Performing Length and Angle Measurements in ProAnalyst®

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Abstract

Two different methods can be applied to measure lengths and angles in ProAnalyst. Graphical annotations allow you to draw text, lines and shapes onto a video image. These are static annotations that can be manually placed on a single frame or specific range of frames of a video. Two of these annotations provide static length and angle measurements.

For dynamic measurements that move with objects in the video, you can configure lines to be drawn between tracked features. The distance between any two tracked features can be displayed frame by frame. Similarly, the angle between any 3 or 4 tracked features can be displayed frame by frame. The resulting feature line measurements can be plotted on a graph as a function of time.

Introduction

This tutorial shows you how to measure lengths and angles of objects in your video images. Static measurements are manually defined and are confined to one or more frames for a quick visual check of a length or angle. Static measurements are performed with the Annotations function.

Dynamic measurements are configured with feature lines as part of the Feature Tracking or Line Tracking process, providing a frame by frame progression of changes in lengths or angles as you view the video.

Files Needed for this Tutorial

Click here to download these files.

sled.mpj	*Valve Spring.mpj*
sled_000.jpg	*valvespring.avi*
sled.ftk	*valvespring.lut*
sled.gfc	*valvespring.ftk*
	valvespring.gfc

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Graphical Annotations and Static Measurements

Static measurement annotations can be used to perform quick measurements in select frames of a video. ProAnalyst automatically saves these annotations in a file with the same prefix as the video and *.ant* as the extension. For example, the annotations for the video *sled_000.jpg* are saved in *sled.ant*.

Note: Only a brief description of annotations is provided here. For more information about graphical annotations and static measurements, refer to the ProAnalyst User Guide.

Adding Length Dimension Annotations to a Video

1. From the File menu, create a new project. Right-click to add the *sled_000.jpg* video and then double-click the *sled_000.jpg* thumbnail.

2. Click the Fast Forward button ▶▶❙ to advance to the last frame of the video. In this example, the last frame is 149.

3. Click the **Annotations** button 🎨 on the right side of the video window to open the Annotations control panel, shown in Figure 1.
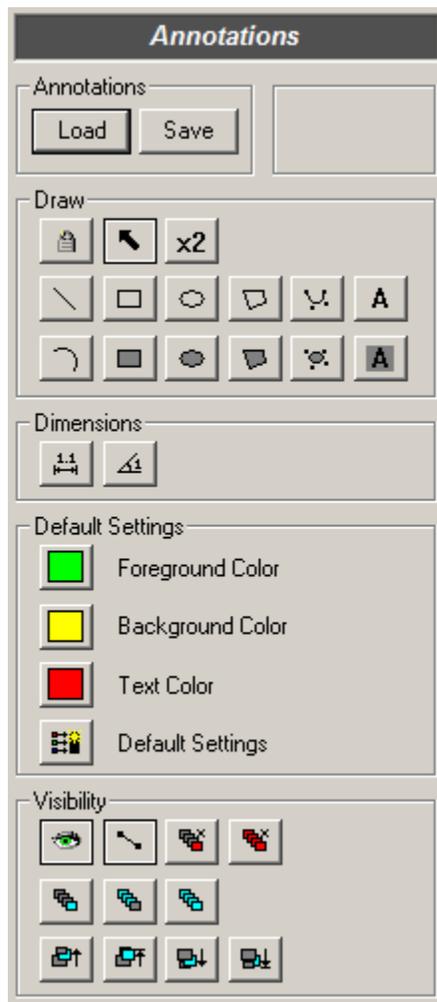

Figure 1. Annotations control panel

4. Click the **Draw Length Dimension** button on the Annotations control panel.

5. Click a point on the seat headrest, hold down the **Control** key, and drag a straight line from the headrest to the back of the head. Release the mouse button. Holding the Control key forces the line to be horizontal or vertical.

6. The length dimension will appear in pixels. The length dimension is given in the same units that were used for calibration, or in pixels if no calibration was done. Figure 2 shows the highlighted length dimension.

    Note: For more information on calibrating your image, please refer to Tutorial 162 -- 2-D Scene Calibration in ProAnalyst.
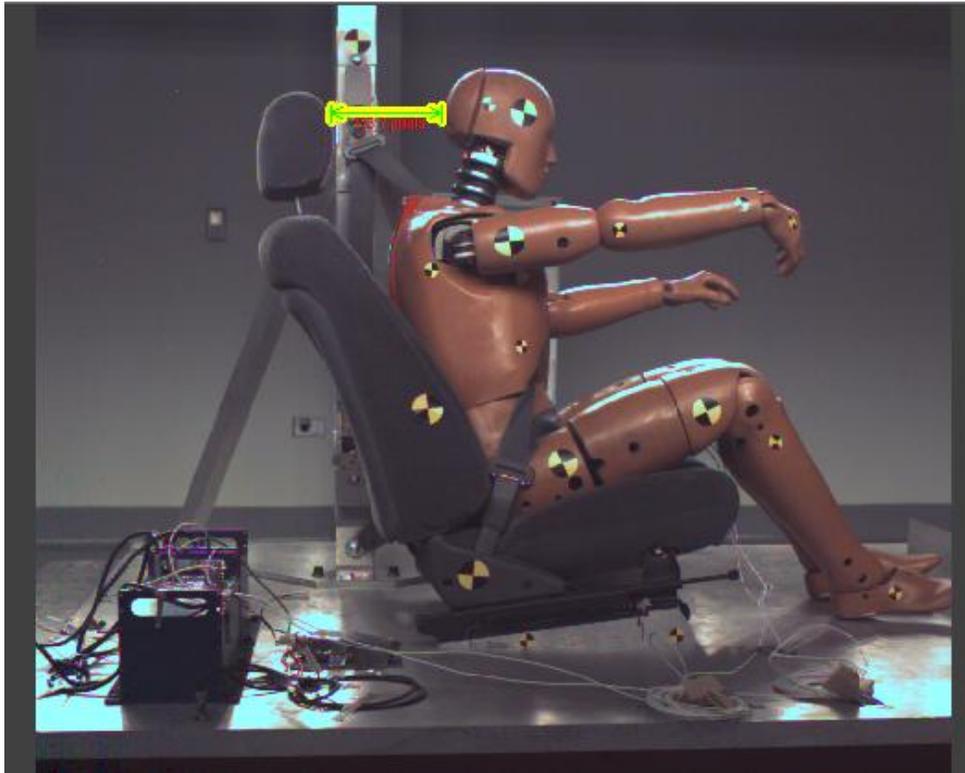

Figure 2. Measured Length Annotation

7. You can click and drag the endpoints and lines to fine tune the length measurement. Double-clicking on the length annotation displays the Annotation Properties window, shown in Figure 3. This window provides options for changing the colors, fonts, and appearance of the annotations.
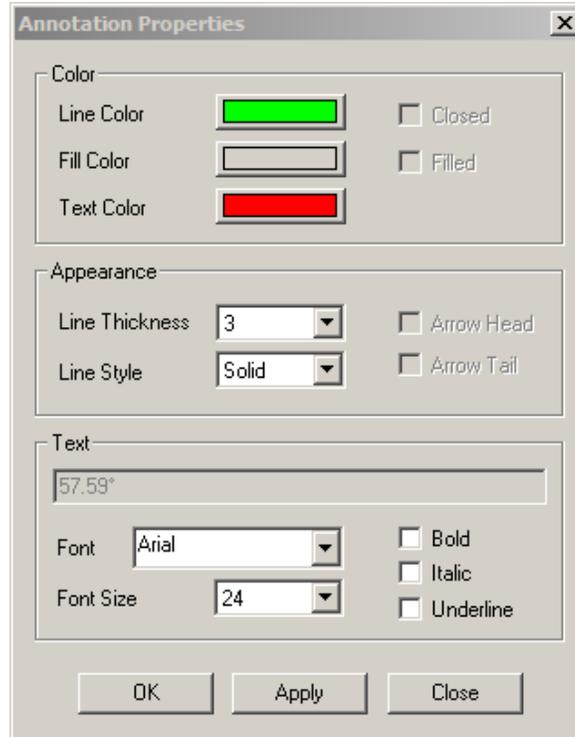
Figure 3. Annotations Properties window

8. To create additional length measurements, repeat steps 4-7.

9. Save your project and give it a name.

Adding Angle Dimension Annotations to a Video

1. With the *sled_000.jpg* video still at frame 149, click the **Draw Angle Dimension** button ▵¹ on the Annotations control panel.

2. Click a point corresponding to the position of the ankle. A highlighted dot appears at the pointer location. Drag a line to the knee and click again. Drag a line along the length of the upper thigh and click on the hip. The angle is highlighted and the angle measurement is displayed in degrees. The measured angle is between the lines connecting the first and last points to the middle point. Figure 4 shows the angle annotation.

Figure 4. Measured angle annotation

3. You can click and drag the end points of the lines to fine tune the angle measurement. Holding down the **Control** key while dragging the mouse will draw a horizontal or vertical line. Double-clicking on the angle annotation displays the Annotation Properties window, shown in Figure 3. This window provides options for changing the colors, fonts, and appearance of the annotations.

4. To create an additional angle measurement, repeat steps 1-3.

Visibility Settings

You can choose from several visibility settings at the bottom of the Annotations control panel. **Show in Current Frame Forward** 🔳 displays the annotation in the current frame and every following frame. **Show in All Frames** 🔳 displays the annotation in every frame of the video. For this example, leave the **Show in Current Frame** button 🔳 selected. (This is the default visibility setting.) The angle and length annotations will only appear in frame 149 of the *sled_000.jpg* video.

Deleting Static Measurement Annotations

To delete a static length or angle measurement, click to highlight it, then press the **Delete** key. A dialog box appears asking you to confirm the deletion. Click **Yes**.

Adding Dynamic Length Measurements

ProAnalyst also allows you to use feature lines to display dynamic measurements of the length of any object in a video by configuring a feature line between any two tracked points. These length measurements are calculated frame-by-frame using the tracked positions of each feature in each frame.

Note: For more information about dynamic length measurements, refer to the ProAnalyst User Guide.

Feature Tracking

In order to display a dynamic length measurement, two features must be tracked in the video. Follow the steps below to track two features in the example video. In this example, the amount of compression in a spring is measured.

