



Human Biomechanical Analysis with ProAnalyst®: A Rugby Kicker

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Abstract

The feature tracking capabilities available in ProAnalyst make it a powerful tool for biomechanical analysis. In a lab setting, motion tracking markers make the process of capturing an athlete's motion extremely simple and efficient. Combined with ProAnalyst's automatic feature tracking, analysis results can be obtained quickly and efficiently, and may be exported to a variety of output formats. Stick figure rendering provides easy access to joint angle measurements. The topics discussed in this tutorial will be: Image processing, automatic feature tracking, manual feature tracking and stick-figure analysis.

File Needed for this Tutorial

Click [here](#) to download these files.

Kick01.avi
Kick01.cfg
Kick01.clb
Kick01.ftk
Kick01.lut
RugbyKick.mpj

Tracking a Rugby Kick

A combination of automatic and manual tracking will be used to track the positions of four markers attached to the rugby player's hip, knee, ankle, and foot. While not required by ProAnalyst, in many cases, the presence of these markers simplifies the motion tracking process considerably.

Tracking the Hip Marker

1. Open ProAnalyst and create a new ProAnalyst project and add the *Kick01.avi* video.
2. Double-click on the *Kick01.avi* thumbnail to open the Measurement Window.
3. The video has been recalibrated such that the first frame is numbered frame -47. Click the Go To End button to advance the video to frame 0 -

Note: On the following page, Figure 1, shows the 0 frame of the Kick01.avi video.

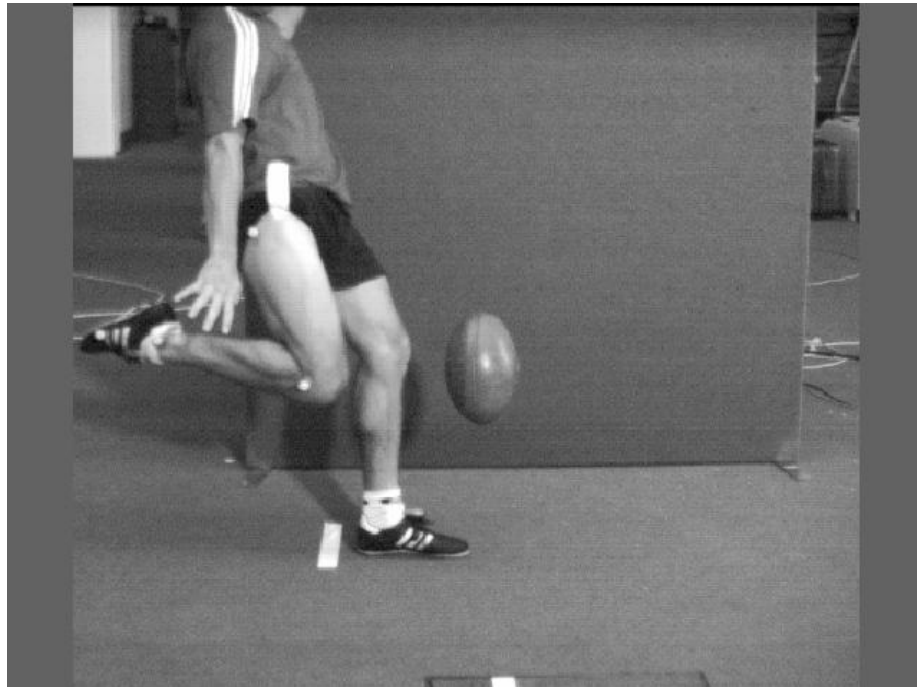


Figure 1:

4. Open the **Feature Tracking** control panel and click the **Enable** button.
5. Define and set a region around the marker located on the player's hip. Keep the region as close to the size of the marker as possible to ensure accurate tracking results.

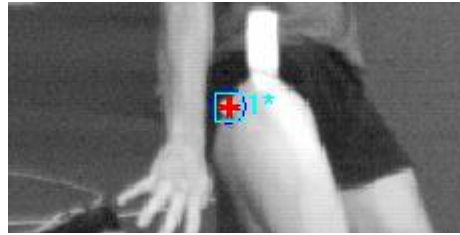



Figure 2:

6. Click the  icon to open the **Track Settings** window. Type **Hip** in the **Feature Label** text field.
7. Click the **Apply** button, followed by the **Close** button.
8. Click the **Track Forward** button.

The hip marker should track accurately the first time through, as shown on the following page in Figure 3. If they do not, it may be necessary to redefine the feature and restart the tracking.

