

Quintic Software

Tutorial Answers

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Tutorial 1 – Getting Started

1) Try opening a number of the other video clips in the athletics, cricket and diving folders.

Watch and write down the name of a video clip showing:

a) Something being hit *Front foot - On drive - Side View* (1)

b) The cricket bowler *Bowling Side View* (1)

c) Someone doing a handstand *10m handstand* (1)

d) Someone spinning around in a circle *Discus Female* (1)

2) Play the video of the diver at all different speeds (Play, Slow x 2, and Slow x 4, Slow x 8, Slow x 16)

3) What happens when you press this button - ?

Resets the video back to the start (Frame 0) (1)

4) a) How many frames does it move forward each time you press the arrow on the right of the video scroll bar? *One*

b) How many frames does the video move when you press the video scroll bar?

The video scrolls 10 frames (1)

5) Set the zoom at 1.0.

In Frame 95, what are the co-ordinates of:

a) The corners of the video

$X = 0.00$ $Y = 0.00$, $X = 719.00$ $Y = 0.00$, $X = 0.00$ $Y = 573.00$, $X = 719.00$ $Y = 573.00$

b) The divers chin $X = 547.00$ $Y = 276.00$

c) The tip of the divers toes $X = 570.00$ $Y = 53.00$ (12)

6) Set the zoom at 3.0

In Frame 95, what are the co-ordinates of:

a) The divers chin $X = 546.00$ $Y = 276.87$

b) The tip of the divers toes $X = 570.00$ $Y = 52.20$

In Frame 150, what are the co-ordinates of:

- c) The divers chin $X = 415.00$ $Y = 255.33$
- d) The tip of the divers toes $X = 314.00$ $Y = 302.00$

In Frame 167, what are the co-ordinates of:

- e) The divers chin $X = 331.33$ $Y = 264.67$
- f) The tip of the divers toes $X = 311.00$ $Y = 183.33$

In Frame 186, what are the co-ordinates of:

- g) The divers chin $X = 289.13$ $Y = 208.67$
- h) The tip of the divers toes $X = 265.80$ $Y = 119.67$

In Frame 197, what are the co-ordinates of:

- i) The divers chin $X = 285.13$ $Y = 200.47$
- j) The tip of the divers toes $X = 371.13$ $Y = 260.80$

In Frame 218, what are the co-ordinates of:

- k) The divers chin $X = 202.27$ $Y = 484.33$
- l) The tip of the divers toes $X = 299.27$ $Y = 335.67$ (12)

7) Do you think that one set of coordinates is more accurate than the other? Explain your answer.

Coordinates at the higher zoom factor are more accurate as they allow you locate the object more closely. (3)

8) In amongst the video clips in the 'athletics' folder there is a secret message stored on the memo pads. Find the words and rearrange them to make a sentence:

.....

Rearranged: EVERYBODY KNOWS THAT P.E LESSONS ARE THE BEST (2)

(/ 37)

Tutorial 2 – Make a Mark

RECAP

Open 'Bowling – Back view' from the cricket folder

1) Set the video at frame 40 and zoom of 1.0. What point has the coordinates

$X = 387.00$ $Y = 142.00$? *Knee (Patella)*

2) At Frame 53 and zoom of 1.0, what are the coordinates of:

a) The top of the bowler's right hand $X = 405.00$ $Y = 379.00$

b) The ball $X = 349.00$ $Y = 205.00$

c) The toes on the bowler's right foot $X = 382.00$ $Y = 88.00$

QUESTIONS

Using the video file '400m Hurdles' from the athletics folder

1) What distinctive point during the action do these markers indicate?

$59 = take-off$

$65 = left\ foot\ passing\ over\ hurdle$

$71 = right\ foot\ passing\ over\ hurdle$

$77 = left\ foot\ contact\ landing$

$85 = right\ foot\ contact$ (5)

2) Use these markers to find out how much time there is between:

a) Take-off and landing? $0.36secs$

b) Take-off and the left foot passing over the hurdle? $0.12secs$

c) Frames 65 and 71? $0.12secs$

d) Frames 77 and 85? $0.16secs$ (2)

3) Open another video of your choice and use the markers to pinpoint 5 key stages during the action. Note down the 5 frames you have marked, what key stages of the action they mark and the times between them.

| Frame number | Description | Time Difference |
|--------------|-------------|-----------------|
| | | |
| | | |
| | | |
| | | |
| | | |

4) Experiment with the different buttons for drawing shapes. What are the functions of these buttons?

= *Free hand drawing*

= *Line Drawing*

= *Draw vertical line*

= *Draw horizontal line*

= *Rectangle drawing*

= *Circle drawing*

(6)

Open video 'bowling – back view' from the cricket folder.

5) Use the function to circle the head of the bowler in frame 38. Now describe the movement of the head in the next 10 frames. Eg.. Does it move left/right? Suggest a reason why.

Between frames 38-43 the head moves diagonally right, this is to allow the shoulder to complete circumduction and align the bowling arm in the correct position. Between frames 44-48 the height of the head decreases because as the right foot makes contact with the floor the right knee flexes, there is also flexion at the hip joint, which also lowers the trunk.

Open video 'bowling side view' from the cricket folder

6)

(a) Scroll to frame 29 (this is the point of 'front foot contact' and is a key point in the cricket bowling action). On this frame draw:

(i) A thick red horizontal line along the bowler's eye line (A).

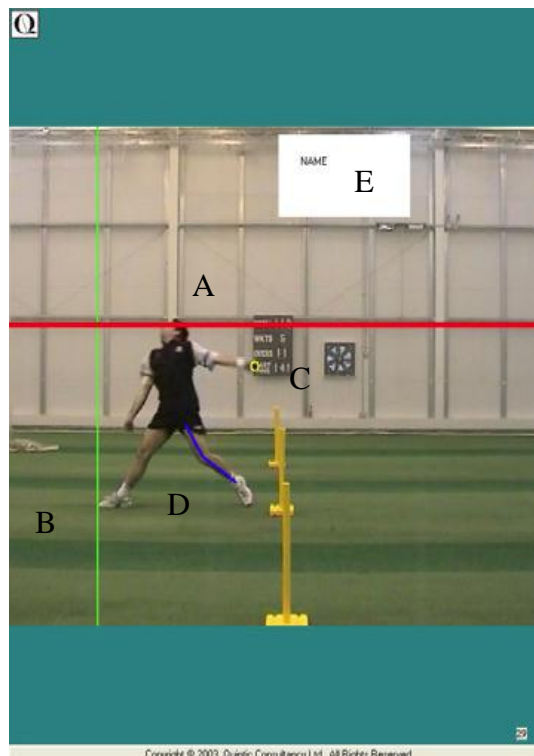
(ii) A thin green vertical line starting at the bowler's left toes (B).

(iii) A yellow thin circle around the ball (C).

(iv) A blue, medium-thickness line that runs along the left leg (D).

(v) A box filled in white with red writing inside it stating your name (E).

(ii) Click on the camera button at the bottom of the screen to create a 'Single Image capture'.



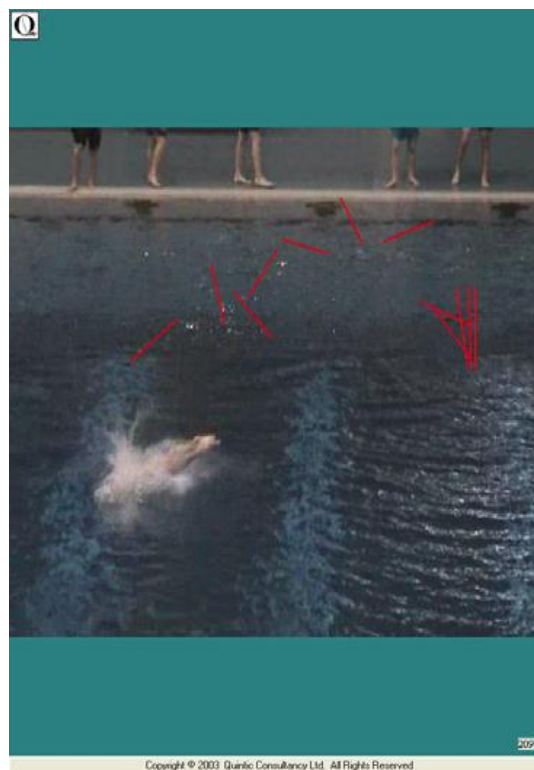
Open video '10m - Twist' from the diving folder

7)

(i) Scroll to frame 89. Draw a line down the length of the diver's body. Repeat this every 10 frames until they enter the water in frame 209. Use all these buttons in the process.

This will allow you to see the path of their body during the dive.

(ii) Click on the camera button at bottom of the screen to create a 'single image capture'



Open 'Batting 4 – SV ' from the cricket folder

Scroll to frame 62 (Impact).

Draw angles A, B, and C again. Write down the size of the angle and any noticeable differences between the two frames.

Description A

Angle = 68.00° the angle of the bat to the horizontal has decreased because the batsman has brought the bat through the downswing and tilted forwards to play the shot.

Description B

Angle = 9.20° the elbow angle has decrease due to the batsman repositioning the bat. The shoulder has been elevated and flexed as well as the elbow joint flexing.

Description C.

Angle= 4.32° the angle of the lower leg has decreased because the batsman has reduced his stride (distance between his feet) by adducting the hip joint.

(6)

(/ 45)

Tutorial 3 – Take a Picture

RECAP

Open ‘Long jump – female’ from the athletics folder

1) Set markers: once during the run-up, once at take-off, twice during the air, once on landing, and once lying in the sand. Save these markers.

2) At Take-off, draw the following shapes:

a) A thin, green horizontal line that passes through the athlete’s eyes.

b) A thick, yellow vertical line touching the athlete’s nose

c) A red angle line showing the right knee angle

d) A very thin blue circle around the athlete’s right hand

e) A box with a red background in a corner of the image with your name in it. (3)

3) a) Clear all the drawings from the clip.

b) Now arrange 3 boxes around the image. In each of them write a comment about the technique. Eg. Where is the long jumper looking? How flexed is their knee? Etc.

c) Save the boxes on the image.

QUESTIONS

1) Take a single image capture of the long-jumper and boxes you constructed earlier. Save this image as a JPEG to be recalled later. Ask your teacher if you can print this. (4)

2)

(i) Pick an image from another sport.

(ii) This time arrange 5 boxes around the image and in each of them write one comment about the technique. (5)

(iii) Take a single image capture of this and save it as a JPEG. (2)



3)

(i) Using the video 'Long jump – Female' and the markers you created earlier in the 'RECAP' section create a 6 frame sequence.

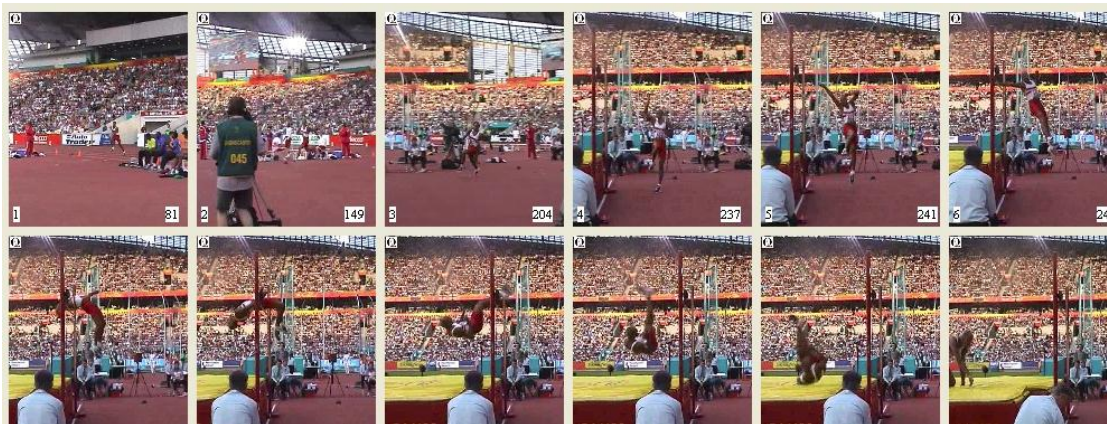
(ii) Save this as a JPEG and ask your teacher if you can print it.



4)

(i) Open the video 'High Jump – Side View' from the athletics folder.

(ii) Create a 12 frame sequence of the jump.



(iii) Name two possible uses for the multi-frame capture function...

- *PowerPoint presentation*
- *Technique analysis*
- *Handouts for coach*
- *Handouts for athlete (4)*

5)

(i) Open the video 'Long-jump – female'

(ii) Scroll to the frame where the jumper takes off. Draw the angle between the jumper's hip, knee and ankle in green. Capture this as the first image of a 9 frame sequence.

(iii) Complete your 9 frame sequence showing the angle between the jumper's knee, hip and shoulder from this point until landing.

(iv) Save this multiple screen capture as a JPEG and ask your teacher if you may print it.