1. Create a new project and right-click to add the *valvespring.avi* video file.

2. Double-click the *valvespring.avi* thumbnail to open the Measurement window.

3. Click the **2-D** button on the right side of the Measurement window to open the Feature Tracking panel.

4. Click **Enable** to begin defining the features to track.

5. Click **Define Region** and draw a box around the arm to the left of the spring.

6. Click **Set Region**. This is Feature 1.

7. Click **Add**, then define and set another region around the threaded hole at the lower right of the image. This is Feature 2. Figure 5 shows the two features.

8. Click the **Track Active Features Forward** button to see the movement of the features.

9. Click **Rewind** on the Play controls to return to the beginning of the video.
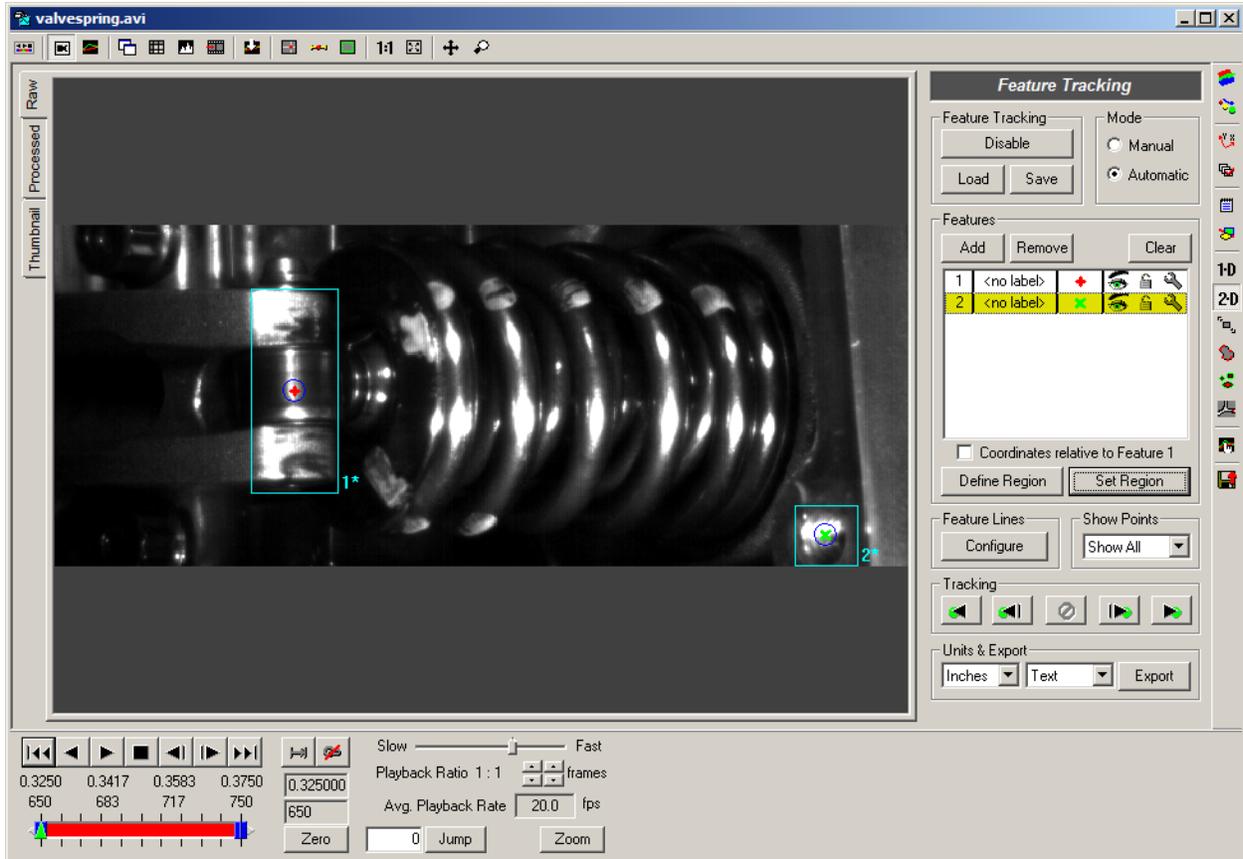
Figure 5. Features defined on valve spring video image

