Sonatest

NDTS

RapidScan3D
Ultrasonic Instrumentation

Quick Start Guide

Part Number: 147363

Setting up the RapidScan3D System

Terminology used in this document includes:

- “instrument” – the black Peli-case and its contents; this does not include the laptop and FaroArm
- “laptop” – the laptop which is connected to the instrument
- “arm” – the FaroArm

Connecting RapidScan Components

Connecting the Cardbus Adapter

The laptop is supplied with a PCMCIA or PCIe adapter card to connect itself with the data capture electronics within the RapidScan instrument. PCIe can only be used on newer laptops.

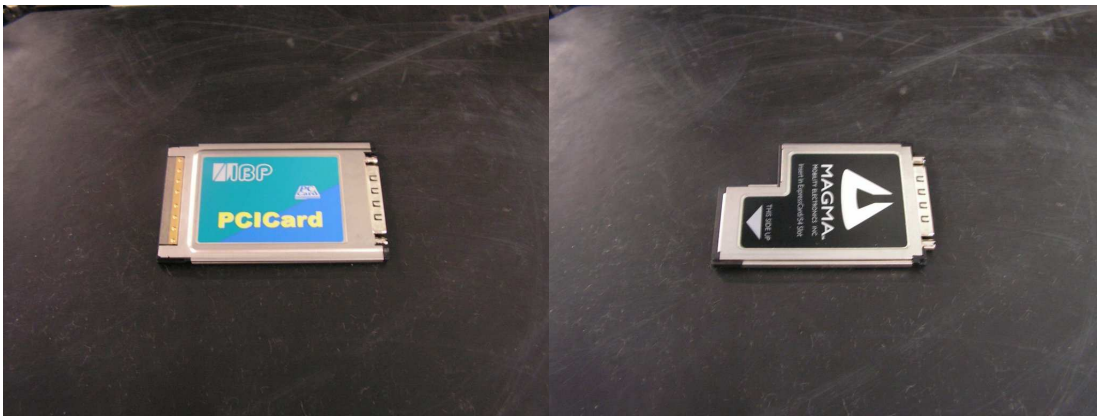

Figure 1: PCMCIA and PCIe Adapter Cards

The socket for the adapter card is usually on the left hand-side of the laptop. The adapter card may currently be separate as in Figure 1: PCMCIA and PCIe Adapter Cards.

The adapter card may be supplied already inside the laptop, as in Figure 2: An attached but unconnected adapter card.

Figure 2: An attached but unconnected adapter card.

If the cardbus adapter is already attached to the laptop, remove it (usually by pressing it in and then it can be pulled out).

If the cardbus adapter is not already attached to the cable from the RapidScan instrument, attach the adapter and tighten both screws. This cable can be identified as it is black and on the left hand side of the top of the instrument, near to the power connector and switch. See Figure 3: A correctly connected adapter card and RS instrument.

Figure 3: A correctly connected adapter card and RS instrument

⚠ Insert the adapter card connected to the cable into the PCMCIA/PCIe slot on the left-hand side of the laptop. Double-check that the two screws on the connector are tight. See Figure 4: Inserting adapter card into laptop.

Figure 4: Inserting adapter card into laptop.

A successfully connected RapidScan instrument and laptop can be seen in Figure 5 below.

Figure 5: A successfully connected RapidScan instrument and laptop.

Connecting Power to the Instrument

Figure 6: RapidScan Instrument Power Connector

Insert the mains cable into the instrument as shown in Figure 6, and switch the instrument on using the power switch. Note that the cardbus adapter must be inserted properly before this step if the data capture electronics are to work properly.

If the button does not illuminate when switched, check the condition of the fuse. The fuse holder is located below the socket.

The equipment is able to run on 110V AC power or 220V AC power.

Filling Wheel Probe Tyre with Water

Ensure wheel probe tyre is filled with water. If the wheel probe has not been used since delivery, it will not contain water. To fill, remove both plastic bungs on the side of the wheel and use provided funnel to insert water until the tyre is full, see Figure 7.

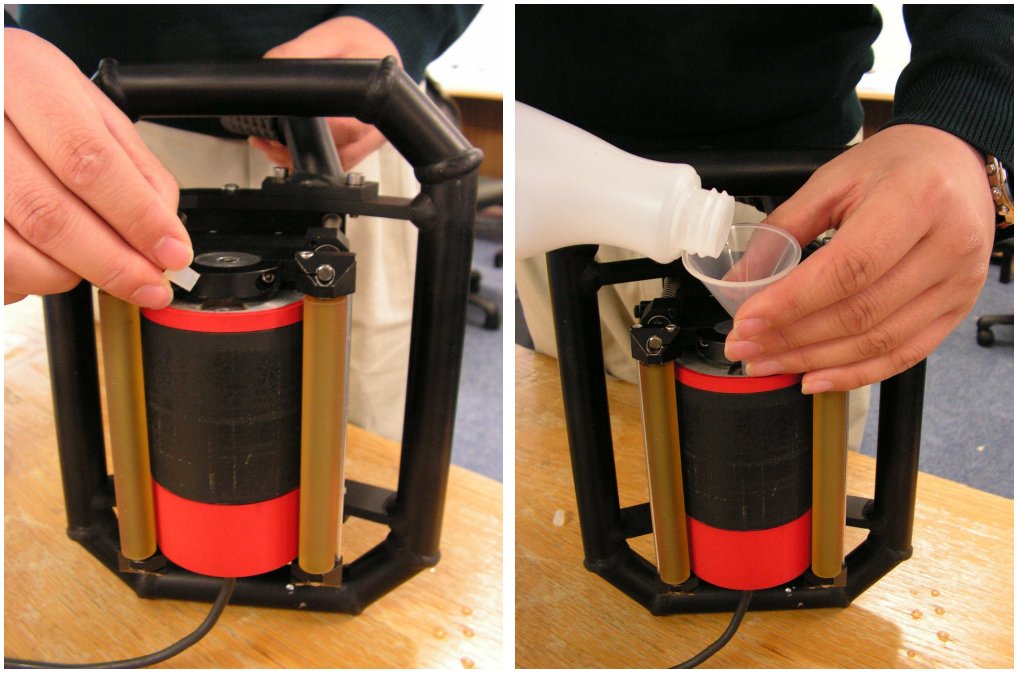

Figure 7: Filling Wheel Probe Tyre with Water

Connecting the Wheel Probe Ultrasonics

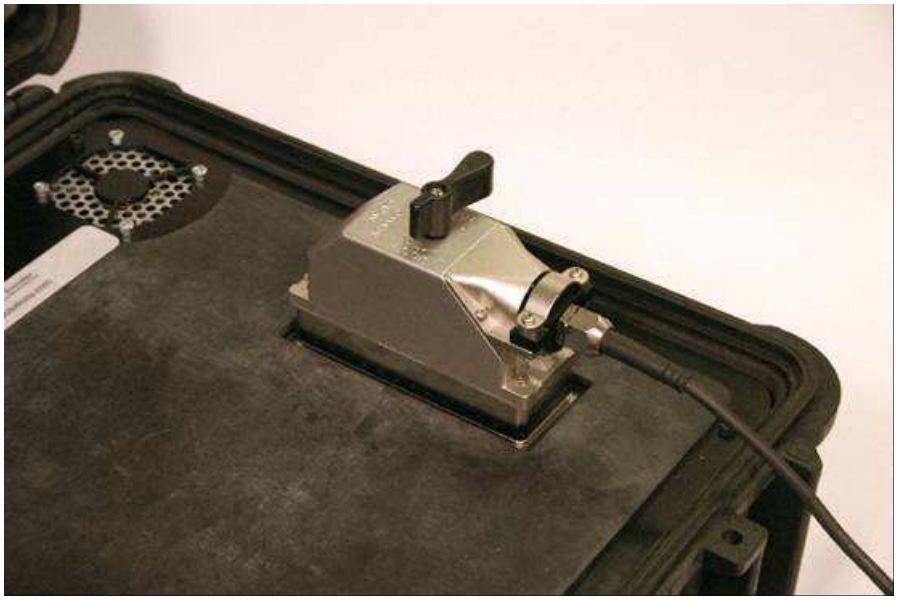

Figure 8: RapidScan3D Wheel Probe Connector

Connect the wheel probe to the instrument by plugging in the large multiway connector as shown in Figure 8. With the connector unplugged, turn the black handle on the connector to the open position and offer the connector up to the RapidScan2 unit. Little or no force should be required in order to do this. If the connector does not fit with zero force applied, check the condition of the connector terminal pins. With the connector in place, turn the handle to the lock position.

Connecting the FaroArm

USB Cable

The USB cable provides the positional information from the arm to the RS3D laptop. The cable is usually blue and has a standard USB connector on one end which connects to the laptop, see Figure 9.

Figure 9: FaroArm USB connector to laptop

Connect the other end of the cable to the arm as in Figure 10.

Figure 10: FaroArm USB-based connector arm

Sync Cable

The sync-cable provides synchronisation between the data-capture hardware within the instrument and the positional information provided by the arm.

The cable is usually black, or grey. Connect the larger end to the RapidScan3D instrument as in Figure 11.

Figure 11: RS3D sync cable connection for instrument

Connect the PS2 connector at the other end of the cable to the arm. See Figure 12.

Figure 12: RS3D sync cable connection for FaroArm

The choice of PS2 connector on the FaroArm is not ideal as it can become loose more easily than other connectors. If the system is not scanning as expected, check this connector is well-inserted.

Arm Battery

Ensure arm battery is connected to arm. See Figure 13.

Figure 13: FaroArm battery connection

Arm Power Cable

Ensure power cable for the arm is connected and the arm is switched on. A green light near the end of the arm should light up, although on some FaroArm models this may not occur. See Figure 14.

Figure 14: FaroArm power connection

Powering up the Laptop

Connect power to the laptop, and re-check that the cardbus adapter card is inserted properly in to the laptop.

Ensure that the RapidScan instrument is switched on. The laptop can now be switched on. Switching on the laptop before the instrument means that the communication between the laptop and

ultrasonic hardware will not work correctly and C-scan sessions cannot be started until the laptop is re-booted.

Log on using the **`Operator`** user account, no password is required.

Starting the Software

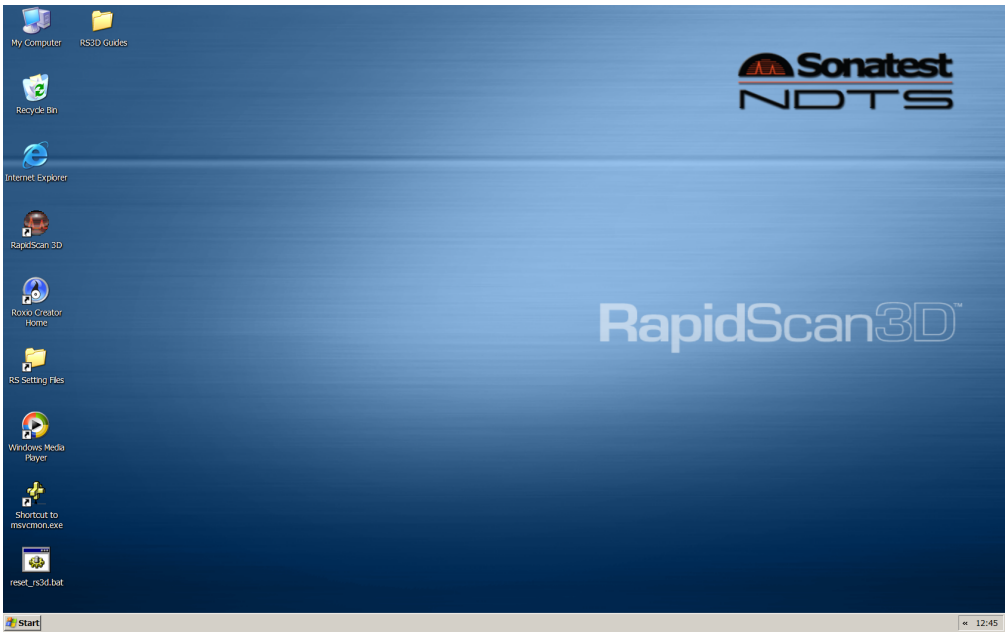

Figure 15: RapidScan Desktop Screenshot

Click on the **`Rapidscan 3D`** icon

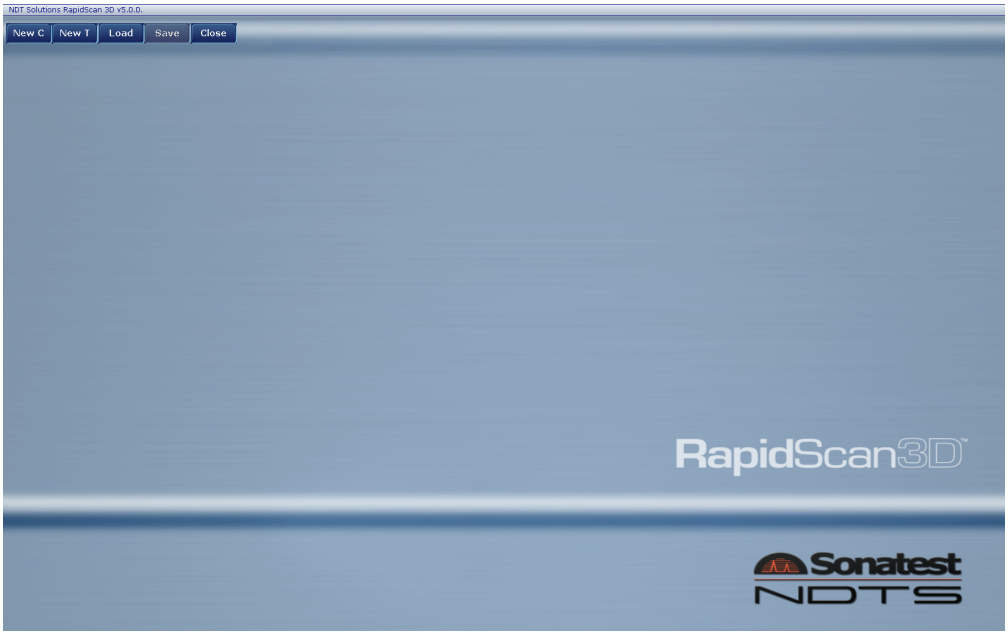

Figure 16: RapidScan Opening screen

Click on the **`New C`** button to start a new C-scan session.

Setting up FaroArm for First Use

Select **`Generate`** menu, see Figure 17: Generate menu selection.

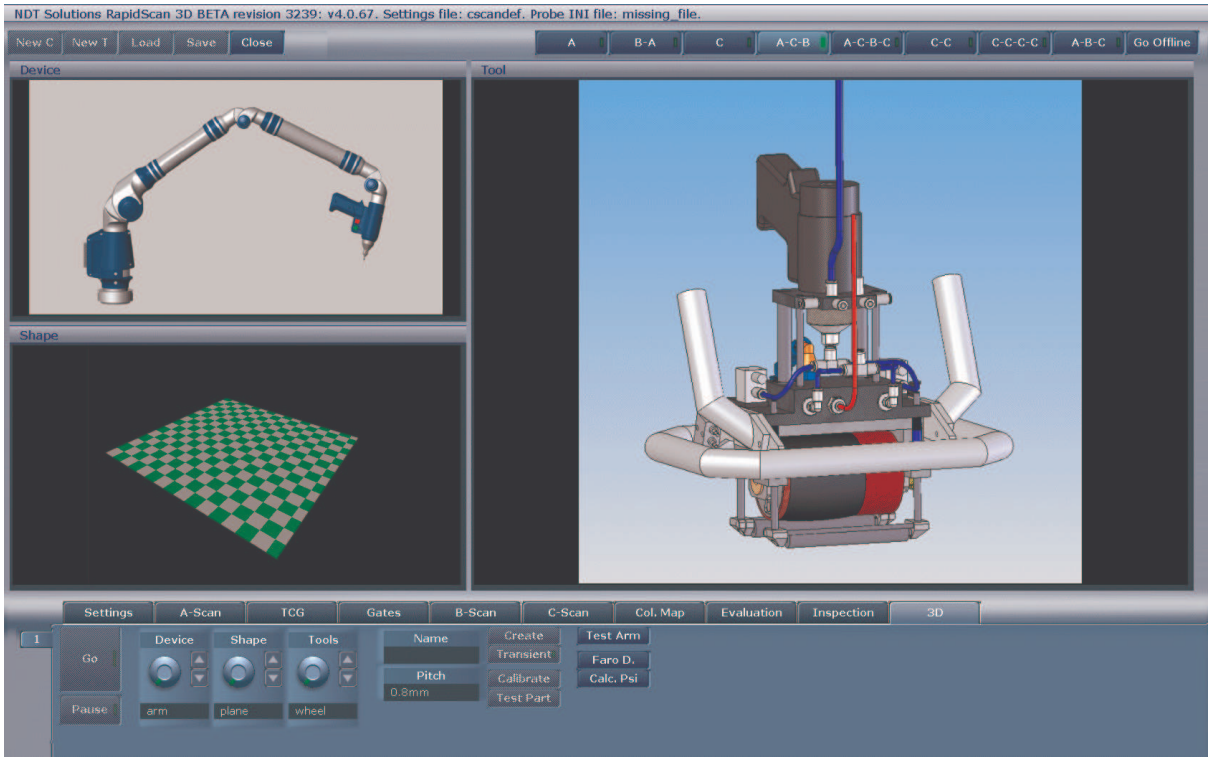

Figure 17: Generate menu selection

Select **`Faro Dlg,`** to display the Faro dialog. See Figure 18.

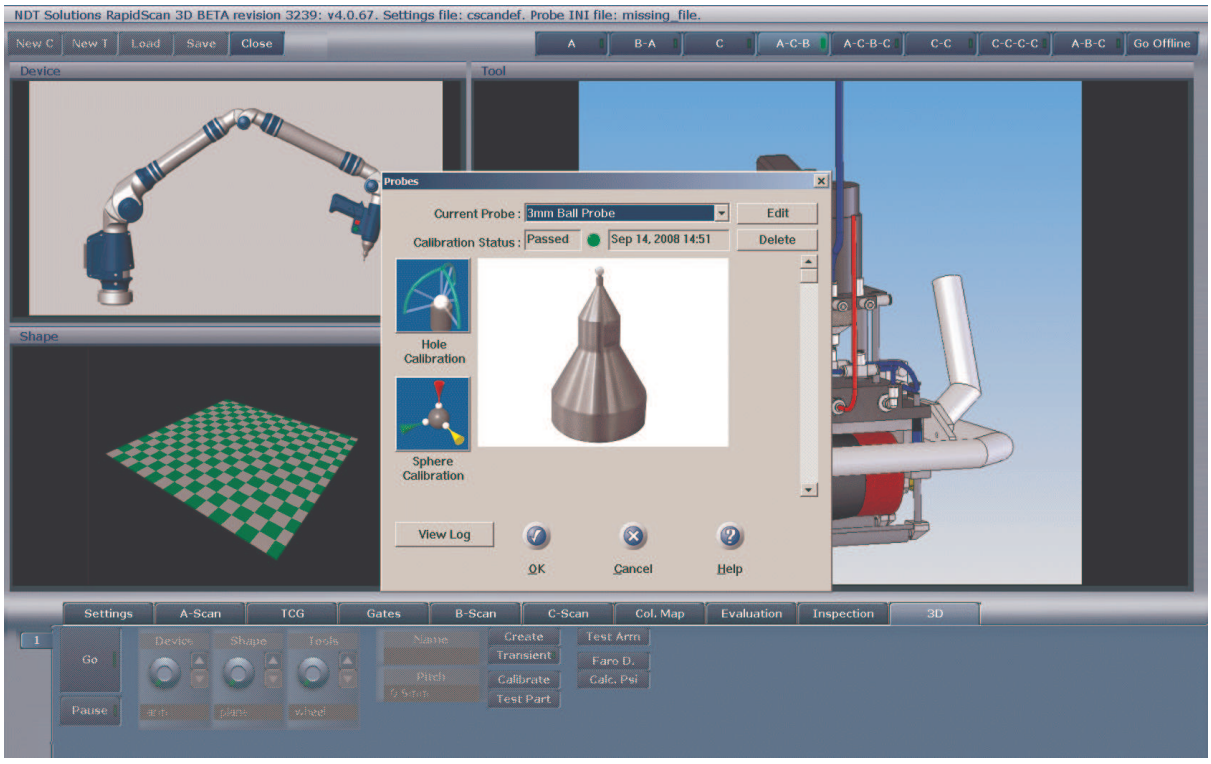

Figure 18: Faro Dialog

Selecting Correct Probe

Within the Faro dialog, check that **`Current Probe`** is set to **`3mm Ball Probe`** and **`Calibration Status`** is **`Passed`**: see Figure 19. If not, calibration is necessary after *Reference Encoders* stage. Attach the ball probe marked with *3mm* to the end of the FaroArm.

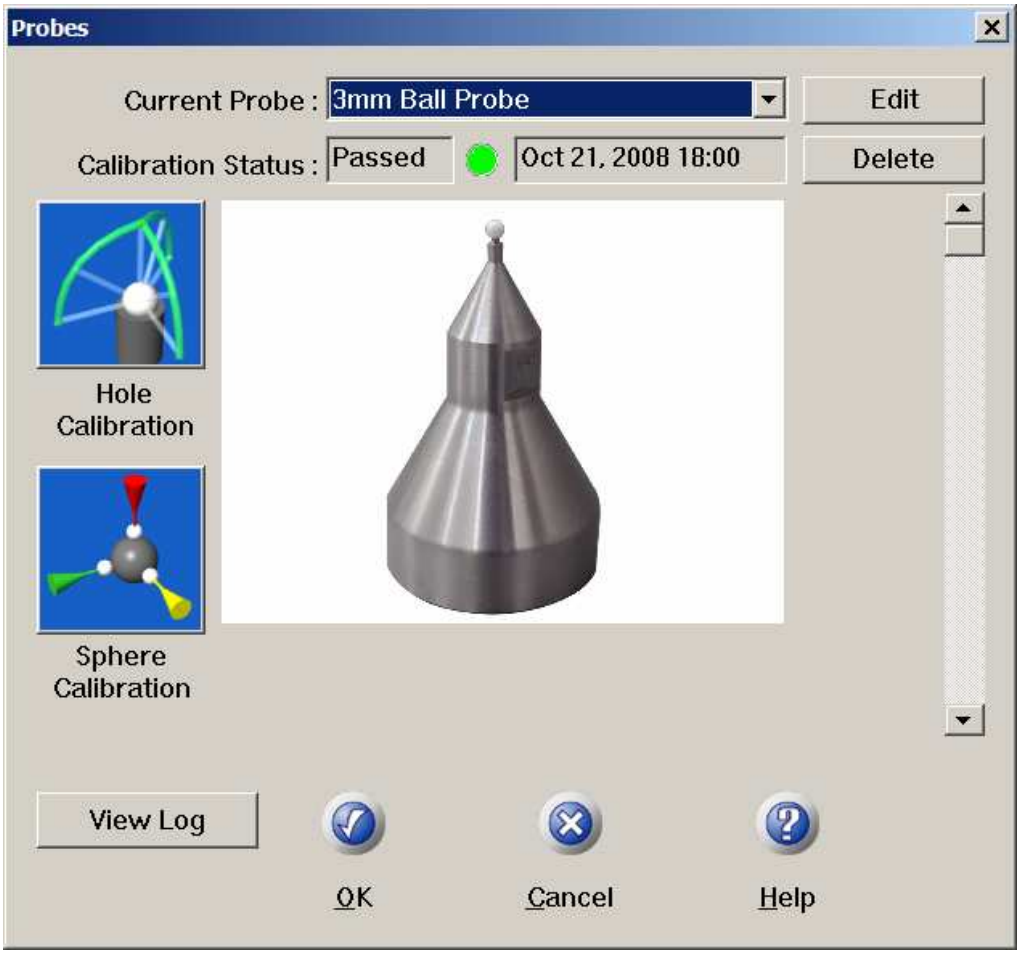

Figure 19: A successfully calibrated probe in the Faro dialog

Checking Probe Configuration

Select **Edit** within the Faro dialog to bring up the probe configuration dialog. See Figure 20: Probe Configuration dialog.

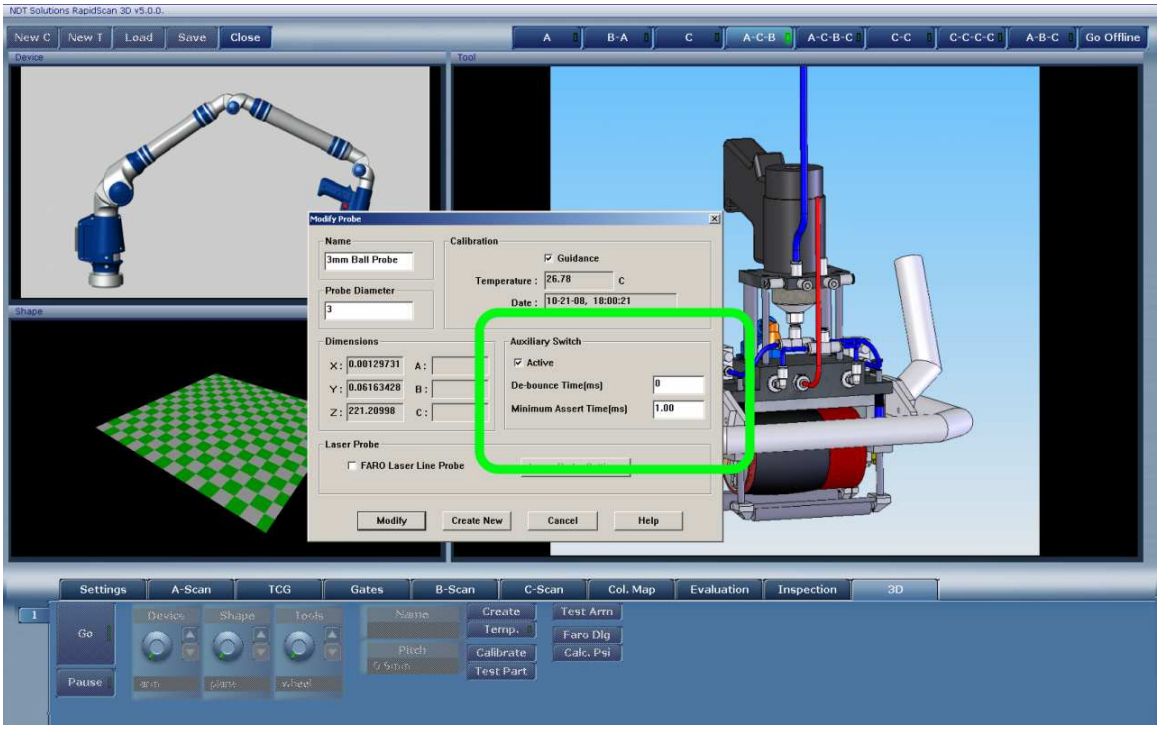

Figure 20: Probe Configuration dialog

Ensure that **Auxiliary Switch** checkbox is selected. Ensure **De-bounce Time** is zero and **Minimum Assert Time** is one as shown in Figure 21. Click **Modify**

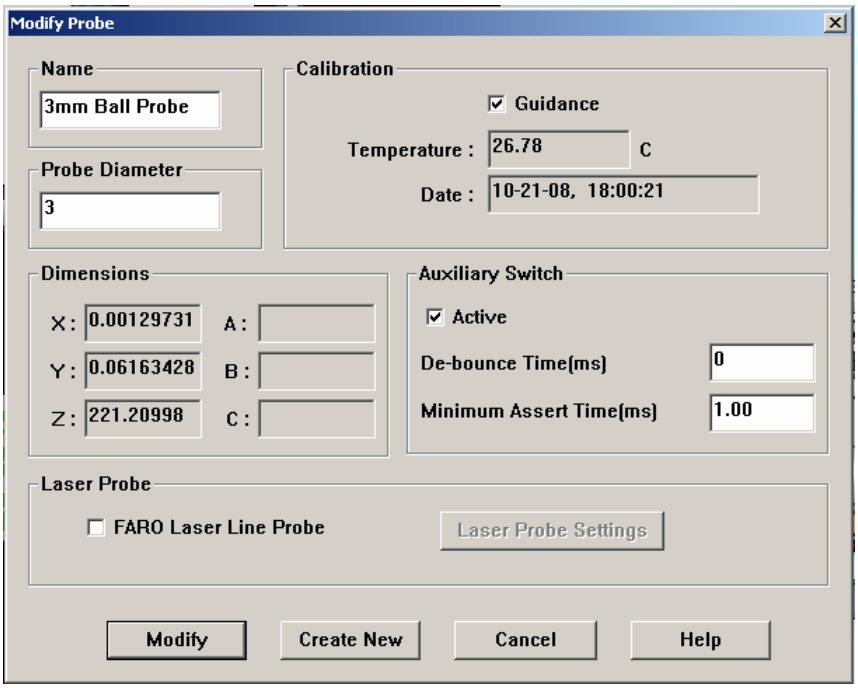

Figure 21: Parameters for a correctly configured Faro ball probe

Referencing the Encoders

The referencing of the arm encoders must be done once each time an arm is switched on. The method involves flexing and rotating each arm joint. The easiest way to ensure that this is done fully is via the **`Hole Calibration`** function in the Faro dialog. This is used even when a hole calibration is not necessary and, in which case, this function is cancelled before performing the full hole calibration procedure.

Select **`Hole Calibration`** button and look for a new picture of the arm with a number of red arrows shown on its joints, see Figure 22. If the arm encoders have already been referenced, this picture will not appear.

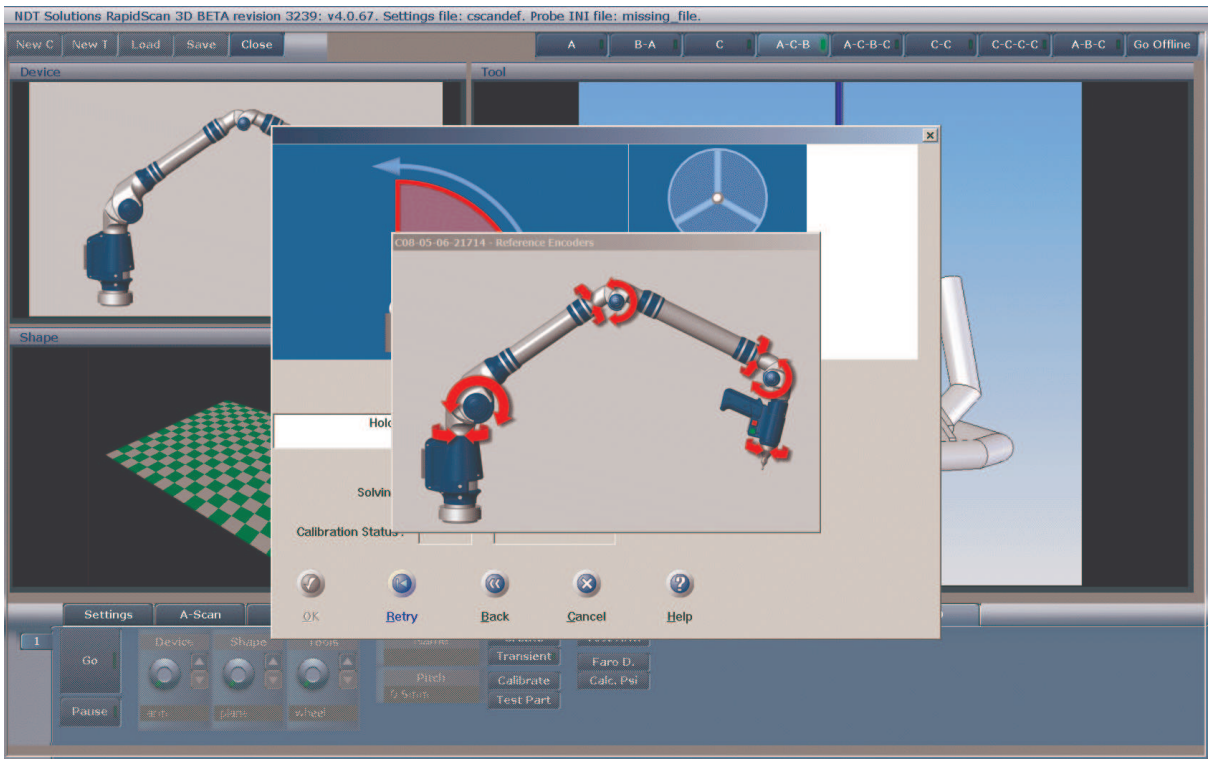

Figure 22: Arrows showing unreferenced arm encoders.

Flex and rotate arm until all joint arrows are exercised and the picture of the arm disappears.

If a calibration of the ball probe is not required (if it is described as **`Passed`**, see above) then click **`Cancel`** to return to the Faro dialog; click **`Cancel`** again as the arm is now ready to be used. Otherwise, perform a hole calibration.

Hole Calibration

The Faro dialog will now show the display seen in Figure 23: Faro dialog hole calibration.

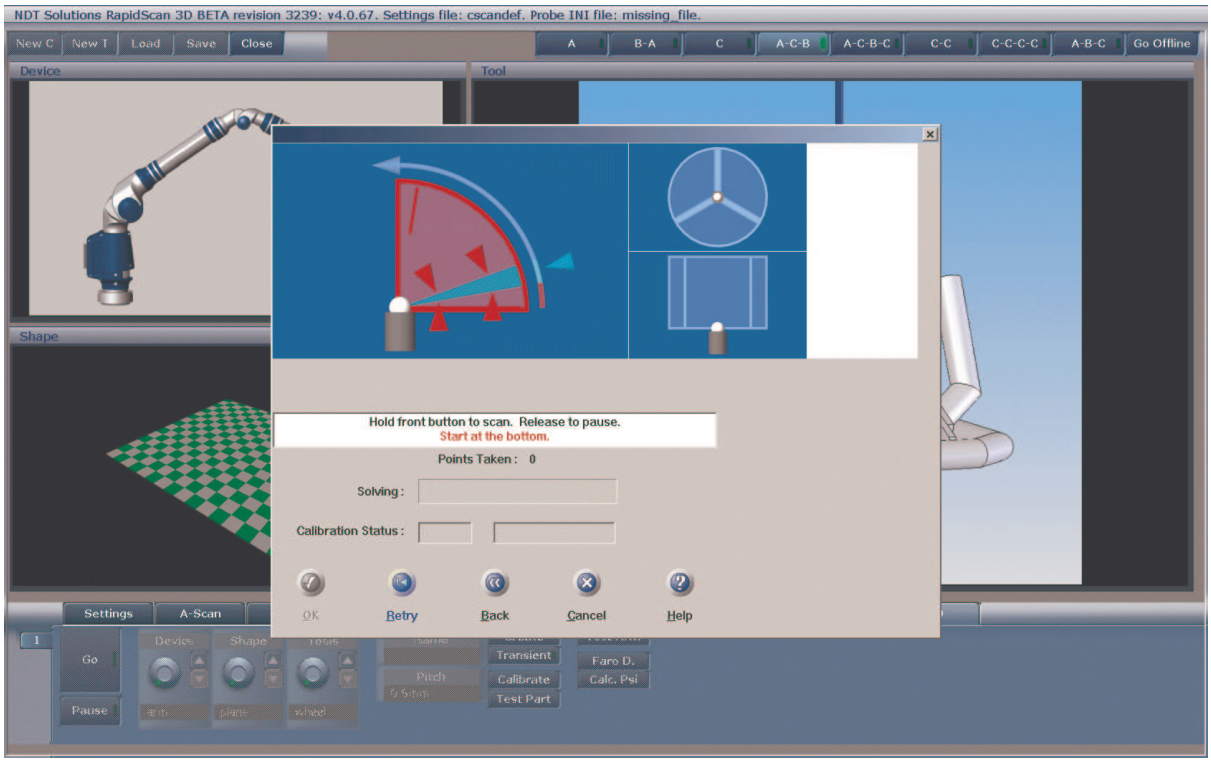

Figure 23: Faro dialog hole calibration

The calibration castle shown in Figure 24 should be clamped down to a firm surface around 50cm from the base of the arm.

Figure 24: The FaroArm Calibration Castle

The ball probe must be placed within the castle as shown in Figure 25.

Figure 25: First stage of hole calibration

The next stage is to keep the ball probe within the castle but bring the angle of the end of the arm down ninety degrees, see Figure 26: Point where points are collected for first stage of hole calibration.

Figure 26: Point where points are collected for first stage of hole calibration

Press and hold the green button on the arm and, while keeping the ball probe in the castle, rotate the end of the arm so that it is back to pointing vertically. See Figure 27 and Figure 28 for examples of this. See Figure 29: Hole calibration movement guides marked by green rectangle for the help provided by the Faro hole calibration dialog in keeping the movement of the probe acceptable.

Figure 27: Part way through collecting first set of points for hole calibration

Figure 28: Almost completed collecting first set of points for hole calibration

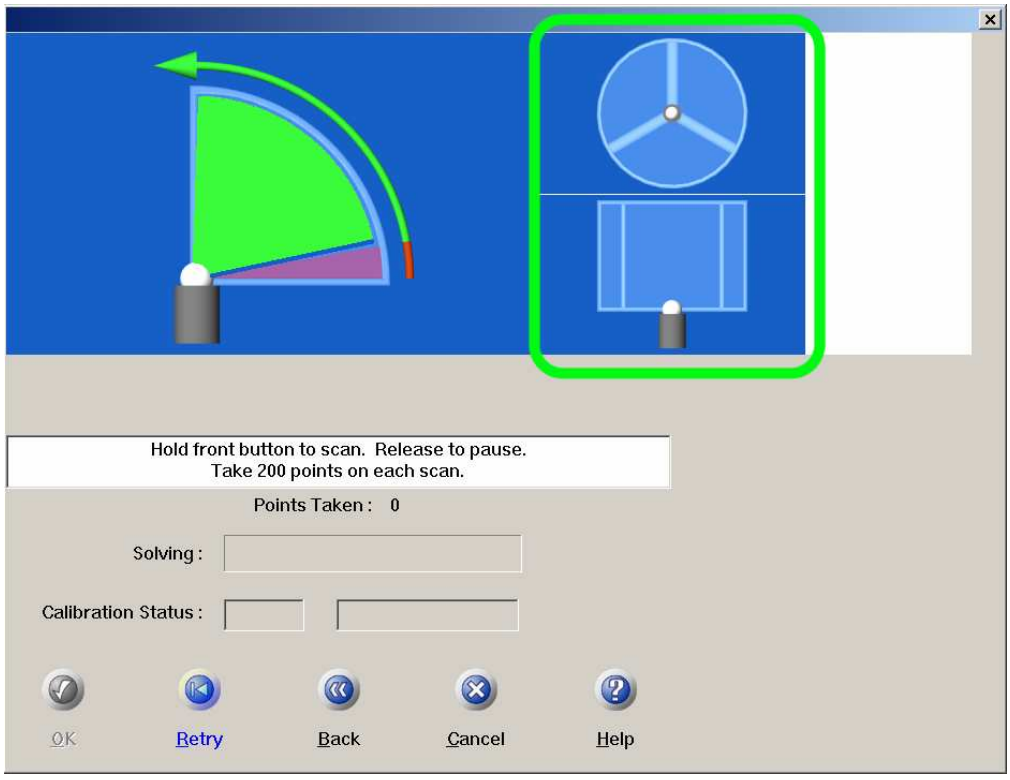

Figure 29: Hole calibration movement guides marked by green rectangle

The hole calibration guides will show the next two positions that points must be acquired in for a complete hole calibration. Keep the ball probe within the castle at all times to increase the chances of a successful calibration.

Once a calibration has been performed successfully, click **OK** to return to the Faro dialog and hit **OK** to return to the RapidScan 3D software.

Calculate Psi Zero-Angle

Remove the ball probe and fit the white zero-angle calibration cube shown in Figure 30 to the end of the arm. The ring which is usually screwed onto the arm below the ball probe can be used to hold the block in place.

Figure 30: White Zero-Angle Calibration Block

Select **`Calc .Psi`** within the **`Generate`** menu and follow on-screen instructions. The block should be flat on a surface with the handle of the arm pointing upwards. Click the green button to record the angle. The expected angle should be around zero. If the procedure produces a value of around 180 degrees, change the position of the block and repeat until a value close to zero is found.

Connecting Probe to Arm

Place end of arm through connecting hole on probe, matching the three markers so the arm (handle square to assembly) and probe click into place, see Figure 31. Screw metal collar onto end of arm until tight.

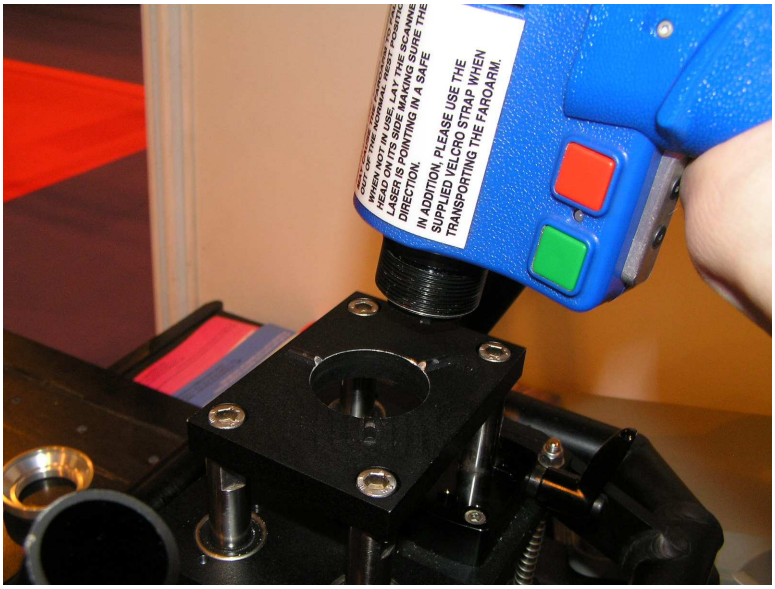

Figure 31: Connecting wheel-probe to FaroArm

Configuring the Geometric Settings

The geometry to be used for the inspection now needs to be specified using points selected by the FaroArm. For simplicity, these points can be collected with the wheel-probe attached to the arm; in this case, the position collected corresponds to the middle of the base of the black portion of the probe wheel.

Select the **Generate** menu, see Figure 32.

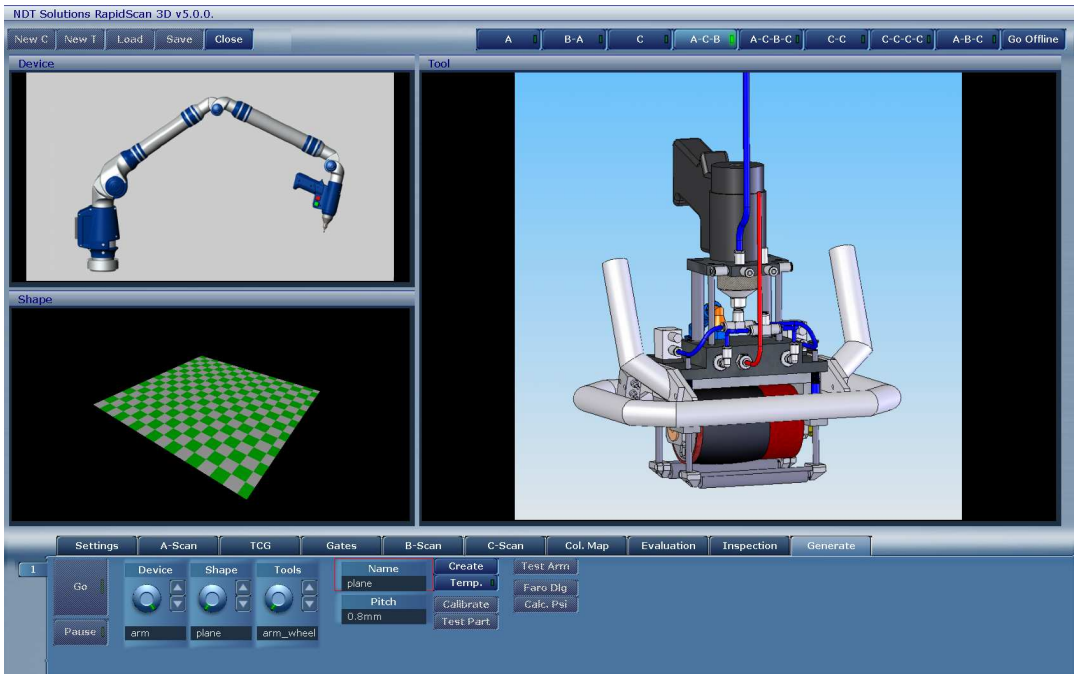

Figure 32: Generate Menu

Ensure **Device** is set to **arm**, **Shape** is set the **plane**, **Tool** is set to **arm_wheel**. If a curved object is to be scanned, choose a cylinder or sphere based stock-shape class. Enter a name for the inspection in the **Name** box and hit return. Enter an alternative pitch in the **Pitch** box if desired and hit return (common choices would be 0.8, 1.2, or 1.6mm. Higher values trade-off scan resolution with scan area.) Hit the **Create** button to start the geometry calibration procedure.

Geometry Setup

Calibrating the Stock-Shape

Follow the on-screen prompts to calibrate the stock-shape geometry by selecting points using the FaroArm, as shown in the first three images of Figure 33.

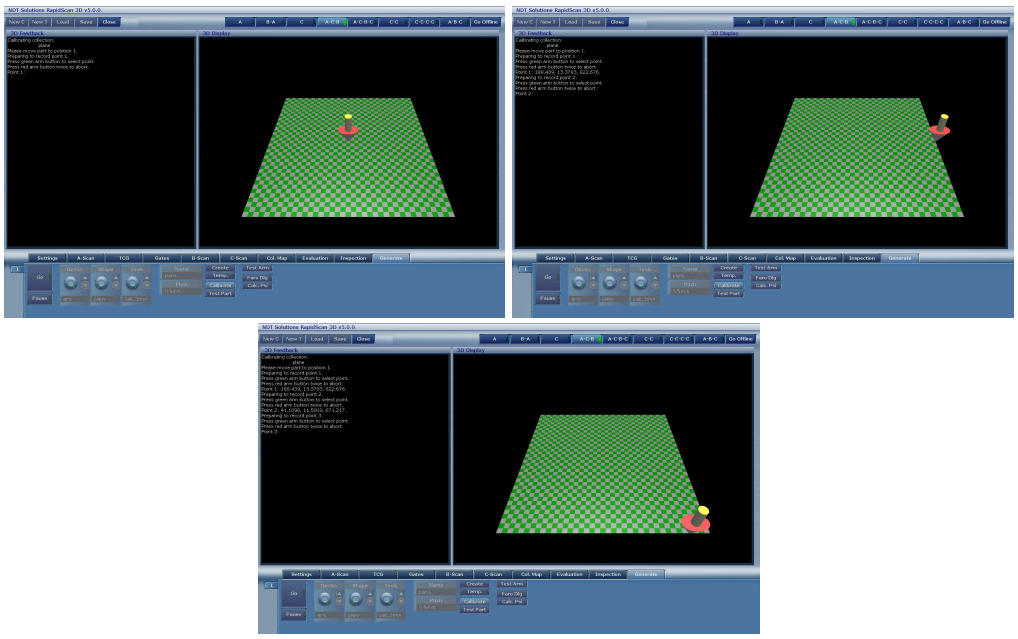

Figure 33: Calibrating the Plane Stock-Shape

Testing the Stock-Shape Calibration

Select **`Test Part`** and ensure the **`Current distance`** and **`Current angle`** measurements are small across the area to be scanned. The distances should be less than 5-10mm and the angles should be less than 5-10 degrees. See Figure 34.

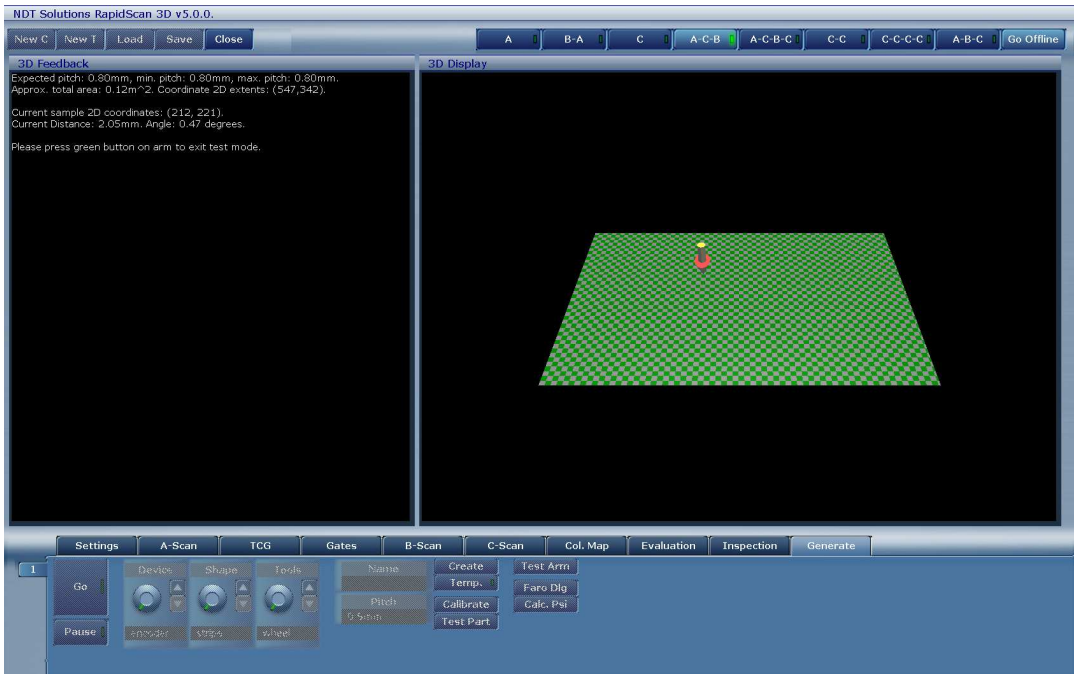

Figure 34: Testing the Stock-Shape Calibration

Configuring the Ultrasonic Settings

Probe and Scan Setup

The settings for the probe and ultrasonic hardware now need to be initialised.

Array Settings

Select the **Settings** menu, then choose sub-menu two by clicking on the number **2** below and to the left, see Figure 35.

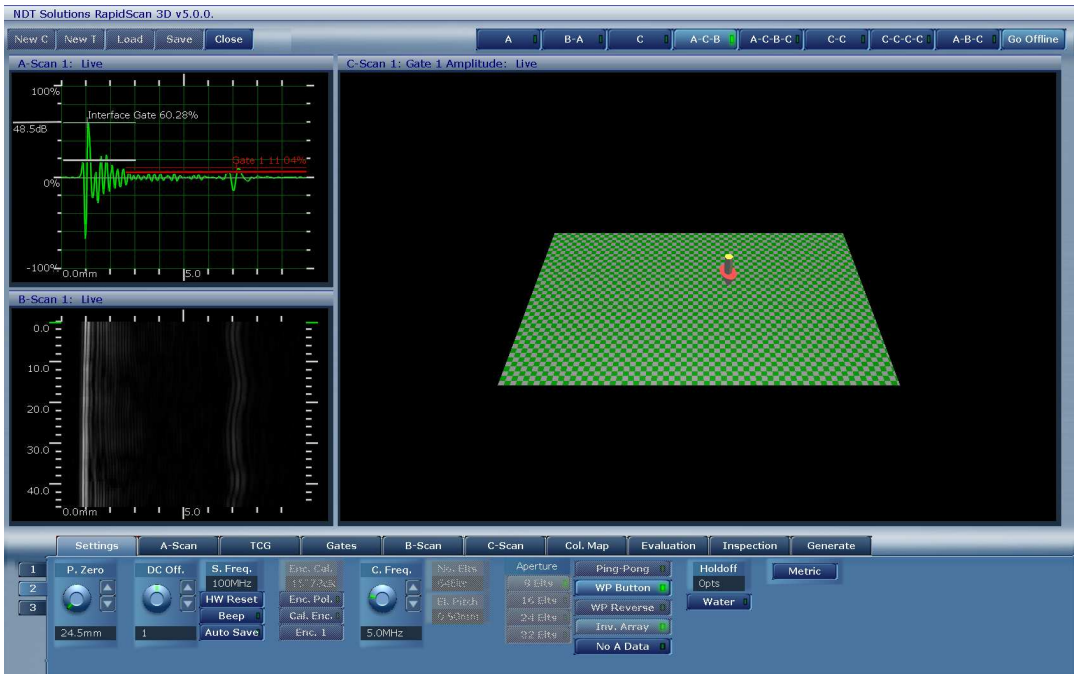

Figure 35: Settings Sub-Menu 2

Press the wheel-probe onto the part firmly as it would be held during scanning. Adjust the **P.Zero** (probe zero) control so that the interface echo is entirely within the A-scan and begins approximately 1mm from the start of the trace, see Figure 35.