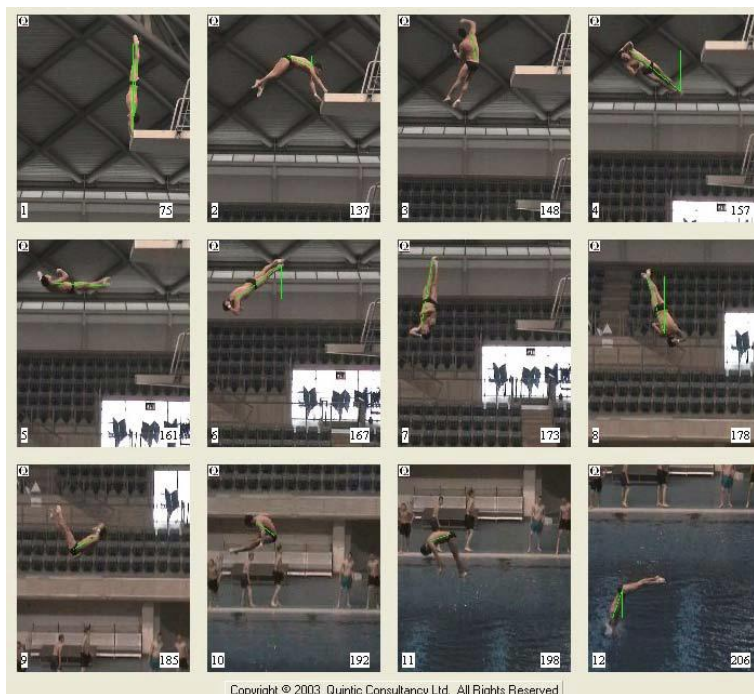


(5)

6)

(i) Open the video '10m - Twist' from the Diving folder.

(ii) Create a 12 frame sequence using the 'angle to the vertical' function along the length of the diver's body (draw the line shoulder to hip if the body is not completely straight). (4)



(iii) When has the diver completed their first complete somersault? (Hint: the diver begins with their body creating a 0° angle to the vertical)

At frame 174 the diver has completed his first 360 degree somersault (2)

7) For a video clip of your choice create a 12 frame sequence which features a different kind of shape or angle on each frame. Use this to show the variety of functions you have learned to use by changing the colour, thickness and background to your shapes. When you have finished, save it as a JPEG and ask your teacher if you may print it. (5)

(/ 37)

Tutorial 4 – Synchronisation

RECAP

Only compete this if you have Quintic Sports, Quintic Coaching or Quintic Biomechanics.

Open 'IG-Side' from the golf folder

1)

(i) Scroll to the frame just before the golfer starts his back swing.

(ii) Measure the angle between the golfer's arms.

(iii) Create a 6 frame multiple screen capture sequence of this skill with this angle visibly drawn in each frame.

(iv) Save this as a JPEG.

(v) Open this multiple screen capture sequence in Microsoft Word and add an appropriate title.

(vi) Below this picture, type a short description of putting technique that you have learned from watching this clip. Focus particularly on the angle of the arms throughout the shot.

QUESTIONS

1) Open the following videos. For each one state whether they are best viewed in the vertical mode the horizontal mode or whether they are equally as good in both. (*Hint: Watch the whole clip through in both modes before deciding on your answer*)

| Video | Best in Vertical | Best in Horizontal | Both |
|------------------------|------------------|--------------------|------|
| Sprint Start – Side on | | X | |
| Rugby Drop Punt | X | | |
| Boxing UC Shot | X | | |
| Cricket - Bowling SV | | | X |
| Trampoline 2.5 twist | X | | |

(5)

Think of 3 other sports actions that could be seen completely in the Vertical and Horizontal Mode.

| Vertical | Horizontal |
|----------------------------|----------------------------------|
| Trampoline | Hurdles |
| Rings | 100 m sprint |
| Diving (vertical movement) | Golf swing (horizontal movement) |

(6)

Open the video clip 'Drop-punt right' from the Rugby Folder

2) You are a PE teacher; describe this skill to a beginner : They are right footed.

- *Start with feet shoulder width apart, arms slightly in front of your body with elbows flexed holding the ball at the top (left hand) and the bottom (right hand) at waist height.*
- *Look down at the ball and take 2 strides starting on your left leg, leaning slightly forward.*
- *When right foot contacts with the ground after the 2nd stride drop the ball from waist height. Extending the left arm to the side and behind.*
- *As the ball is dropping aim to plant the left leg to the side of where the ball is dropping.*
- *Start to lean back slightly while bringing right (striking) leg forward. Keep leg flexed at the knee until both thighs are level.*
- *Flex knee causing kicking action of the lower leg, while plantar flexing the foot. So that contact with the ball is made on the laces (top of the foot).*
- *Aim to kick the ball when it is about 15 cm off the floor.*
- *After kicking the ball the leg should continue to flex at the hip joint, extension of the knee continues until horizontal.*
- *Left arm should also flex forward to help keep balance.*
- *The leg will start to decelerate 2 frames after impact and be brought back down to the ground under control.* (5)

3) Now, imagine you are teaching this skill to a left-footed person. Write down how you would describe the movement to them.

- *Start with feet shoulder width apart, arms slightly in front of your body with elbows flexed holding the ball at the top (right hand) and the bottom (left hand) at waist height.*
- *Look down at the ball and take 2 strides starting on your right leg, leaning slightly forward.*
- *When left foot contacts with the ground after the 2nd stride drop the ball from waist height. Extending the right arm to the side and behind.*

- *As the ball is dropping aim to plant the right leg to the side of where the ball is dropping.*
- *Start to lean back slightly while bringing left (striking) leg forward. Keep leg flexed at the knee until both thighs are level.*
- *Extend the knee quickly causing kicking action of the lower leg, while plantar flexing the foot. So that contact with the ball is made on the laces (top of the foot).*
- *Aim to kick the ball when it is about 15 cm off the floor.*
- *After kicking the ball the leg should continue to flex at the hip joint, extension of the knee continues until horizontal.*
- *Right arm should also flex forward to help keep balance.*
- *The leg will start to decelerate 2 frames after impact and be brought back down to the ground under control.* (5)

4) In the video clip Drop-punt right from rugby folder you have ‘flipped’ the image.

(i) Use this mirror-image to write a description of the skill to the lefthander you are teaching. *See answer for question 4* (4)

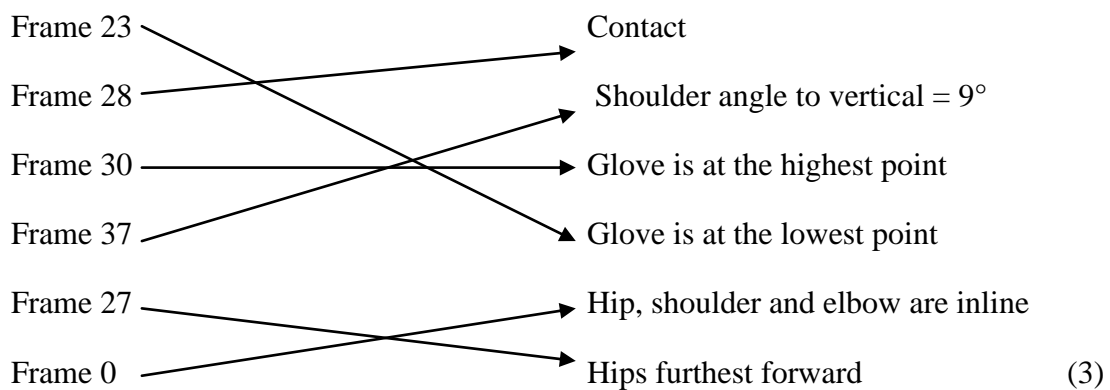
(ii) Was it easier to write this description than your answer to question 4? Explain your answer.

This exercise should now be a lot easier as the video will now show the skill, as a left footed player would perform it. (3)

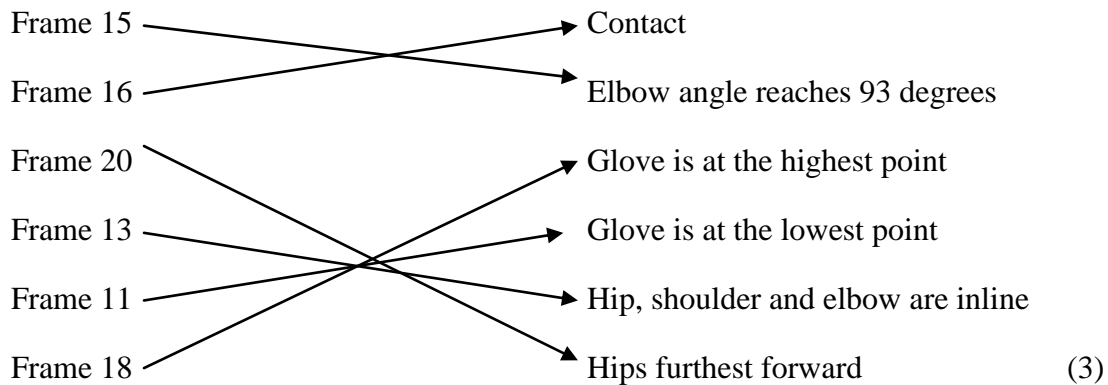
5) (i) Open the video ‘Boxing UC shot’ from the boxing folder in the main window.

(ii) Open the video ‘Boxing arm shot’ from the boxing folder in the best window.

(iii) First look at the video in the main window. Match up the frames with the correct description of the action you can see in them. The first one has been done for you.



(iv) Now look at the video in the Best Window. Match up the frames with the correct description of the action you can see in them.



7)

(i) Pause both videos at the point of impact (use the video scroll bar to get the exact frame).

(ii) Synchronise the videos

(iii) Describe any differences you see in:

Path of arm during the movement?

During the uppercut, the arm stays flexed throughout the movement where as with the straight arm punch the arm goes from flexion to extension in a short period of time to generate the force.

Angle of the elbow at impact?

Angle of elbow during the straight-arm punch is 167 degrees where as in the uppercut it is 112 degrees at contact this shows that the elbow is in a more flexed position at contact during the uppercut.

Height of shoulder throughout the movement?

During the straight arm shot the height of the shoulder remains constant where as during the uppercut the shoulder height drops quickly at the start then increases back to the original height by the time contact is made.

Angle of the shoulder at impact?

The angle of the shoulder at impact with the straight arm punch is 97degrees where as with the uppercut the angle is 71 degrees.

Path of the hand in the follow-through?

In both movements the path of the hand punches through the pad before returning to the start position. During the straight arm punch the arm returns back to body in straight line. Where as during the upper cut the arm returns back to the start position before moving to the side.

8)

(i) Open the video 'discus female' from the athletics folder in the main window.

(ii) 'Set Background' at Frame 0.

(iii) Describe the differences you can see in the player's movement between the background and:

Frame 11?

Athlete's arm has moved clockwise (backwards) from starting position, left leg is flexed, and closer to the Ground.

Frame 20?

Athlete has now started moving anticlockwise and has passed her starting position, body has become more upright (extended) and legs are also extended.

Frame 34?

Athlete has continued rotating anticlockwise and is now balanced on her right leg with her left leg flexed behind her. Her throwing arm (right) is also now behind her body. Athlete has also completed a full rotation and is positioned in the centre of the circle.

Frame 44?

Athlete has continued rotating anticlockwise and is now totally off the floor, her throwing (right) arm has come in front of her body and her left arm is flexed and at her side. Athlete is now also positioned at the front of the throwing circle.

Frame 54?

Athlete has continued in her anticlockwise movement and is landing on her right leg while her left leg is flexed and still in the air, the athlete is now also facing out of the cage towards the field, with both arms extended into the air.

(10)

9)

(i) Open the video 'Batting - Off-drive - FV' from the cricket folder in the Main Window

(ii) Open the video 'Batting - On-drive - FV' from the cricket folder in the Best Window.

(iii) Synchronise the two videos at ball impact.

(iv) Name 3 differences and 3 similarities you can see between the two shots.

Differences

Similarities

.....

.....

(6)

(/ 60)

Tutorial 8a – Manual Digitisation

RECAP

1) When capturing video footage what are the trim in and trim out functions?

Trim in and Trim out and allow unwanted frames to be removed from the captured film making sure you only save the frames you really need.

2) What is the maximum amount of time for which you should capture in one go?

No more than 60 seconds.

3) What is the name of the piece of equipment that links the video camera to the computer?

Fire wire.

4) What is the difference between capturing at 'Half' and 'Full' size?

You can capture no more than 60 seconds at a time when using the video capture size FULL. If you are capturing at HALF size you can capture for as long as you like.

QUESTIONS

Using the video 'Bowling – Side View' from the cricket folder

1) Calibrate the video by knowing that the bowler's right forearm (elbow to wrist) is 0.3 metres long (draw vertical line in frame 19) and the base of the middle set of stumps is 0.2m wide (draw horizontal line).

2) Calibration works by measuring the distance between 2 points on screen and working out how far this is in real-life. Distances on screen are measured in 'digitising points' (dp), which is the number of coordinate points it covers in the horizontal and vertical directions.

(i) Which letter represents coordinate measurements in the horizontal direction? *X coordinate*

(ii) Which letter represents coordinate measurements in the vertical direction? *Y coordinate*

3) A scale is created which tells you how many metres are represented by 1 digitising point.

(i) Use the scale $1\text{dp} = 0.1$ metres to calculate the real lengths of these objects:

| Object | Lengths on video (dp) | Real lengths (m) |
|-----------------------------------|-----------------------|------------------|
| <i>Example: Rugby ball length</i> | 3 | 0.3 |
| Cricket bat | 9 | 0.9 |
| Rugby player's shoulder width | 4 | 0.4 |
| Football goal width | 70 | 7.0 |
| Netball post height | 30.5 | 3.05 |
| Cyclist's lower leg | 3.5 | 0.35 |
| Hockey stick | 10 | 1.0 |

(ii) Can you use the scale $5\text{dp} = 0.1$ metres to calculate the real lengths of these objects.

(Hint: it may help to change this scale to work out how many metres are represented by 1 digitising point.)

| Object | Lengths on video (dp) | Real lengths (m) |
|-----------------------------|-----------------------|------------------|
| <i>Example: Ballet shoe</i> | 13 | 0.26 |
| Long jump pit | 350 | 7 |
| Diving platform height | 500 | 10 |
| Tennis ball | 5 | 0.1 |
| Basketball net diameter | 22.5 | 0.45 |
| Javelin length | 105 | 2.1 |
| Trampolinist's hip width | 20 | 0.4 |

4) Can you calculate the scale when given the lengths on video and in real life in these examples? This time calculate the scale by working out how many digitisation points represent 1 metre – '1m = ?? dp'

| Object | Lengths on video (dp) | Real lengths (m) | Scale |
|---------------------------|-----------------------|------------------|--------------|
| <i>Example: long jump</i> | 180 | 6 | 1m: 30dp |
| Diving board length | 50 | 5 | 1m: 10dp |
| Volleyball net height | 300 | 3 | 1m: 100dp |
| Cricket stump | 20 | 1 | 1m: 20dp |
| Kayak paddle | 50 | 2.5 | 1m: 20dp |
| Rowing oar | 70 | 3.5 | 1m: 20dp |
| Squash racket | 125 | 1.5 | 1m: 83.333dp |

5) Imagine you have digitised video clips of two different swimmers performing the same stroke. Explain why it is important to calibrate both clips in order to compare the speeds of the two swimmers.

Both clips must be calibrated as the swimmers will have different limb lengths, the swimmers may have different techniques as well.

Open the video 'sprint start' from the athletics folder.

6) You are going to digitise one complete cycle of the runner's left leg.

(i) At what frame numbers are you going to start and end your digitisation? Justify your answer.

You would use frames 50-62 to digitise the sprinters movement.

This is from the set position (where he firsts start's to move) to frame 62 left toe contact with the floor

(ii) Create this template for your digitisation.

(iii) Why can't you continue to digitise after frame 65?

You cannot continue to digitise after frame 65 as after this point the camera starts to pan sideways. Therefore no data (velocities, accelerations) would be able to be generated.

(iv) Which point do you think will show the greatest peak values of horizontal velocity – hip, knee, ankle or toe? Explain your answer.

The joint with the greatest value of horizontal velocity will be the athlete's toe. This is because velocity = distance / time. As the toe has the furthest distance to travel in the same time increment. Also the toe is where the majority of the running force is generated through so during toe off.

(v) Which point will show the lowest peak values of horizontal velocity throughout the stride – hip, knee, ankle or toe? Explain your answer.

The joint with the lowest velocity is the toe as during the swing phase of the gait movement the leg is returning to the start position. Therefore there is no large force acting upon the foot or toe.

Tutorial 9 – Digitisation Analysis

RECAP

Open the ‘no twist side view’ from the trampoline folder.

- 1) Create this digitisation template
- 2) Calibrate the video by drawing a line in the horizontal direction across the bed of the trampoline. It is 4.28 in length.
- 3) Digitise the video between frames 117 and 168.
- 4) Save the digitisation trace.

Questions

Open the video ‘no twist side view’ from the trampoline folder.

1)

(i) Set markers at frames 8, 46, 62, 88, 145, 209. What key points during the movement do these frames represent?

Frame 8 *Take off.*

Frame 46: *At peak of jump, has rotated through 90 degrees*

Frame 62: *Has now rotated through 180 degrees and is starting descent.*

Frame 88: *Has now rotated another 90 degrees and is landing on trampoline bed.*

Frame 145 *Athlete is now inverted and CM is at peak height.*

Frame 209: *Athlete has rotated 180 degrees back to start position and is preparing to land.*

(ii) Load the digitisation trace you created in the ‘RECAP’ section.

(iii) Create a 6 frame ‘multiple screen capture’ displaying some parts of the digitisation trace on the 6 marked frames in accordance with the following instructions. Do this by pressing down the following buttons:

Frame 12 = +

Frame 15 = +

Frame 17 = +

Frame 19 = +

Frame 22 = + +

Frame 34 = + + +

(iv) Save this sequence as a JPEG and ask your teacher if you can print it. (6)


(vi) Using your knowledge of the functions of these tools, explain why the combination of + would cause NO lines to be displayed on the screen

This is because one of the buttons shows the trace of the whole video where as one shows the trace of only one frame. Plus both of these buttons cannot be pressed at the same time.

(2)

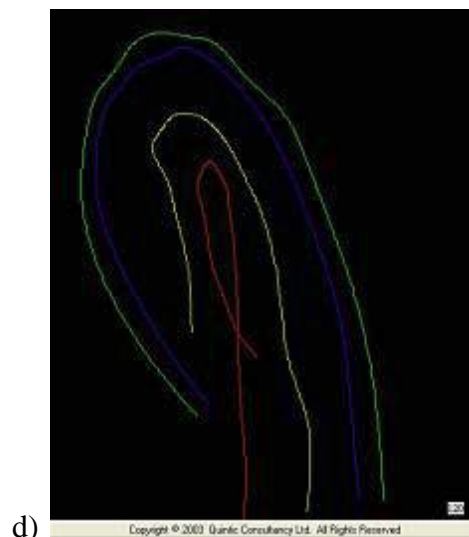
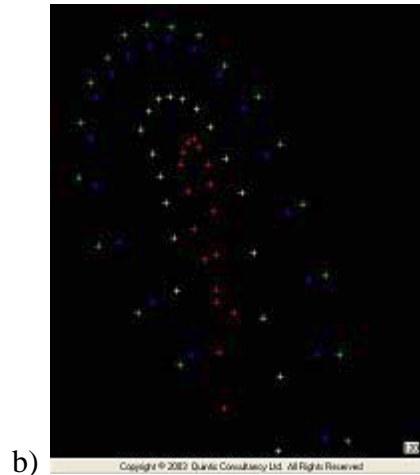
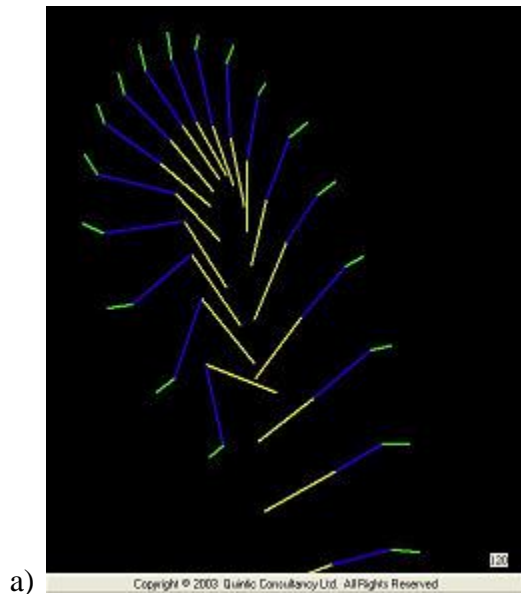
2) Body segments are always measured between joints (I.e. The lower leg is measured between the knee and the ankle bone; not the floor). Use the ruler function to measure the following lengths of body segments:

| Body segment | Length |
|-------------------------|--------|
| Forearm | 0.29 |
| Foot | 0.22 |
| Lower leg | 0.51 |
| Upper arm | 0.28 |
| Hand | 0.20 |
| Thigh | 0.44 |
| Trunk (shoulder to hip) | 0.64 |

3) Open the Animation Window. Scroll to frame 117. These buttons are used in various combinations to display the digitisation trace in this window. 

(i) Which buttons are used in combination to create the following pictures?

(Hint: Take note of the frame number in the bottom right hand corner of each animation)



(ii) In the animation window create images using the following combinations of tools.
Each time save it as a JPEG:

a) +

b) ++

c) ++

d) ++

(iii) In Microsoft Word, open all four JPEGs you have just created in part (ii) of this question. Adjust their sizes to ensure they all fit on one page.

(iv) Type in the title 'Animations of Trampolinist' and type your name at the top of the page. Ask your teacher if you may print this. (6)

4) Using the video 'no twist side view' from the trampoline folder

Open the analysis window by clicking on this button

When you press 'Play' in the main window what happens in the analysis window?

The graph scrolls along with the video. (1)

5) Select 'Display axis' from the menu across the top of the analysis window.

(i) Change the axis to 'Distance'. What is the unit of measurement? *Metres (m)*

(ii) Change the axis to 'Velocity'. What is the unit of measurement?

Meters per second (ms^{-1})

(iii) Change the axis to 'Acceleration'. What is the unit of measurement?

Meters per second per second (ms^{-2}) (3)

6) Select 'Save results' from the menu across the top of the analysis window and then 'Save results as an Excel file' from the drop-down menu.

Open Microsoft Excel from your desktop and open the results you just saved.

Use these results to answer the following questions:

(i) What is the horizontal distance of the right toe at frame 116?

0.00m

(ii) What is the horizontal distance of the right hip at frame 167?

- 0.087m

(iii) What is the horizontal distance of the right ankle at frame 149?

0.198m

(iv) What is the horizontal distance of the right knee at frame 131?

- 0.208 m

(v) What is the vertical distance of the right ankle at frame 116?

0.00m

(vi) What is the vertical distance of the right toe at frame 134?

- 2.201m

(vii) What is the vertical distance of the right hip at frame 158?

- 0.069m

(viii) What is the vertical distance of the right knee at frame 167?

1.161m

(8)

(/ 55)