10. Click **Configure** to display the Line Configuration window.

11. Click **Add Line**. The number 1 is displayed in the Line Number field.

12. Change the size of the line to **6**.

13. Add **Feature 1** and **Feature 2** to the line by clicking on the feature name and then the right arrow button ➡. Figure 6 shows the Line Configuration window.
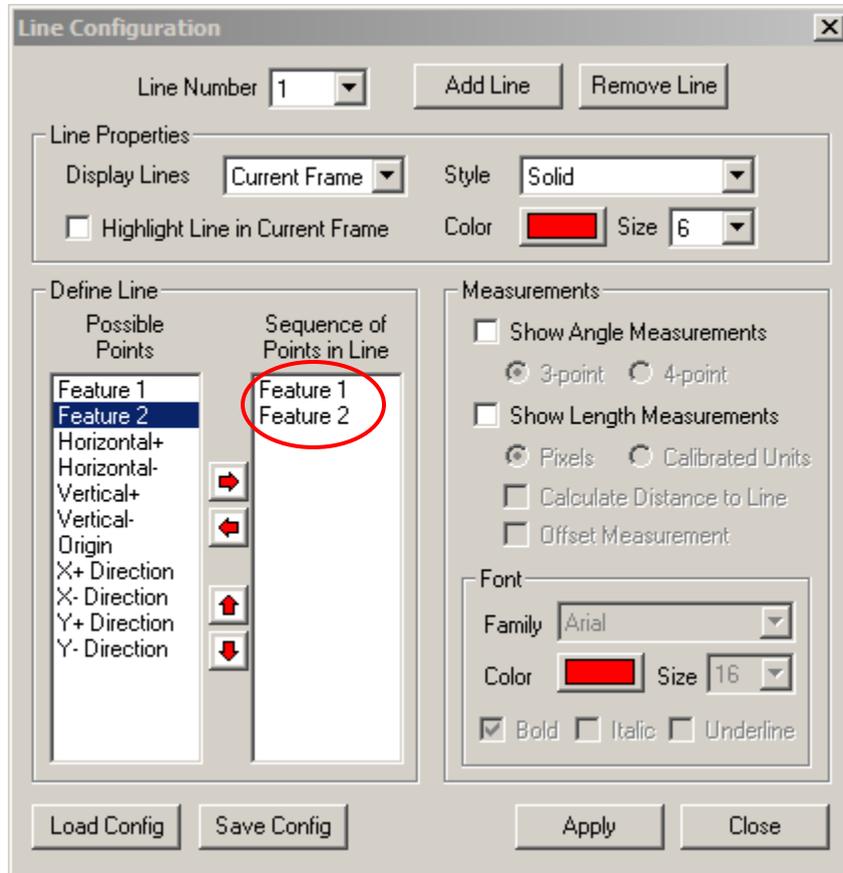
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Figure 6. Line Configuration window

14. Check the **Show Length Measurements** box, and change the setting to **Calibrated Units**. Change the font size to **24**.

15. Click **Apply** and then **Close**. A line connecting Features 1 and 2 is displayed with the distance displayed in inches.

16. On the Feature Tracking control panel, select **Show Current** from the Show Points dropdown menu. Click the Play controls to see the movement of the features. The length measurement changes as the spring moves.

We can also make a more advanced measurement than simply showing the distance between two points. Suppose that we want the horizontal distance between Features 1 and 2. To show this value, let us edit the line configuration for Line Number 1.

17. Click **Configure** to display the Line Configuration window, shown in Figure 7.

18. Select **Vertical +** from the list of possible points and click the right arrow ➡ button to add it to the list.

19. Check the box next to **Calculate Distance to Line** in the Measurements section of the window.
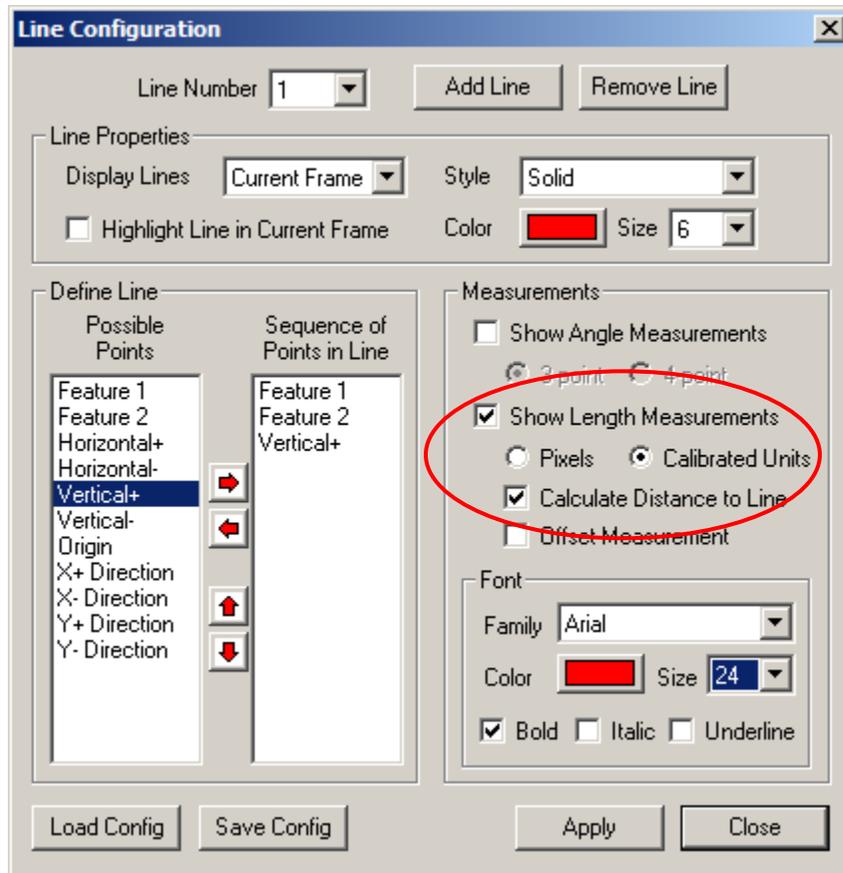
Figure 7. Line Configuration window with Measurements selected

20. Click **Apply** and then **Close**. The video should now display the distance from Feature 1 to the line created by connecting Feature 2 to the Vertical + direction, as shown in Figure 8.
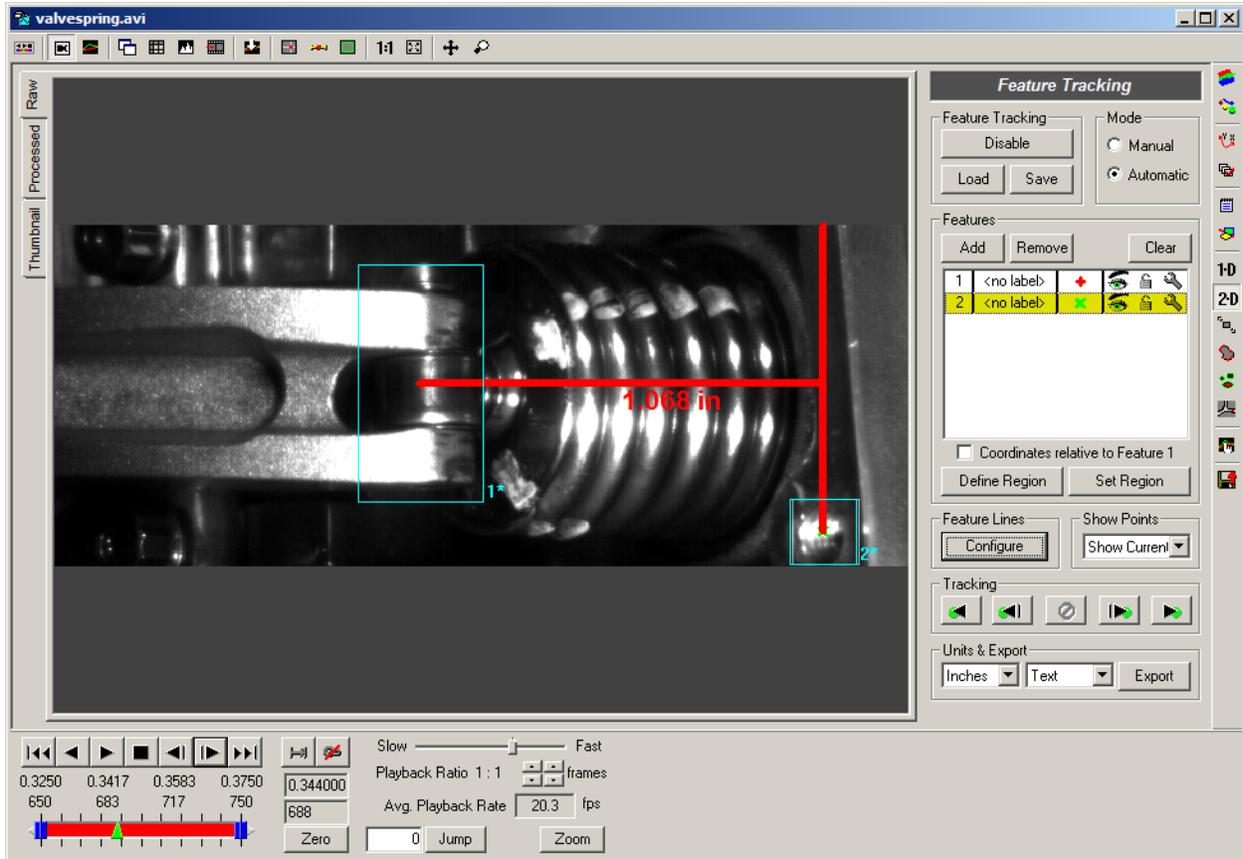
Figure 8. Dynamic length measurement

21. Click **Save** to save the feature tracking and line configuration data in a file with a *.ftk* extension, *valvespring.ftk* in this case.

22. Save your project, give it a name, and close the project.

Adding Dynamic Angle Measurements

In addition to dynamic length measurements, ProAnalyst also lets you configure lines to display dynamic measurements of the angle between any 3 or 4 tracked points. Angle measurements are calculated frame-by-frame by using the coordinates of tracked features in the video.

Note: For more information about dynamic angle measurements, refer to the ProAnalyst User Guide.

3-Point Angle Dynamic Measurement

1. Open the project you created using *sled_000.jpg* and double-click on the thumbnail to open the Measurement window.

2. Click the **Rewind** button ▐◀◀ to return to the beginning of the *sled_000.jpg* video.

3. Click the Image Processing 🔳 button to open the Image Processing control panel.

4. Click **Display B&W**. Under B&W Image Settings, adjust the **Exp./Log.** slider until it resembles the one shown in Figure 9. Image Processing will improve feature tracking accuracy.
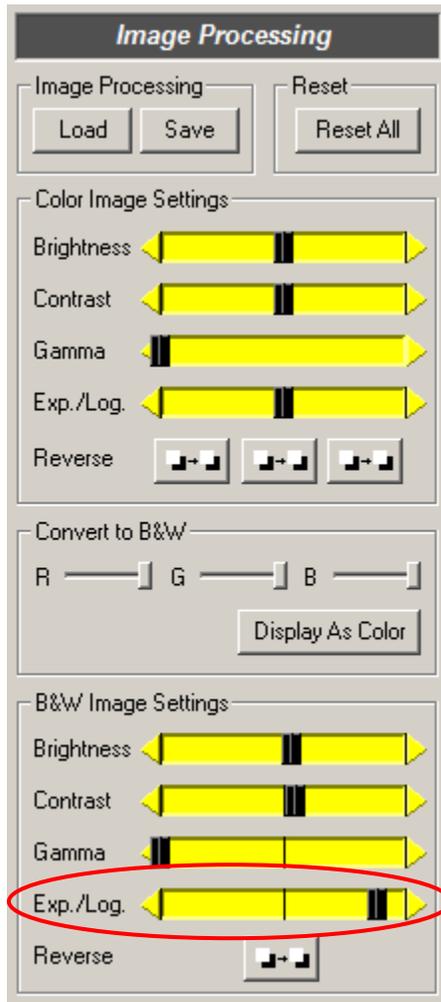

Figure 9. Image Processing Control panel

5. Click the **2·D** button on the right side of the window to open the Feature Tracking panel.

6. Click **Enable** to begin defining the features to track.

7. Click **Define Region**. Position the reticle and draw a box around the target on the upper arm. Click **Set Region** to set the upper arm target as Feature 1. Click the **Add** button to add the elbow target as Feature 2. Define and set the region. Next, add the wrist target as Feature 3, defining and setting the region. Figure 10 shows the three features.
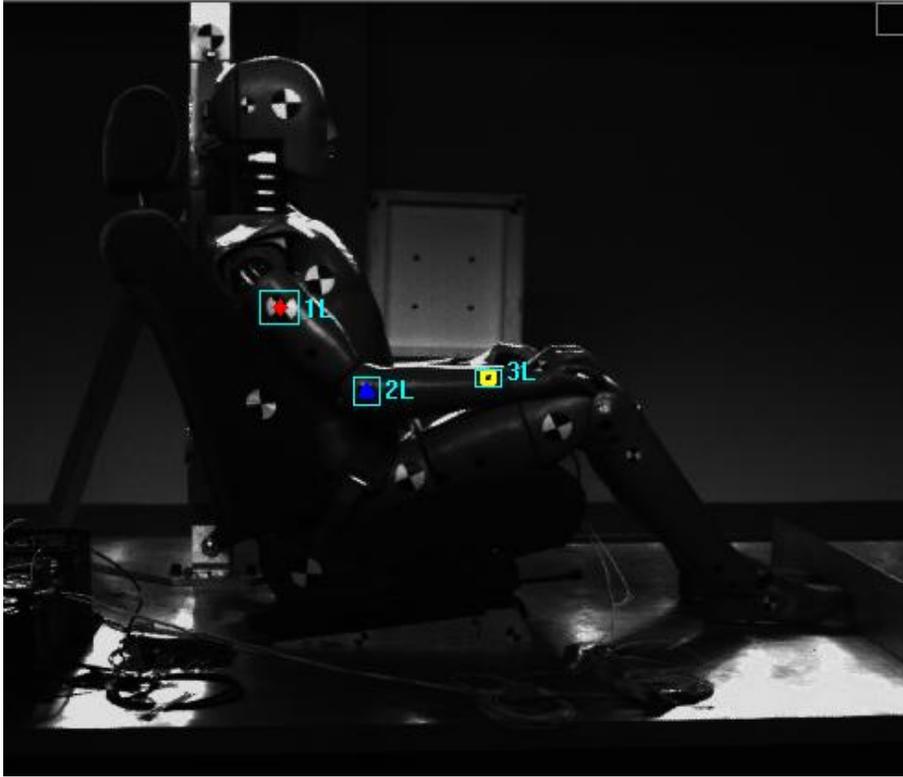

Figure 10. Arm features defined

8. Click on the Wrench ⚒ icon to the right of the **Feature 1** line in the Feature Tracking panel. The Feature 1 Track Settings window is displayed, as shown in Figure 11.

9. Under Feature Rotation, click the checkbox next to **Enable**.

10. At the bottom of the panel, click the checkbox next to **Apply Settings to All Features**.
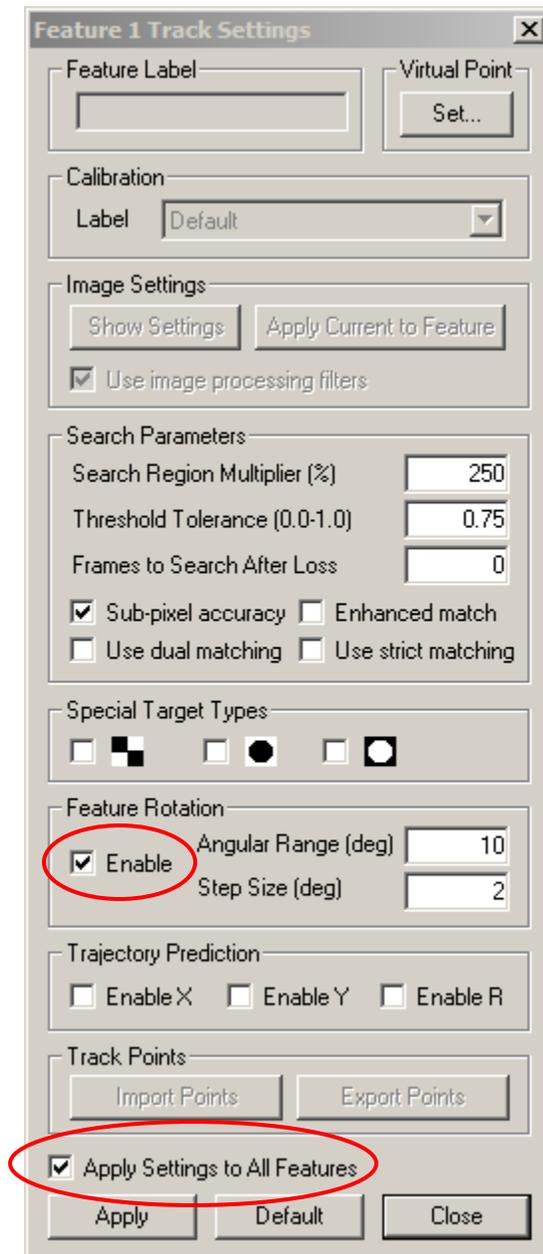
11. Click **Apply** and then **Close**.

