In this example, the procedure from the main article on 2D video analysis will be clarified. On the basis of a long jump video we are going to show you how you can carry out a simple and efficient movement analysis with the help of the freeware “SkillSpector”. At this point it should be noted that the video material used is semi-optimal and does not meet our guidelines. This has a negative effect on the accuracy of the determined parameters.

We are going to explain how to use SkillSpector using the athlete’s run-up velocity as an example (we have taken more parameters, but more on this later). We have proceeded as follows:

Create a new sequence and load the video to be analyzed:

```
Digitizing > Open Video
```

Select model and calibration method:

```
Sequence > Model Wizard > Simple Full Body > Default 2D
```

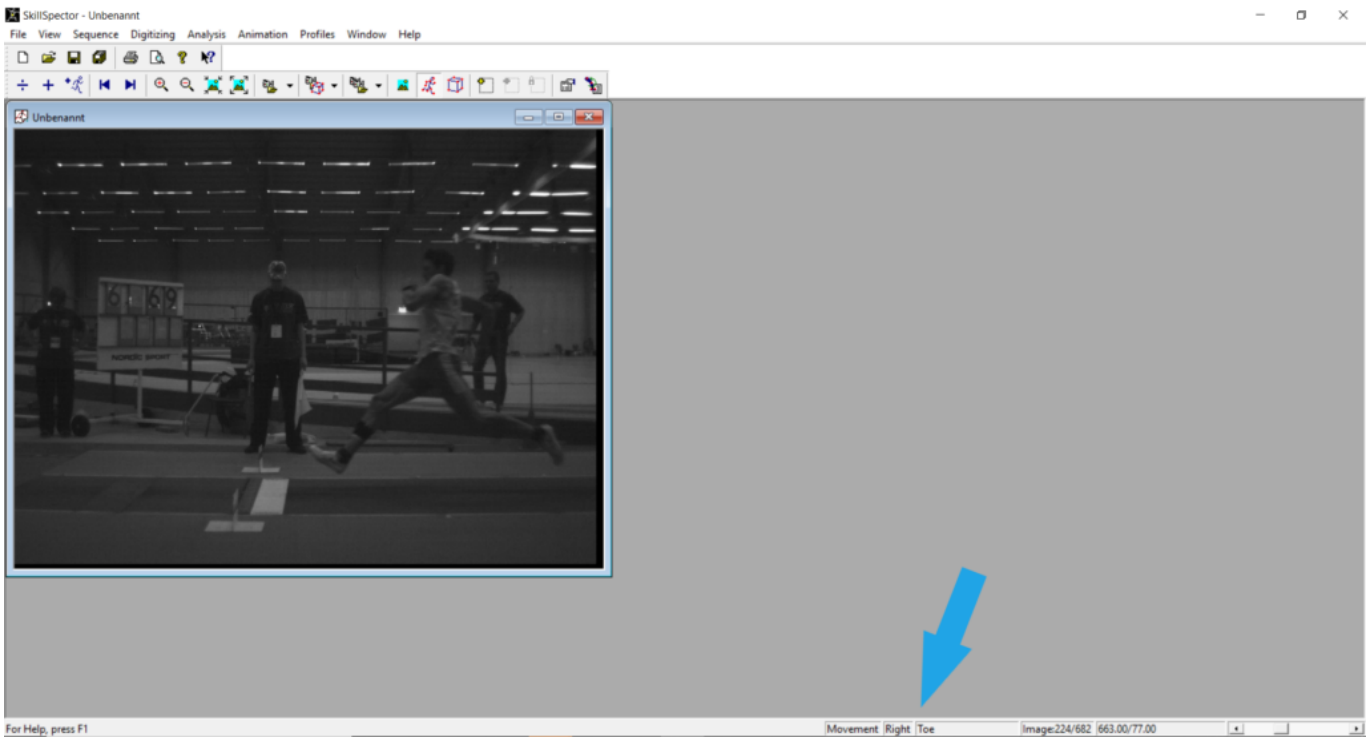
SkillSpector already has some built-in biomechanical models that can be used. In this case we chose the “Simple Full Body”. This model consists of 15 single body segments, which are labeled with a total of 18 marker points.
As calibration method we choose “Default 2D”.

Digitization of the movement:

```
Digitizing > Mode > Movement
```

This is the most time-consuming step. Here you have to select the anatomical landmarks by hand in the given order. This depends on your model and is shown in the bottom right corner

of the program (blue arrow). After you have labeled the first frame, the cursor automatically jumps to the position where it expects the corresponding marker in the next frame. We think this a cool feature, which definitely helps to save time.



As mentioned above, the video was not recorded according to our guidelines. The image quality and exposure are not optimal, which sometimes makes it difficult to select the anatomical landmarks precisely. This is further complicated by the fact that the athlete does not wear markers on his skin. In addition, the chosen camera position prevents precise marking of the athlete's right shoulder and right elbow. Both joints are covered by the athlete's own body. To be able to determine the coordinates exactly, a second, synchronized camera would have to film from the opposite side.

It took us just over 10 minutes to digitize this one trial. You can roughly imagine how much time it would take for longer and multiple trials.