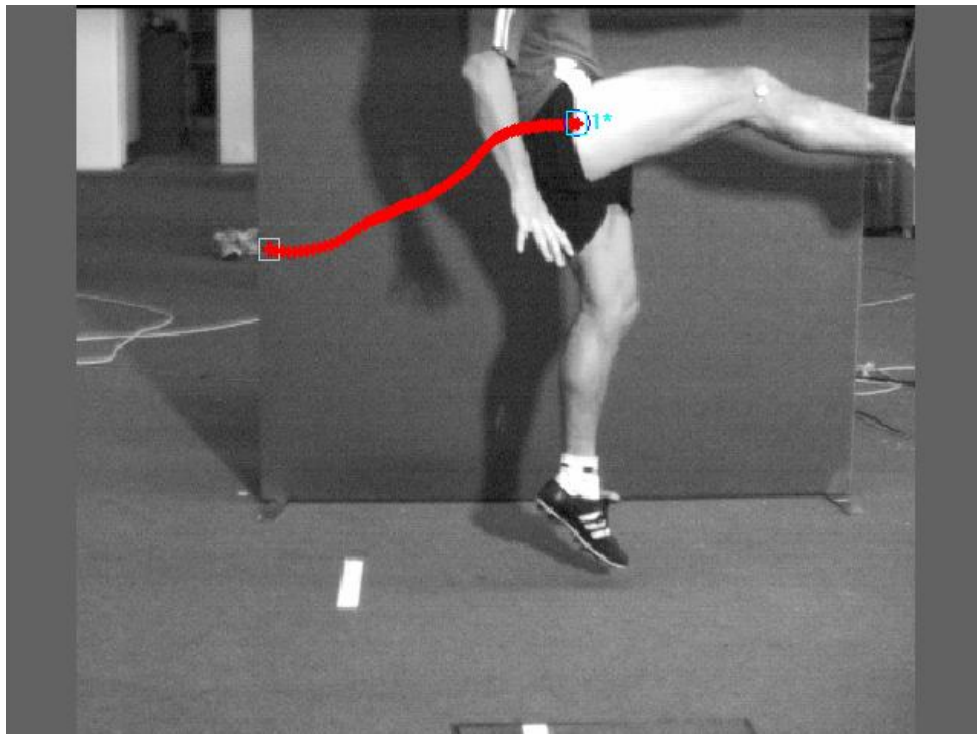


Figure 3:

9. When you are satisfied with the accuracy of the feature track, click the Lock icon associated with the feature -

Tracking the Knee Marker

The knee marker changes in appearance over the course of the video sequence. We will process the image to enhance the appearance of the marker, and then perform a two-stage auto-track to ensure the most accurate results.

10. Advance the video to frame 40.

11. Click the Add button to add a new feature.

12. Open the Image Processing control panel and click the Display B&W button.

13. Adjust the B&W Image Settings sliders to enhance the appearance of the marker relative to the skin-tones surrounding it as shown on the following page in Figure 4.



Figure 4:

14. Define and set a region around the knee marker. The size of the region is not as critical to a successful track as it was for the hip marker.

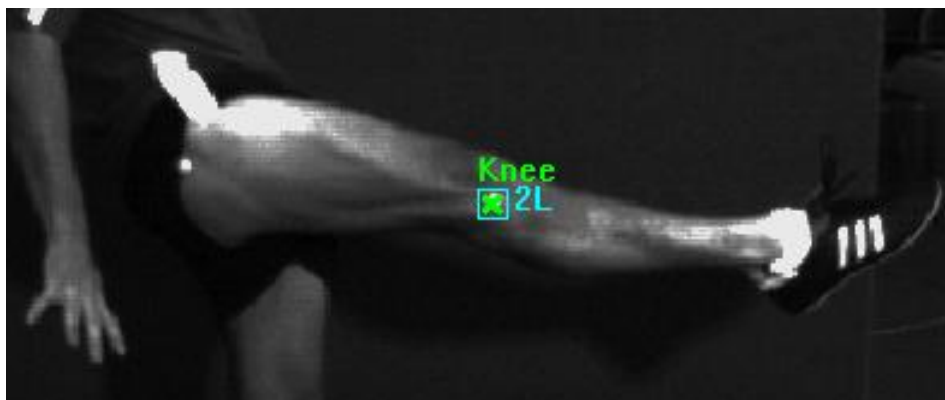



Figure 5:

15. Click the  icon to open the Track Settings window. Type, "Knee" in the Feature Label text field.
16. Check the Enable button in the Feature Rotation frame.
17. Click the Apply button followed by the Close button.
18. Click the Track Forward button.
19. After ProAnalyst completes the forward track, reset the video to frame 40 and click the Track Backward button.
20. Backward tracking will take you beyond frame 0. To delete these extra points, set the video to frame -1. Right click on the video and select Feature Tracking Clear Features Current Feature, Current Frame Backward from the pop-up menu.

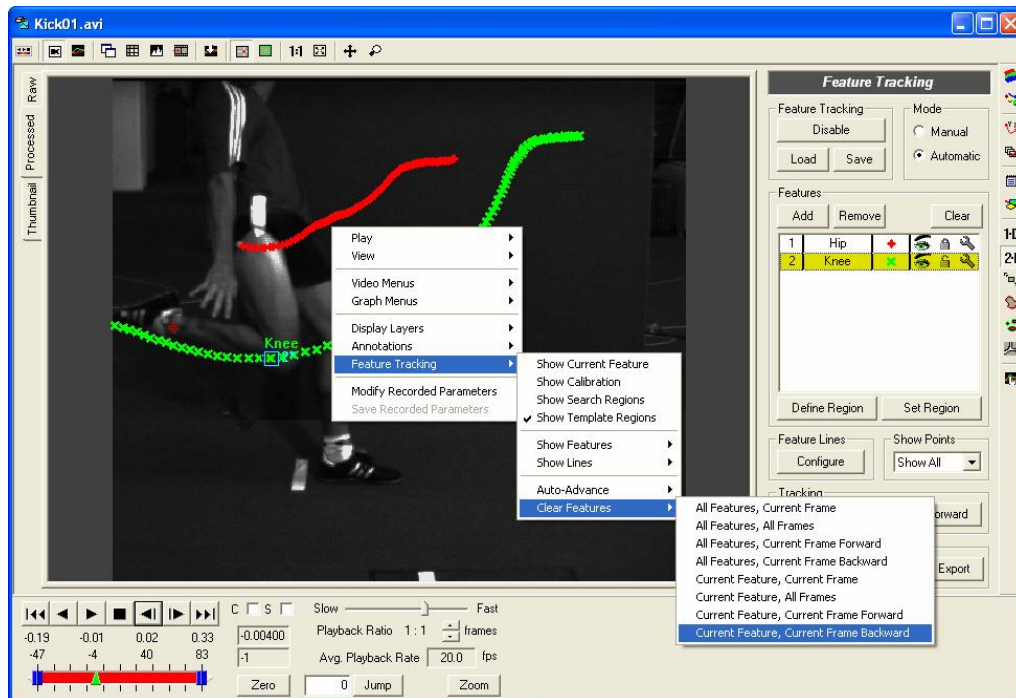


Figure 6:

12. Click the icon to lock the feature.

Note: It is possible to auto-track the knee marker from frames 0 to 83 without applying any image processing. Attempt to achieve this result by modifying the size, position, and parameters of the feature region.

Tracking the Ankle and Foot Markers

The foot and ankle markers present a number of difficulties that make accurate auto-tracking extremely difficult to achieve. The ankle marker is positioned on a white sock, and is therefore not visually distinct enough for auto-tracking to pick up. The foot marker, on the other hand, actually separates from the foot in frames 17 – 19, making any attempt at auto-tracking a futile endeavor. In these cases, the features of interest will have to be tracked manually.

1. Move the video to frame 0.
2. Click the **Add** button to add a new feature. Label this feature “Ankle”.
3. Set the feature tracking mode to **Manual**.
4. Left click over the ankle marker to position the reticle on that spot.

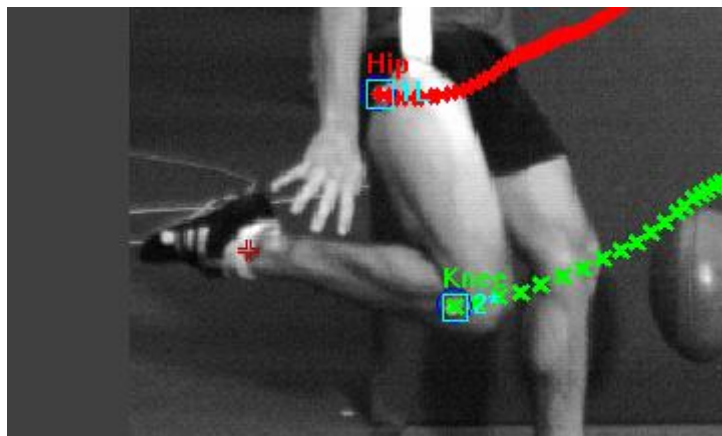


Figure 7:

5. Click the **Set Point** button to set a tracking point. The video will automatically advance to the next frame.

*Note: Points can also be set manually by holding down the **Ctrl** key and right clicking the mouse. When a large number of points have to be set, this method is more convenient than repeatedly clicking the **Set Point** button.*

6. Repeat steps 4 – 5 until the ankle marker leaves the video on frame 78. Adjust the Image Processing settings as necessary to most easily visualize the marker.

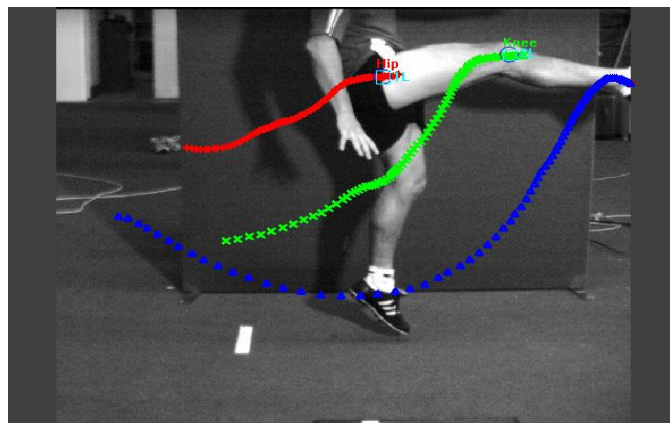


Figure 8:

7. Add a new feature and repeat steps 3 – 6 to manually track the kicker's foot until it leaves the video in frame 53. An easy way to do this would be to use the foot marker as a guide until it separates from the foot in frame 18. The marker's former position can be easily estimated for frames 19 – 53.

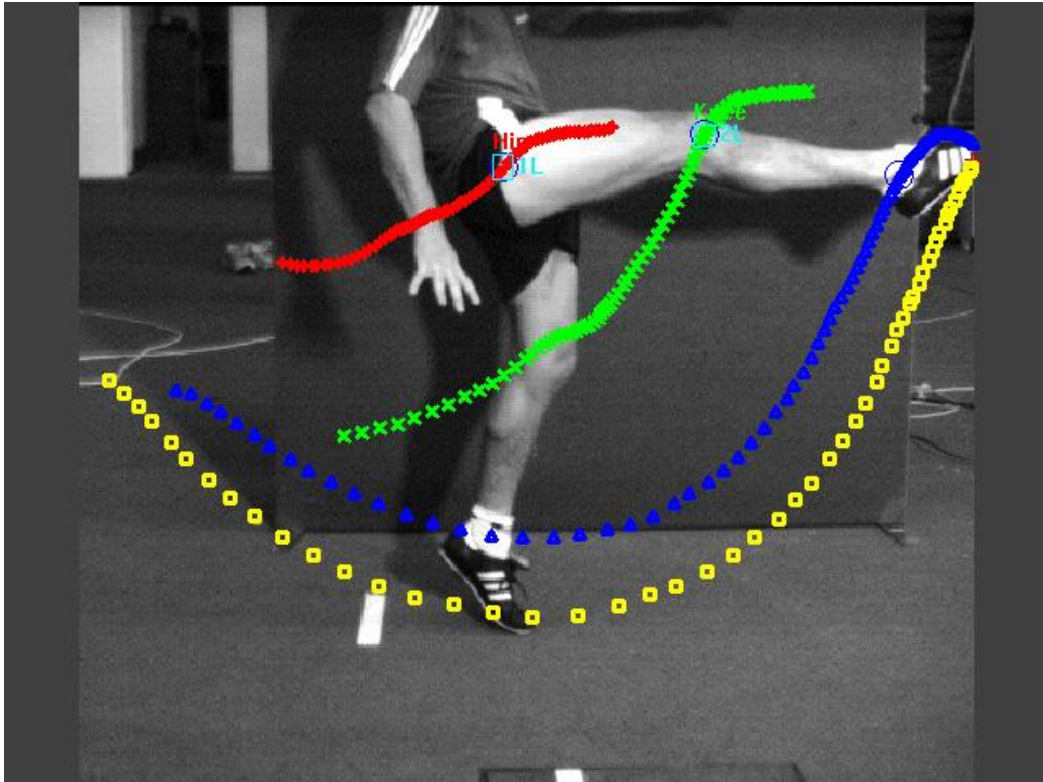


Figure 9:

Adding Feature Lines

1. Click the **Configure** button to open the Line Configuration window.
2. Click the **Add Line** button to create a new feature line.
3. Select **Feature 1** in the **Possible Points** frame, and click the button to move it into the **Sequence of Points in Line** frame.
4. Repeat step 3 for **Feature 2** and **Feature 3**.
5. Check the box labeled **Show Angle Measurements**.
6. Click the **Apply** button. An angle measurement will be drawn between the kicker's hip, knee, and ankle.
7. Repeat steps 2 – 6 to add a feature line between the kicker's knee, ankle, and toe.

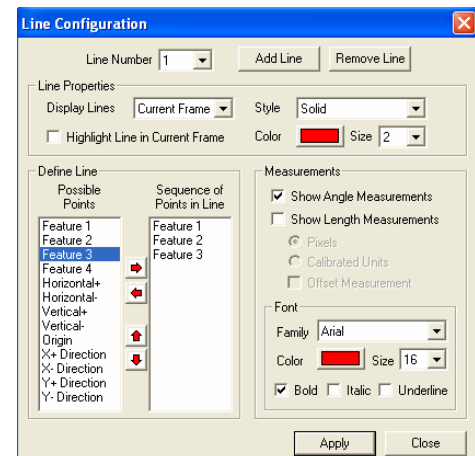


Figure 10:

8. Click the **Close** button.

9. Click the icon associated with each feature to hide the tracking points. The lines extending down the kicker's leg from his hip to his toe will remain visible.

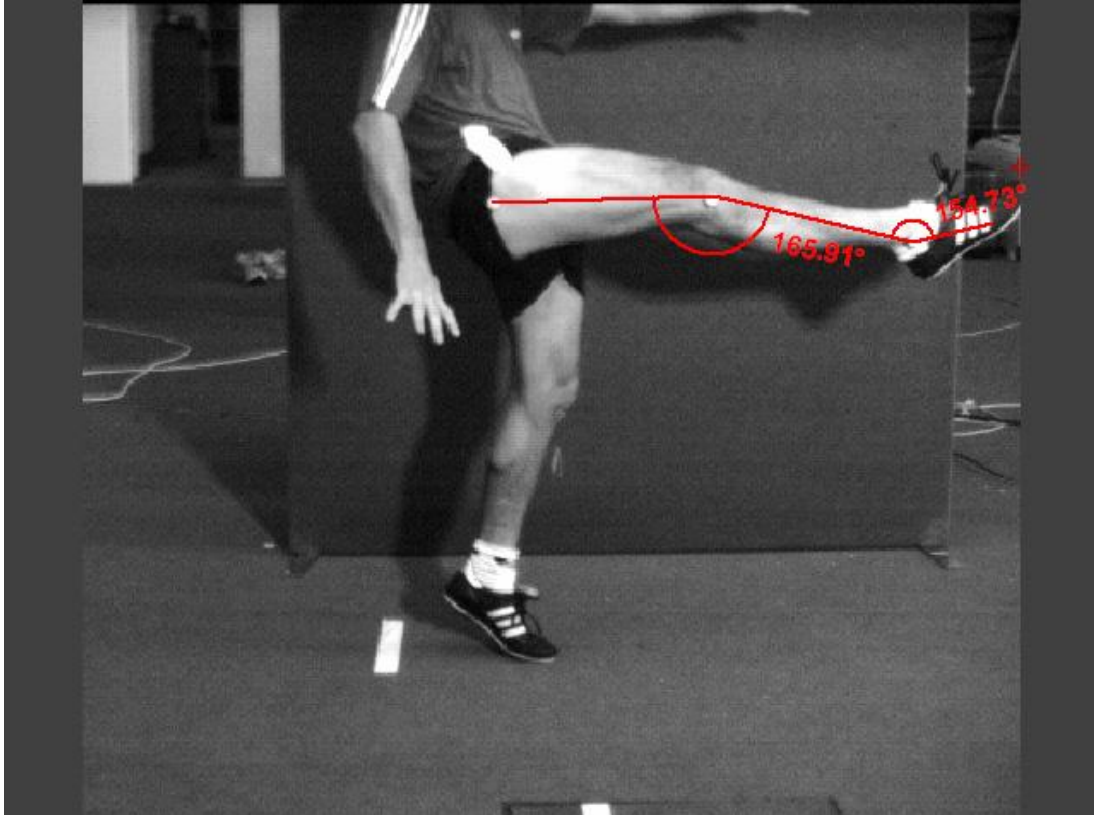


Figure 11:

10. Playback the video to see an accurate stick-figure representation of the kicker's leg overlaid on the original video image.

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