Figure 11. Feature 1 Track Settings window

12. Click the **Track Active Features Forward** button ![icon] to see the movement of the features. If any features are lost during the tracking, you can return to the beginning of the video and redefine the features.

13. When you are satisfied with the tracking, click on the **Lock** icon 🔒 for each feature.

14. Click the **Rewind** button |◀◀ to return to the beginning of the *sled_000.jpg* video.

15. Click **Configure** in the Feature Lines section of the control panel. The Line Configuration window appears, as shown in Figure 12.

16. Click **Add Line**. Add Features 1, 2, and 3 to the line by clicking on each feature name and then the right arrow button ➡.

17. Change the size of the line by selecting **6** from the dropdown menu. Check the **Show Angle Measurements** box, and leave the setting at **3-point**. Change the font size to **24**.
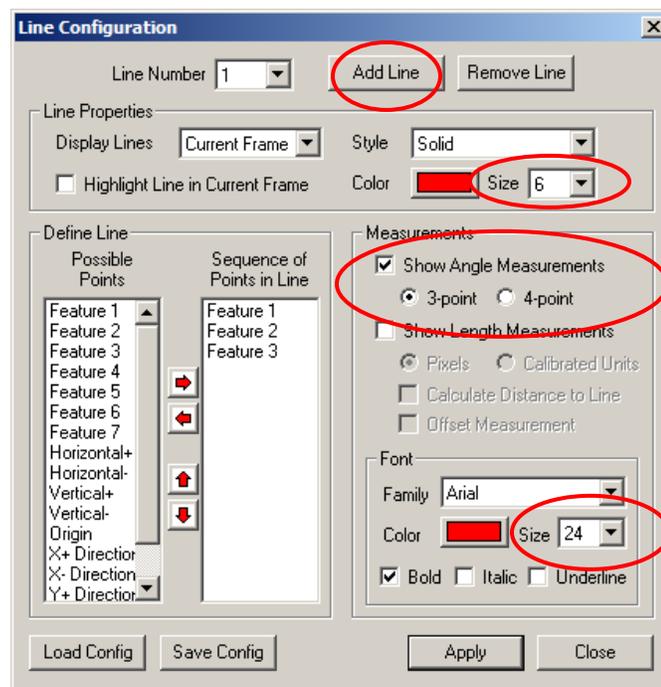

Figure 12. Line Configuration window

18. Click **Apply** and then **Close** to save your settings. The line is displayed with the second point as the angle vertex. The angle measurement is shown in degrees.

19. On the Feature Tracking control panel, select **Show None** or **Show Current** from the Show Points dropdown menu. Click on the Play controls to see the video play with the dynamic angle measurement shown in every frame. Notice that the angle measurement decreases and increases as the arm moves. Figure 13 shows an example of a 3-point angle.
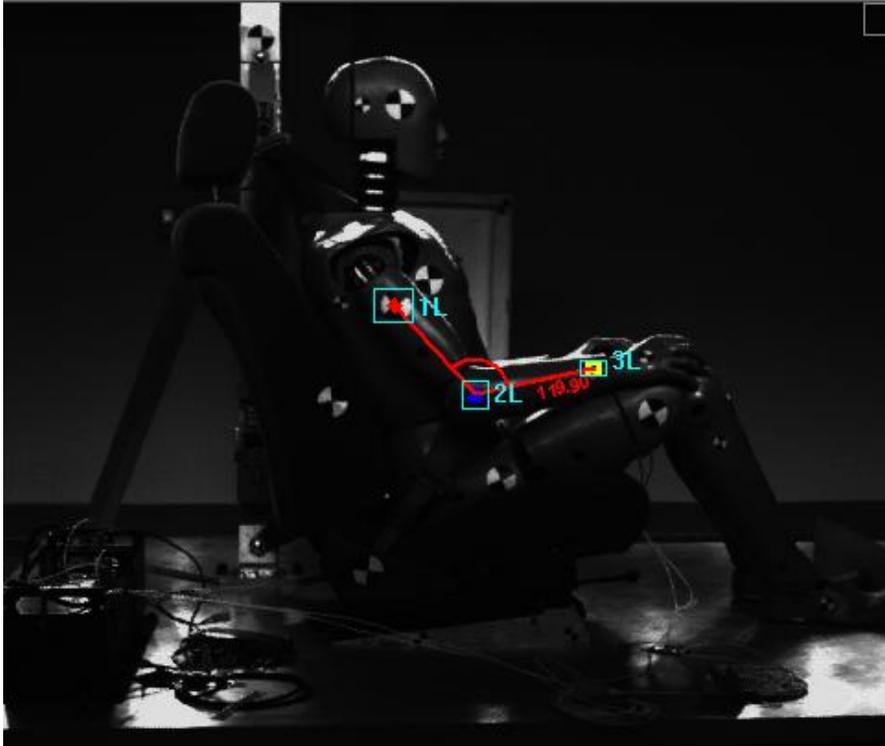