P.Zero should be approximately 25mm for the arm wheel-probe.

Adjust **C.Freq.** (probe array frequency) to match the probe (typically 2.25MHz , 5MHz, 11.5MHz.) This is 5MHz for the standard arm wheel-probe.

Material Settings

Select the **A-Scan** menu, see Figure 36.

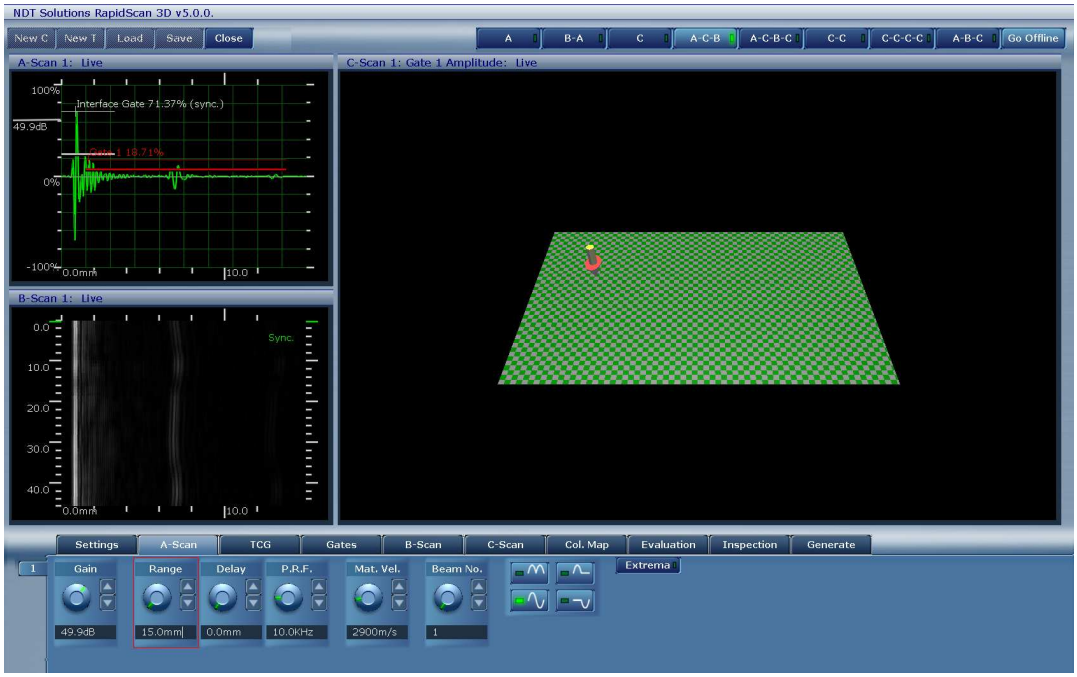

Figure 36: A-Scan Menu

Set the **Gain** dial so that the interface echo is approximately 80% of FSH (full-screen height.)

Set **Mat.Vel.** (material velocity) to match component; typically 2900m/s for composite, 5920 for steel.

Set **Range** to component thickness plus 30-50% (e.g. 11-12mm for an 8 mm sample)

Set **PRF** to 10khz for samples under 5-10mm, 5kHz for anything thicker.

The A-scan shown in Figure 36 demonstrates RapidScan 2 configured with these settings.

Time-Corrected Gain Settings

If the amplitude of the backwall echo is significantly lower than the interface, then TCG may be applied to increase the gain according to depth into the sample.

Select the **TCG** menu, see Figure 37.

Select the **Log.** and **Interface** buttons.

Adjust the **Gradient** dial until the backwall echo is a similar height to the interface echo as in Figure 37.

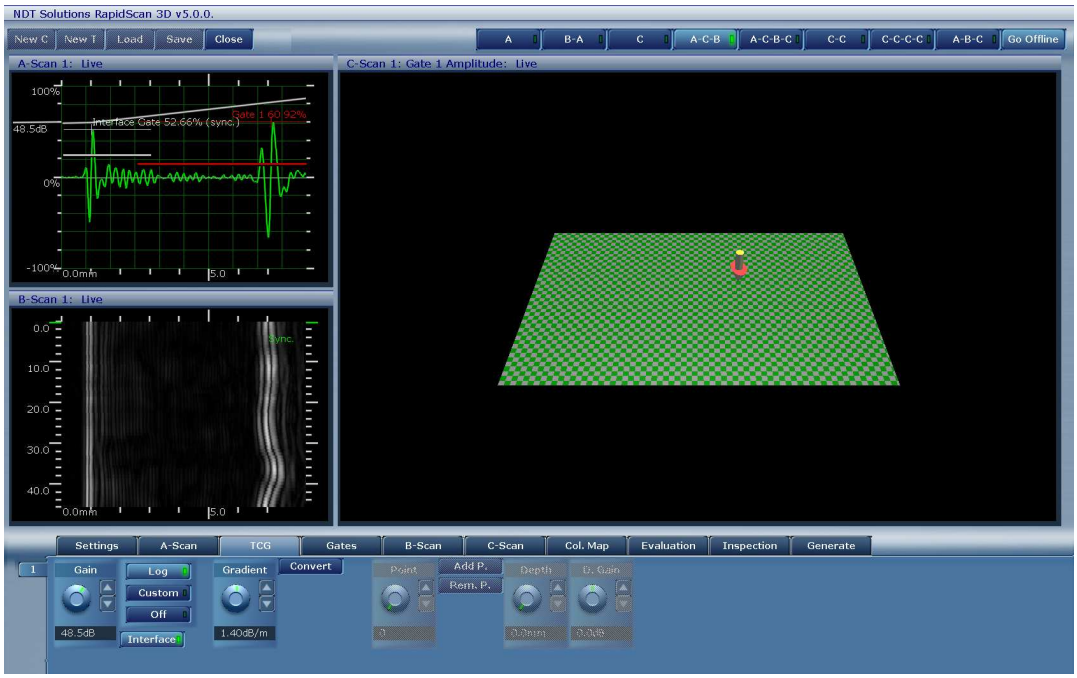

Figure 37: TCG Menu

Gate Settings

Select the **Gates** menu.

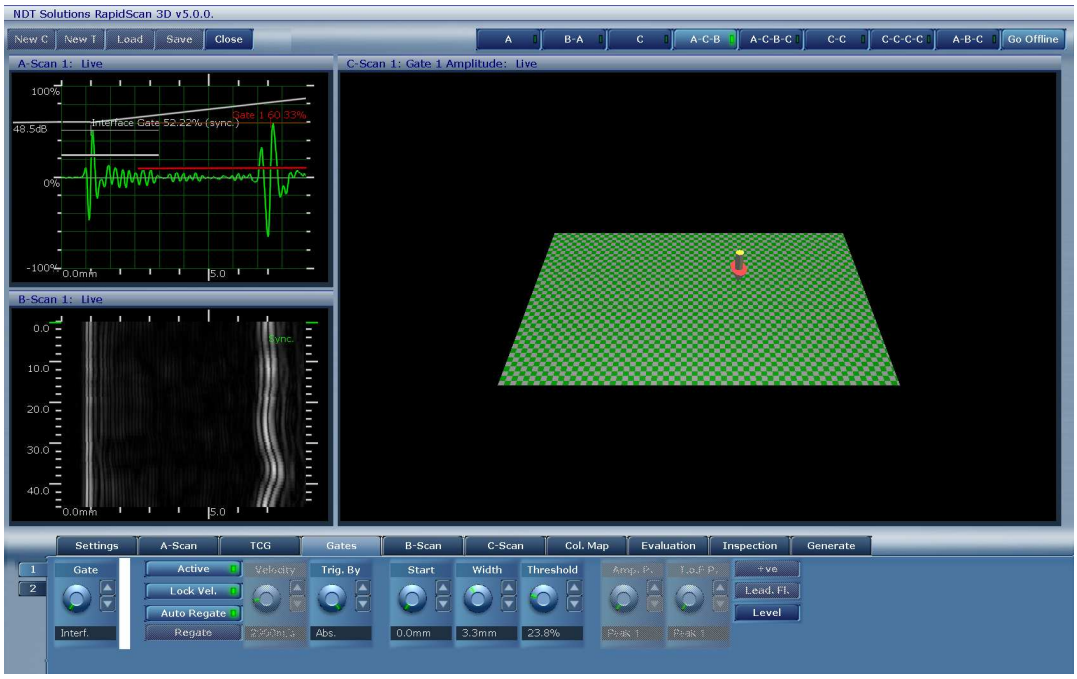

Figure 38: Gates Sub-Menu 1

Interface Gate

Select the **Interf.** gate on the **Gate** control (white gate.) See Figure 38.

Check that **Active**, **Lock Vel.** and **Auto Regate** buttons are activated.

Set **Start**, **Width** and **Threshold** dial controls so that the interface gate covers the entire interface echo cleanly (above low level artefacts.)

The mouse can also be used to position the gate; drag the beginning of the gate drawn on the A-scan left or right to set the **Start**, drag the end left or right to set the **Width** and drag the middle up or down to set the **Threshold**.

Measurement Gate

Select **Gate 1** (red gate) using the mouse or dial control.

Set **Trig-by** dial to **Interf.**

Set **Start** to beyond the end of the interface echo. The interface and gate 1 are allowed to overlap.

Set **Width** long enough to break backwall echo and extend beyond almost to the length of the A-scan.

Set **Threshold** to about 5% FSH (full-screen height.) See Figure 38.

Performing a C Scan

Setting the View Layout

Select the **C-C-C-C** view on the top of the screen to view multiple C-scans during scanning or select **A-C-B** view to see a single C-scan as well as the A and B-scans during scanning.

Select the **C-Scan** menu., see Figure 39.

Select **C-1**, and set **Gate No.** to **Gate 1**, select **Amp.** set **Rel. To** to **Abs**. , select **3D**. Select **C-3** to match these settings but choose **2D** instead.

Select **C-2**, and set **Gate No.** to **Gate 1**, select **ToF.** set **Rel. To** to **Interface**, select **3D**.

Select **C-4** to match these settings but choose **2D** instead.

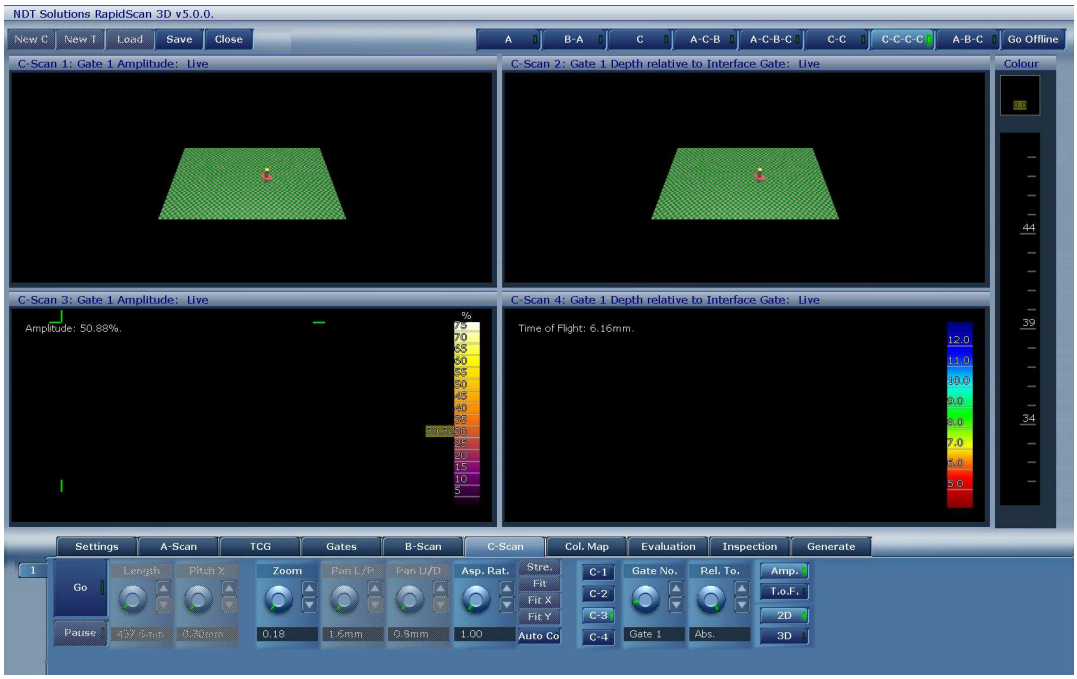

Figure 39: C-C-C-C View (before scan)

Recording and Evaluating Scan Data

Ensure that the area of the sample to be scanned has a thin film of water applied using the water spray bottle provided.

Hit the **Go** button and provide firm pressure downwards and forwards to the wheel probe to scan the sample. The stripes can be collected at any orientation.

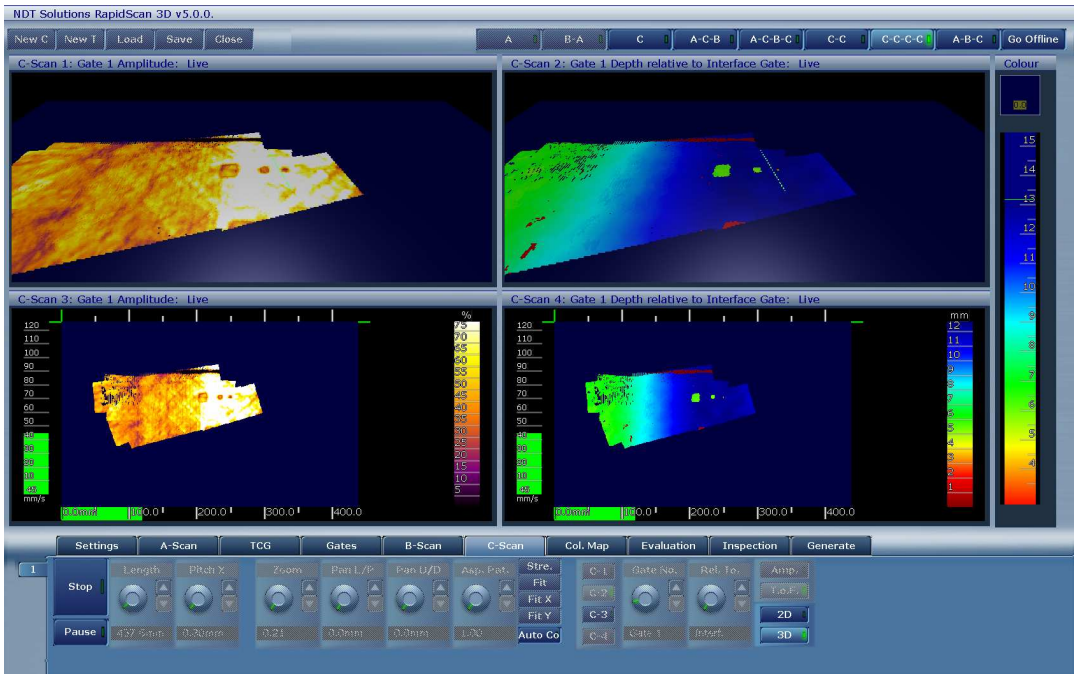

Figure 40: C-C-C-C View (during scanning)

Figure 40 shows an example of the display of the RapidScan 3D system during scanning. Press **Stop** to finish the scan.

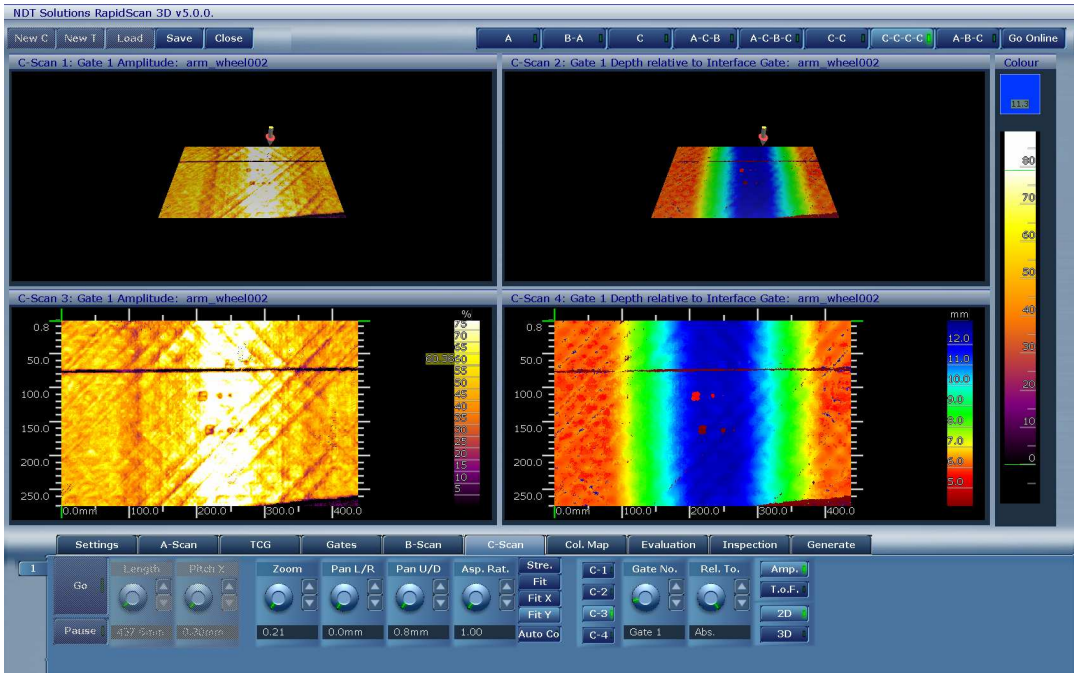

Figure 41: C-C-C-C View (after scan)

Depending on the view layout and sample chosen, the result of the scan will look similar to Figure 41 or Figure 42.

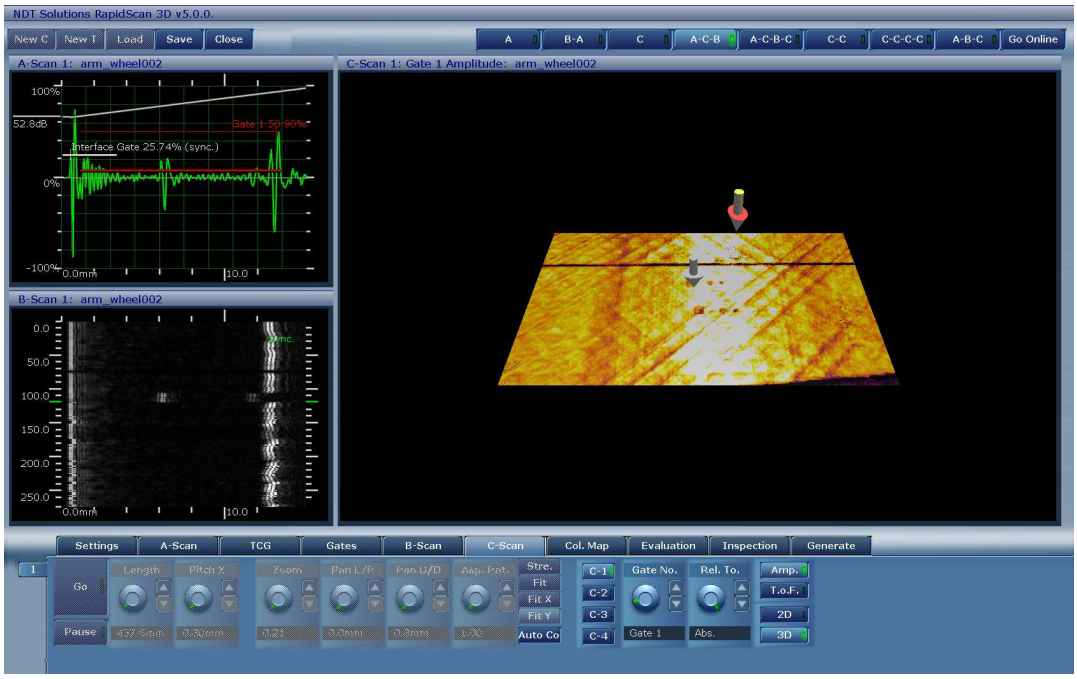

Figure 42: A-C-B View (after scan)

Select **A-C-B** view and drag the mouse cursor on the 2D or 3D C-scan using the right button to evaluate A-scans and B-scans at different positions on the sample.

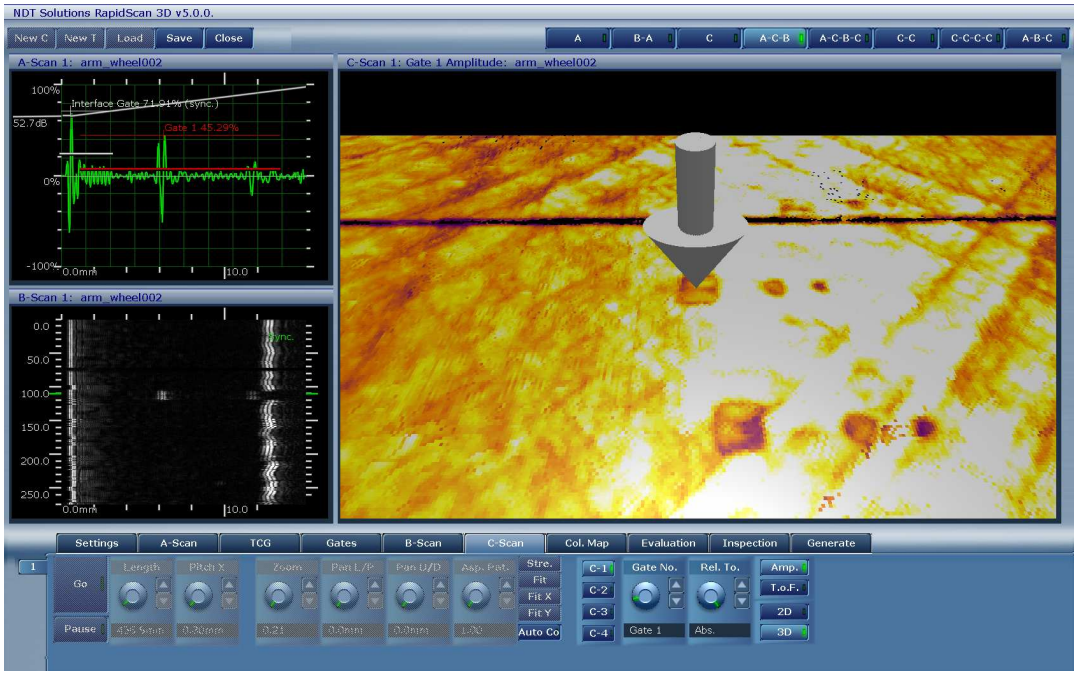

Figure 43: Inspecting A and B-Scans in 3D

Double click with the left mouse button to inspect a region of the part. The grey arrow shows the currently selected A-scan, see Figure 43.

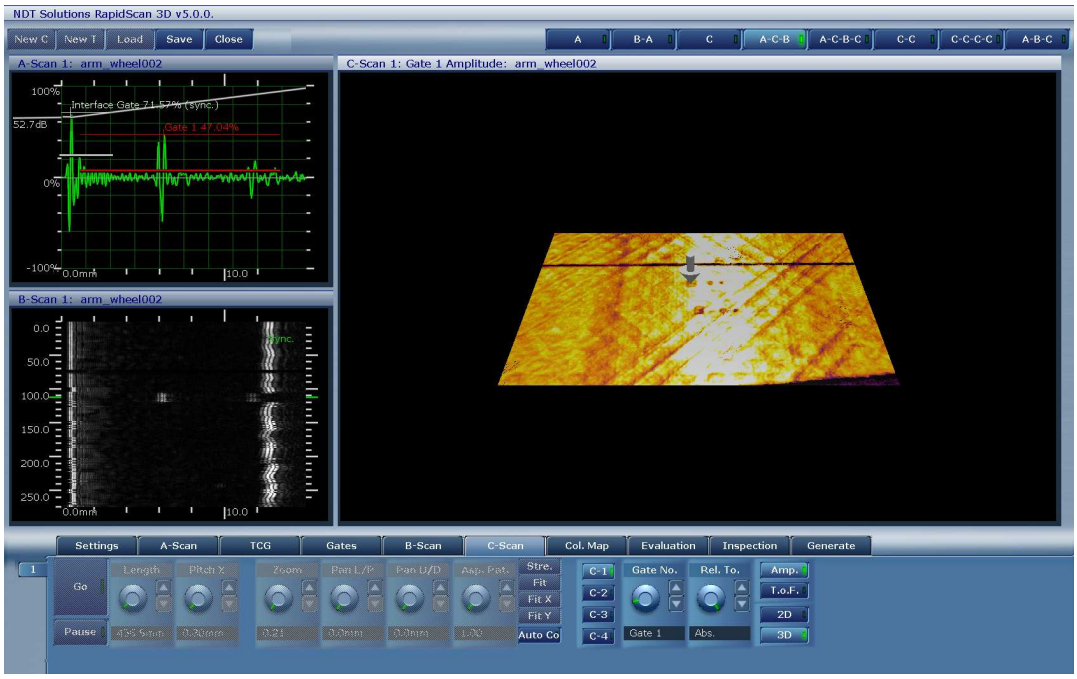

Figure 44: Inspecting A and B-Scans in 3D (reset view)

Double right click with the mouse to reset the view, see Figure 44.

A-scans can also be selected after the scan using the FaroArm. Attach the 3mm ball-probe and click on the part using the green arm button. Click with the red button to inspect regions of the part.

Setting up the Scan Colour-Map

Select **C-2** to view the depth C-scan, note the range of the colour-map may not be configured to match the depth of the sample.

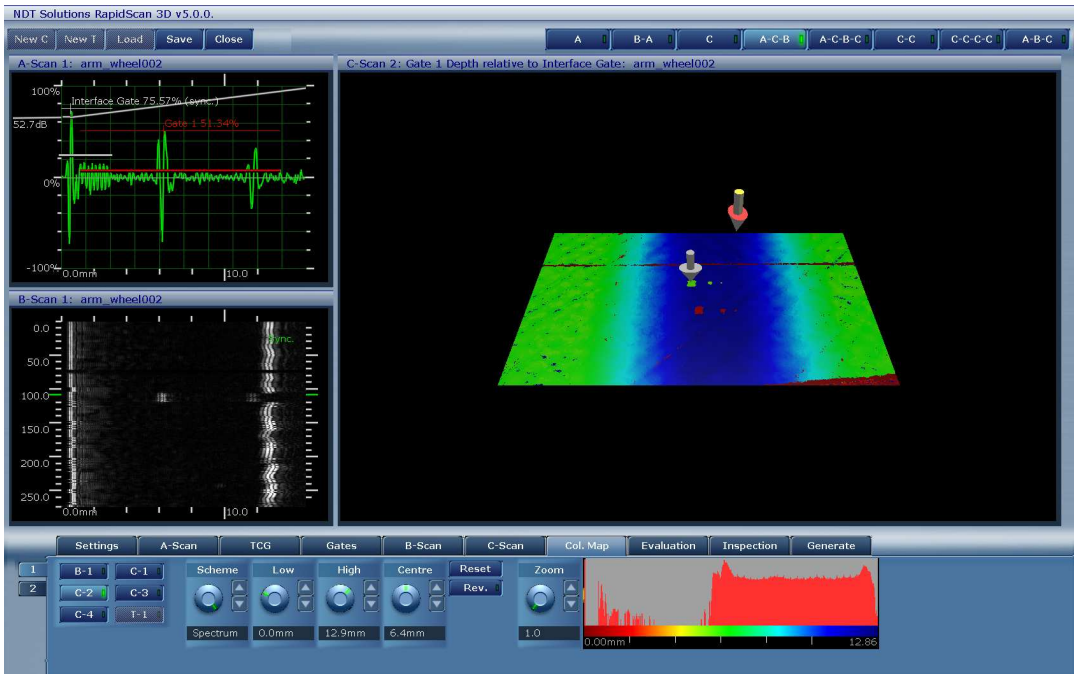

Figure 45: A-C-B Depth View (before colour-map adjustment)

Click **Col-Map** menu. Select **C-2** and change the **Low** value to match the data collected, see Figure 45.

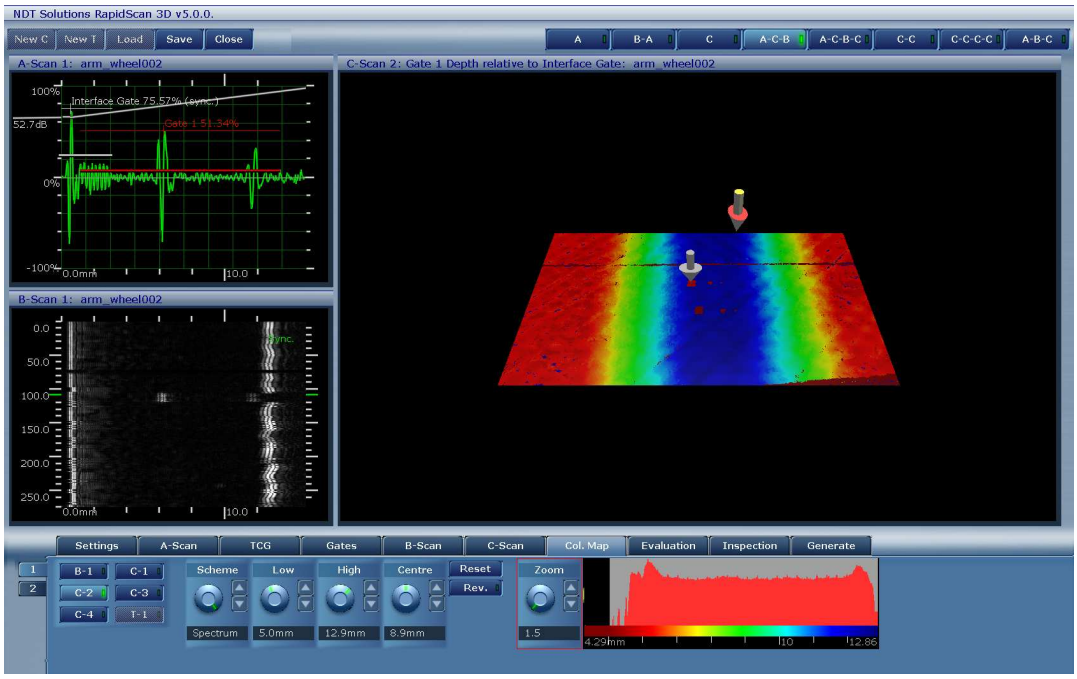

Figure 46: A-C-B Depth View (after colour-map adjustment)

Saving Image Data

Select an A-scan, click on the A-scan window and hit Ctrl-I to save an image of the current A-scan.

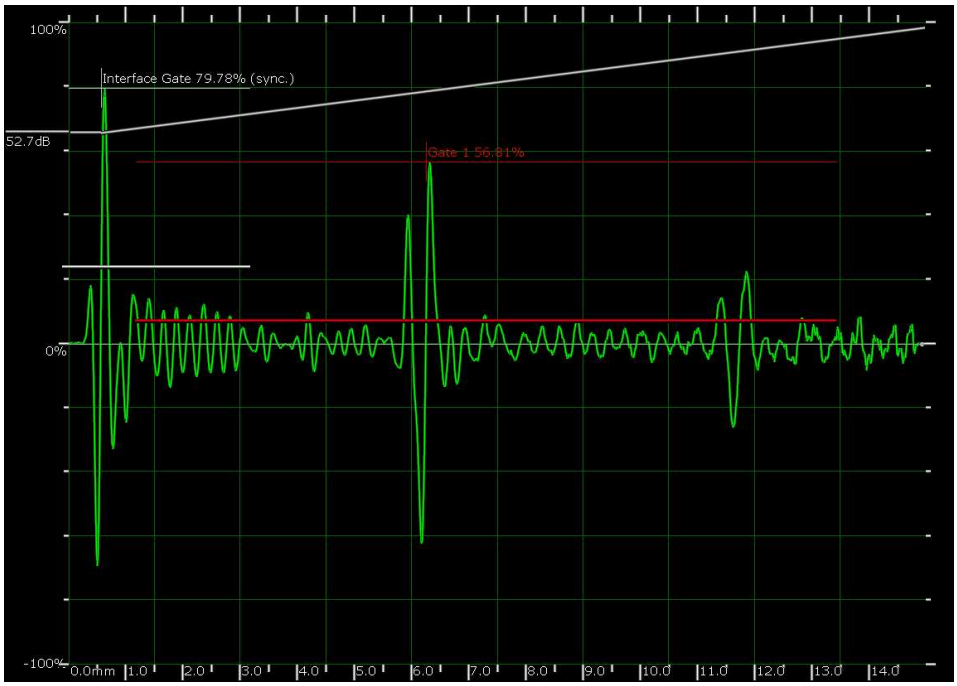

Figure 47: A-Scan Image File from Ctrl-I

Select a B-scan, click on the B-scan window and hit Ctrl-I to save an image of the current B-scan.

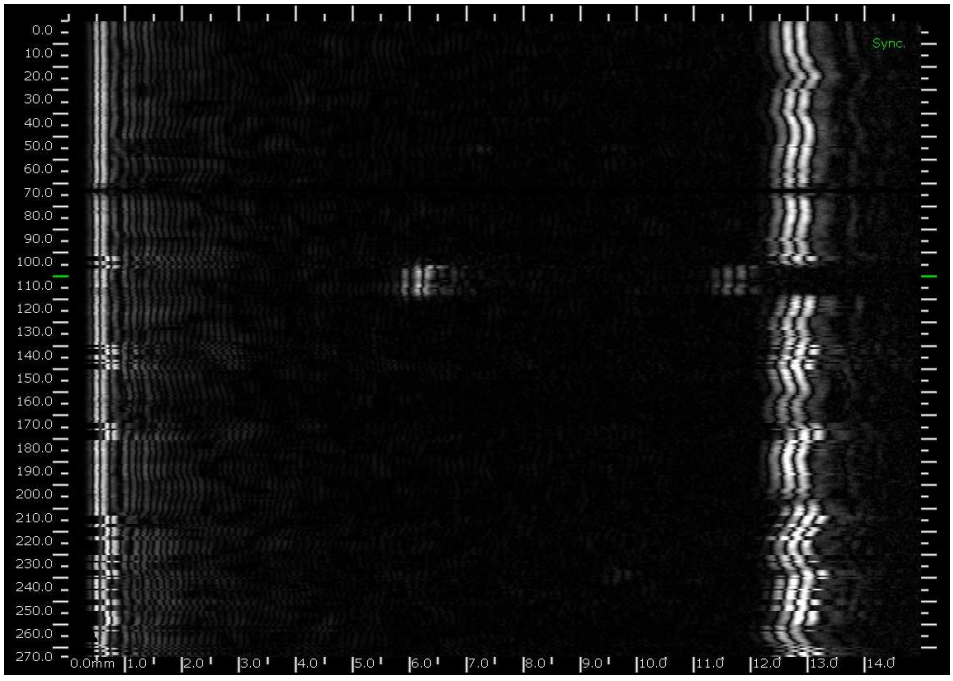

Figure 48: B-Scan Image File from Ctrl-I

Select a 2D view of a C-scan, click on the C-scan window and hit Ctrl-Shift-I to save an image of the current C-scan without scale and defect drawings, with 1-1 pixel-samples. See Figure 49 for an example of the contents of this image file.

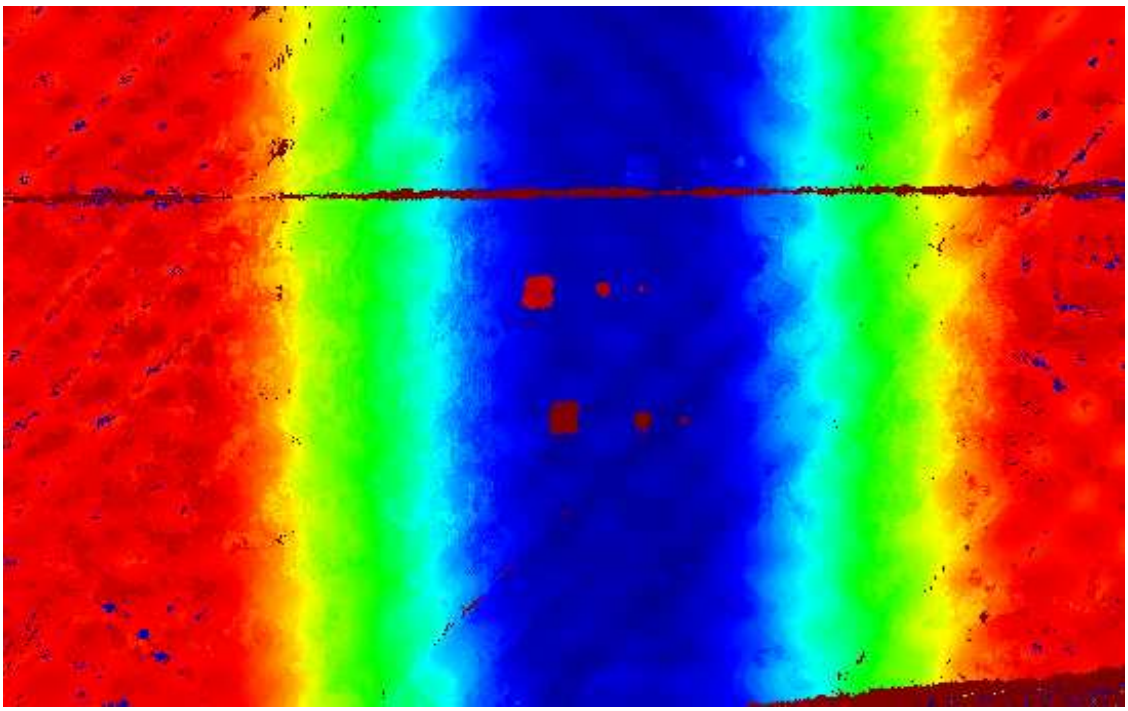

Figure 49: 2D C-Scan Image File from Ctrl-Shift-I

Select a 3D view of a C-scan, click on the C-scan window and hit Ctrl-Shift-I to save an image of the current 3D rendering of the C-scan and geometry data. See Figure 50.

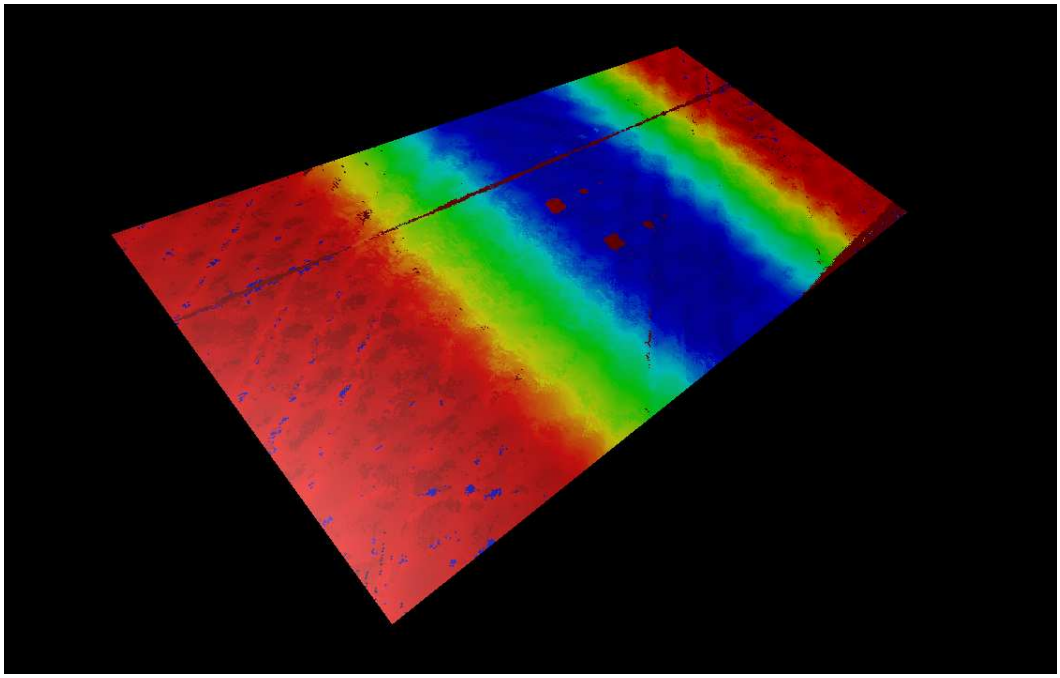

Figure 50: 3D C-Scan Image File from Ctrl-Shift-I

Select a C-scan, click on the C-scan window and hit Ctrl -I to save an image of the current C-scan with scale and defect drawings, scaled to 1-1 physical size. See Figure 51 for an example of the contents of this image file.

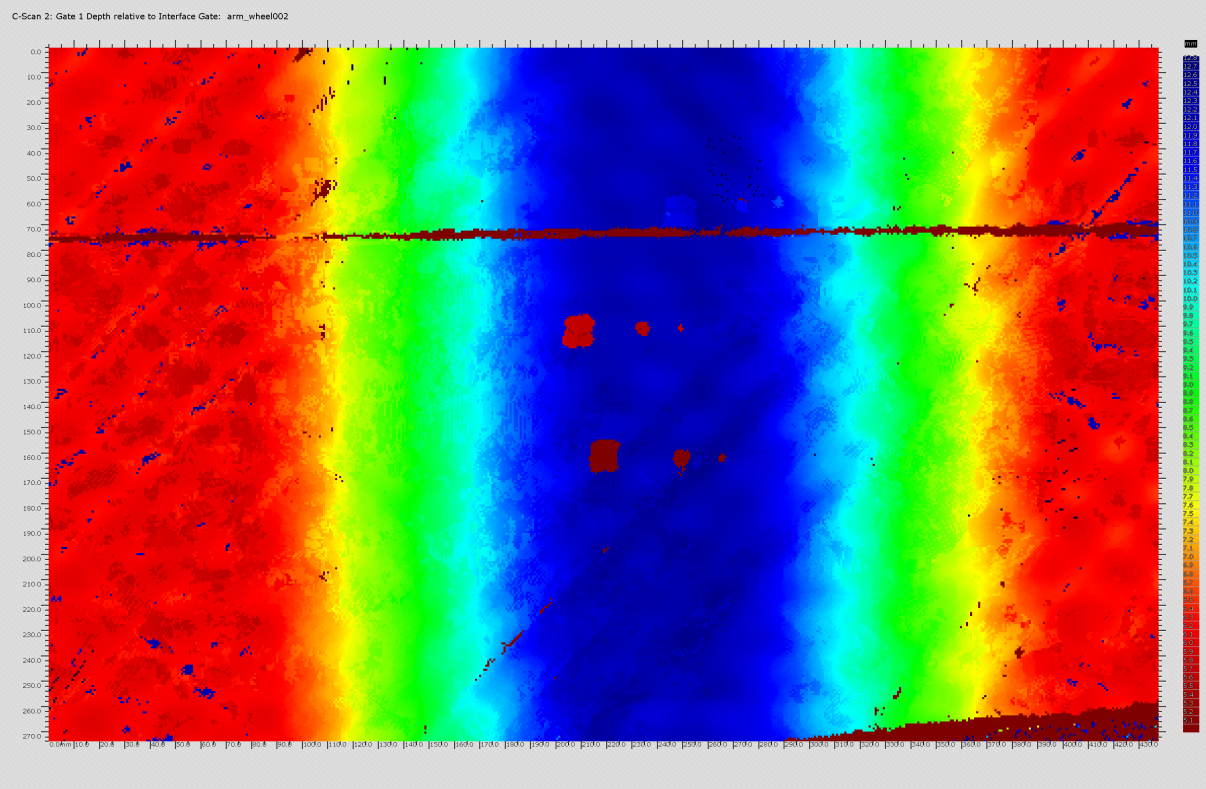

Figure 51: C-Scan Image File from Ctrl-I

Evaluating Distances and Areas

Select **`Evaluation`** menu.

Select **`Linear`** and click and drag on the 3D or 2D C-scan to measure a distance.

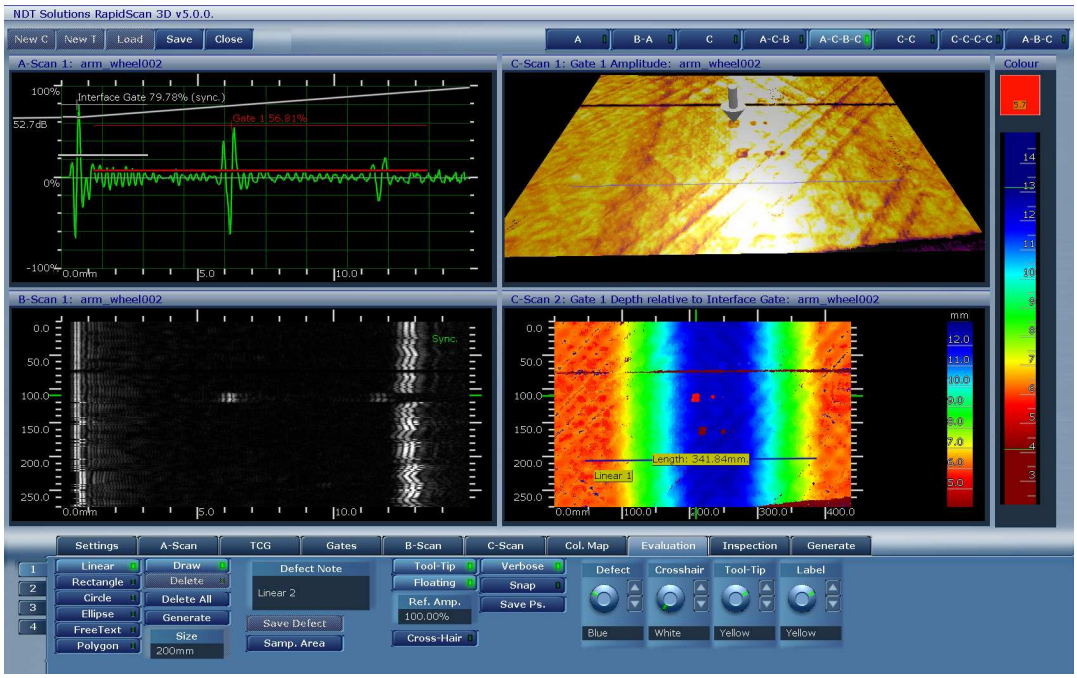

Figure 52: Evaluating Distances using Linear Tool

Select **`Rectangle`** and click and drag on the C-scan to measure an area.

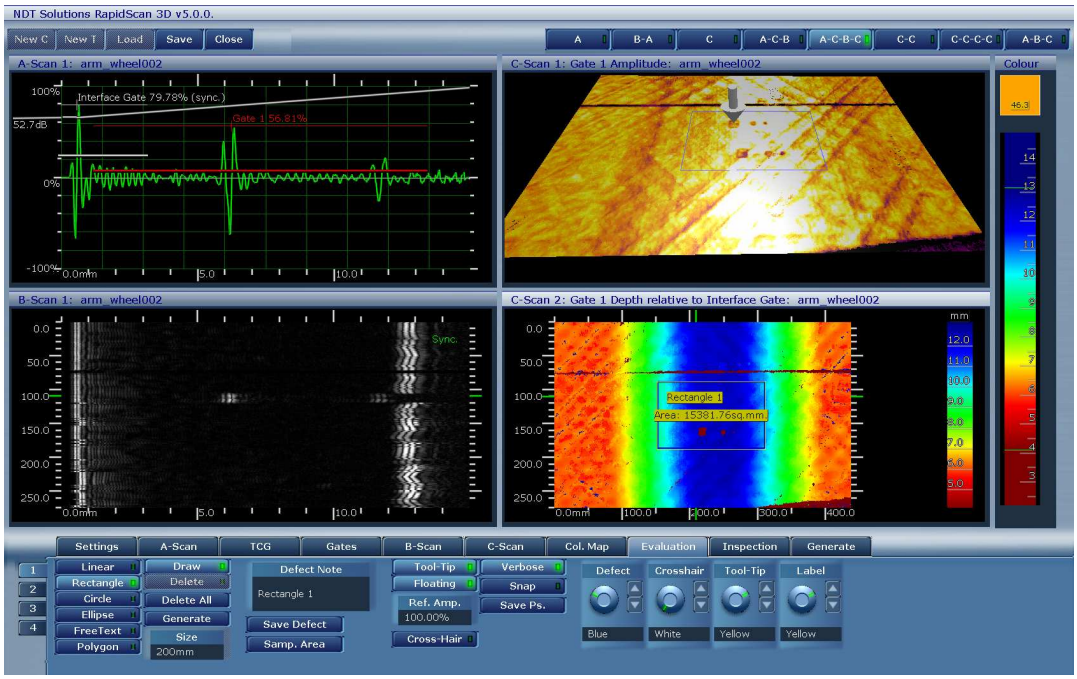

Figure 53: Evaluating Areas using Rectangle Tool

Saving Scan Data

Select Save and provide a filename to save the scan data.

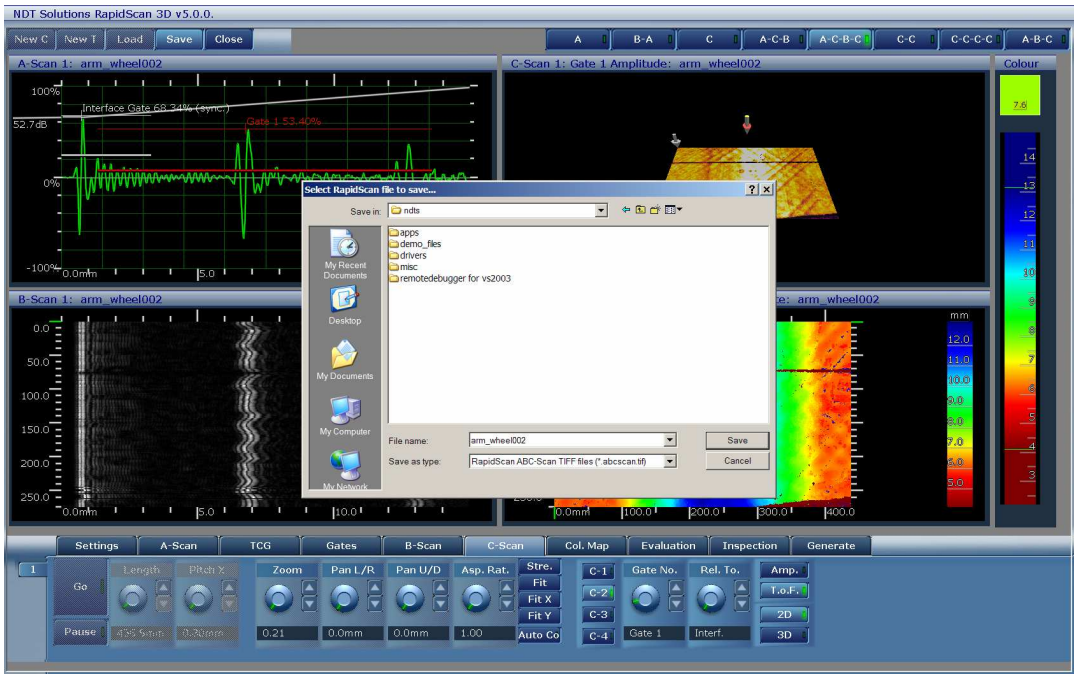

Figure 54: Saving Scan Data

The scan data can be re-loaded at a later date by running the RapidScan software and clicking **Load** on the start screen and selecting the file.