view will open, with just one contribution.



7.2.1.3 Introduction to Zig Detection

The SATC algorithm is only capable of determining periods of target track for when periods the target is travelling at steady course and speed. Without this assumption the number of permutations would make the task impossible.

An algorithm has been developed that considers the current rate of change of bearing, and determines if the bearing rate matches that for two platforms in steady state. Where the bearing rate doesn't match an acceptable range, one or both platforms must be changing course or speed.

This algorithm uses the set of measured bearings, and produces a set of target legs.

7.2.1.4 Generating the Target Legs

As mentioned in the previous step, the process begins with determining the ownship legs. As analysts, we can see what is happening on screen, but **Debrief** cannot; and, the main information source to enable **Debrief** to detect target zigs and generate target legs is the bearing data.



1. In the Maintain Contributions view, expand the Bearing Measurement - Bearing data section. Near the bottom of the control you'll see the MDA (Manoeuvre Detection Algorithm) section.

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Bearing Mea	surement - Bearing	g data					
		+/- 3 degs	145 Measurements			5	- *
Adjust							
Name:	Bearing data	1					
Dates:	12/01/2010	12:00:00 🗘 - 12/0	1/201(14:00:00 韋	The second s			
Error:	✓ +/- 3 deg	s i i i i	1 I I	N N			
			20	5			

2. Now Click on **Slice Tgt legs** and the MDA algorithm will produce a series of legs - see the new **Straight Leg Forecast** entries listed, together with zones shaded green below in the **Target Legs** chart.

	Adjust									^
	Name:	Bearing data								
	Dates:	12/01/201(12:00:00 ‡	- 12/01/20	1(📃 14	4:00:00 ‡	1			11
	Error:	🗹 +/- 3 degs	-							
	MDA:	Slice Tgt legs	Auto-detect ta	get manoeuvi	res					
s	itraight Leg F	orecast - Tgt-1								
	D								5 🜩	×
- S	traight Leg F	orecast - Tgt-2								
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	200 12:00	0 12:15 12:30	12:45 13:00	13:15 13:3	0 13:45	5 14:00	X	Reveal		



7.2.1.5 Grooming the Target Legs

Let's have a look at what the algorithm produces from these target legs:

1. Click on **Calculate Solution**. The algorithm will produce a target track and show it on the plot.





2. These legs closely match the bearing fans. But, prior knowledge indicates that contact almost certainly isn't travelling at 28 knots on the third leg.



7.2.2 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.

7.2.2.1 Introducing Speed Constraint

Fortunately, the ship's log for the subject vessel gives a broad indication of the target's speed during the engagement. We will now add it to our scenario.

7.2.2.2 Adding Speed Constraint

There are a number of ways to add a speed constraint:

- 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.
- We can apply a speed constraint to the whole engagement. To do this, we just right-click on any contribution that covers the whole time period. The full set of bearings is a good candidate for this.

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]**.



The New Contribution dialog will display.



D	New contribution
What is the nam	ne of this contribution
Overall Speed	

- 2. In the **New contribution** dialog box, enter **Overall speed** as the name of this contribution.
- 3. Click on **Ok** and, since the addition of the new contribution means that the existing solution is no longer valid, you will see the target solution disappear.

7.2.2.3 Specifying 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. A maximum speed of 10 knots.
- 4. An (optional) estimate of 9 knots.
- 5. Click on the **Calculate Solution** button.



references						
Auto-Recald	of Constraints	Calculate Soluti	on	Su Su	ppress Cuts	Plot
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Analyst Contr	ibutions					
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Speed Fore	cart - Overall Sp	and				1
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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.



You will also see the new set of target legs, that conform to the new speed constraints:





Note: In the above screenshot, the **Tgt-3** for the target is heading down at SE. Analysts actually believe it was heading NW, since the contact was getting quieter. Since this is the final leg of the dataset, we don't have any successive legs to tie it to - so it could be heading SE or NW, and still match the bearings.

If we wished to manually "force" leg titled **Tgt-3** to be NW, then we could right-click on it in the **Outline View** and select **Add Course Forecast for period covered by [selected legs].**

Name	Visibility				
 I21200.00 (6 items) K Bearing data Tgt-1 					
Tot-2					
Tgt-3	✓ Cut Tgt-3 E Copy Tgt-3 X Delete Tgt-3				
▶	Add Speed Forecast for period covered by [selected legs]				
Frack:SUBJECT	Add Course Forecast for period covered by [selected legs]				
	Add Straight Leg for period covered by [selected legs]				



From the contribution that appears, we would just set minimum and maximum courses to be, say **270** and **350**, as in this screenshot:

\bigtriangledown		270 - 350 °	5 🗘
Adjust			
Name:		Last leg course	
Dates:		12/01/2010 🔲 13:40:00 🗘 - 12/01/2010 💷 13	:55:50
Min:	270 °		0
Max:	350 °		
Estimate:		•	

Instead of that, however, we'll experiment with tuning the solution manually.

7.2.2.4 Generating 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** (in this case it is **121200.00**) and select **Convert to manual TMA track.**

A manual solution (**Track:121200.00_0**) will now appear in the **Outline** view, and the auto TMA solution will be hidden.



Note that the new solution has been automatically marked as Secondary. We are now ready to manually adjust the solution.

Also note that the new TMA Solution comprises 5 legs. This is because **Debrief** has generated **Dynamic Infills** between the TMA steady legs.

7.2.2.5 Tuning TMA Solution Manually

To manually tune the TMA solution:



- 1. In the **Outline** view, ensure the track is selected.
- Click on the Drag Track Segment button on the main toolbar and the Bearing Residuals view will display.

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 aren't, 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.

1. Now, in the **Bearing Residuals** view, click on the **Shear** button.

	× •
	Translate
	Rotate
	Stretch
•	Shear

 In the plot area, begin dragging track segments to minimise the bearing errors. Note, you could manually try to switch the third leg to run in a NW direction, rather than SE.

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.

7.2.2.6 Merging Track Segments

When you are finally happy with your solution it's time to merge the separate track segments into a formal track.

- 1. In the **Outline** view, expand your manual TMA solution.
- 2. Right-click on the **Positions (5 legs)** and, from the popup menu, select **Merge all track segments**.



皆 Outline 🖾 🛛 🕅 🕅	312+2□☑ ▽▫▫				
Name	Visibility				
Track:121200.00 (5 items)					
Positions (5 legs)	Positions				
Tgt-1_a [Recalcu	Merge all track segments				
Tgt-2 (76 positio	Reveal All Positions				
Tgt-3 (20 positio	✓ Cut Positions E Copy Positions				
Frack:OWNSHIP					
Frack:SUBJECT	X Delete Positions				

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

7.2.2.7 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 against your track?

If you'd like a more quantitative score, produce an **XY Plot** of 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 2000 yds, which is not bad when we're using sensor data at around 20000 yds.

7.3 Conclusion

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: _____