Figure 13. 3-point angle

4-Point Angle Dynamic Measurement

1. Click the **Rewind** button ◄◄ to return to the beginning of the video.

2. Click **Add** on the Feature Tracking control panel to add four more features for the leg, using the same procedures as in Step 4 of the previous section. Add, define regions, and set regions for Features 4-7: the ankle, knee, thigh, and hip. Track the features forward, then return to the beginning of the video. Figure 14 shows the new features.
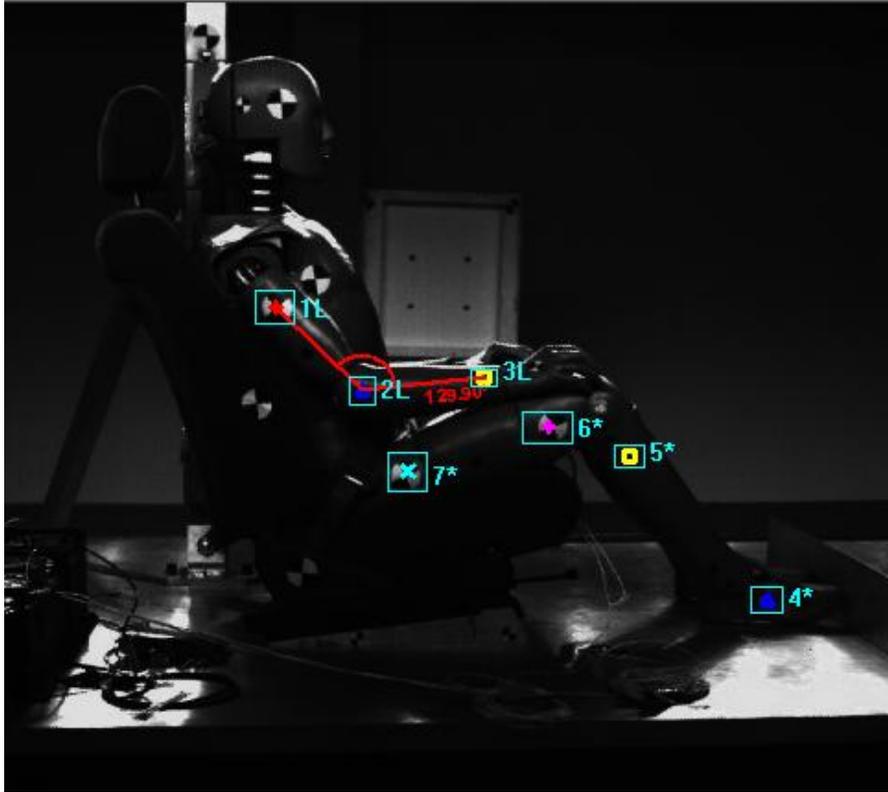
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Figure 14. Leg features defined

3. Click **Configure** to display the Line Configuration window.

4. Click **Add Line**. The number 2 is displayed in the Line Number field.

5. Change the size of the line to **6**. Click on the **Color** box and select yellow from the color chart. Click **OK**.

6. Add Features 4, 5, 6 and 7 to the line by clicking on the feature name and then the right arrow button ▶.

7. Check the **Show Angle Measurements** box, and select the **4-point** setting. Change the font size to **24**.

8. Click **Apply** and then **Close** to save your settings. The line with a 4-point angle is displayed on the leg. The vertex of the angle is the intersection of the lines formed by the first two and last two points. The angle measurement is shown in degrees.

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9. On the Feature Tracking control panel, select **Show None** or **Show Current** from the Show Points dropdown menu. Click the Play controls to see the movement of the features. The angle degree measurements change as the arm and leg move. Figure 15 shows an example of a 3-point angle and a 4-point angle.

Figure 15. 3-point angle and 4-point angle

Deleting Dynamic Angle Measurements

On the Feature Tracking panel, click **Configure**, and remove the check from the Show Angle Measurements box. This will keep the line rendering but remove the angle calculation.

To remove the entire line, select the line number from the Line Number dropdown menu and click **Remove Line**. Click **Apply** and then **Close**.

Congratulations!

You have completed the tutorial and learned how to create both dynamic and static length and angle measurements in ProAnalyst. Two complete tracked projects are available with this tutorial for reference. Open *sled.mpj* and *Valve Spring.mpj* in ProAnalyst to view them. More information on annotations, feature tracking, and length and angle measurements can be found in the *ProAnalyst User Guide*.