Calibration:

After all frames are marked, we load the calibration video:

```
Digitizing > Open Calibration Video
```

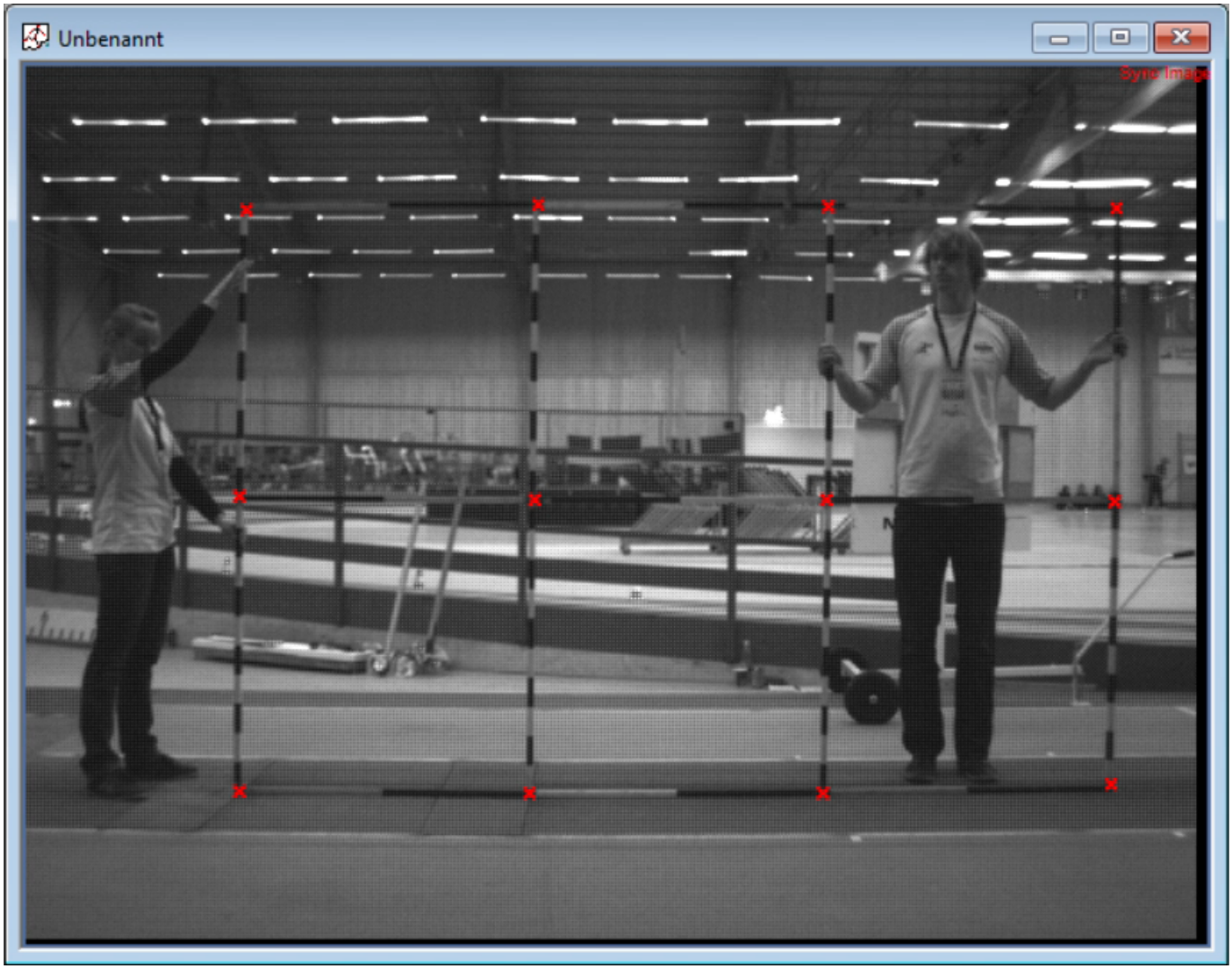
Then you have to change to the calibration mode:

```
Digitizing > Mode > Calibration
```

Now SkillSpector prompts the user to define calibration points with corresponding spatial coordinates:

```
Sequence > Calibration Options
```

In our case we have a calibration object with the dimensions 2m x 3m. In this object we can define a total of 12 calibration points.



Create Animation

Now you have to go back to the movement environment:

```
Digitizing > Mode > Movement
```

To check and visualize the calibration, the digitized sequence can be viewed in an animation at this point:

```
Window > New Animation Video
```

Complete the Data

To enable the complete data analysis we have to enter two more values: The first is the frame rate, because the program needs the exact time between two frames to later determine the speeds and the derivatives of them (as you know: v = s / t). In our case we recorded with 100fps, so the time between two frames is 0.01s.

```
Analysis > Set Video Frame Rate
```

The second value is the body weight. As already described in the main article, the underlying body model, which we defined in step 2, calculates the weights of the individual segments using certain percentages of the total body mass. These are needed, for example, to determine the center of gravity of the body or to calculate energy curves.

```
Analysis > Set Body Weight
```

Data Analysis

The last step is data analysis. SkillSpector also offers a wide range of options for this:

```
Window > New Analysis Window
```

With a right click on the newly created analysis window you can choose between various options and select the one that best fits your needs. Do you want to analyze linear or angular data? Do you want the program to display kinematic or kinetic parameters?

We want to examine the run-up velocity of the athlete and therefore choose:

```
Linear > Kinematics > Add Position, Velocity and Acceleration
```

Now another window opens, in which you specify which curves the program should show you. In this case, we do not select a segment, but the athlete's centre of gravity (CG). From this we want the speed in X and in Y direction. After clicking on "Add Curves", the curves appear in the graph for all the digitized frames.

If you want to further process the data with another program, you can of course export the data. This can be done by right clicking on the graph and then choose "Copy Data to Clipboard". The data is now in the cache of your PC and you can paste it with STR+V e.g. into Excel or MATLAB.

Results

Just as for the start-up speed, the data analysis can also be used for other parameters. As mentioned above, we have done this and summarized the results in an exemplary paper: