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[Academic\_Unit (underlined)]

Volume [X] of [Y]

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Thesis for the degree of [name of degree]

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**ABSTRACT**

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Thesis for the degree of [Doctor of Philosophy\_or\_something]

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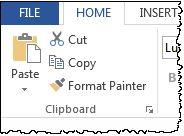


Figure 1 The Clipboard group in Word 2010

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# Databases

## The Difficulties of Acceleration Databases

New techniques benefited greatly by the emerge of challenging databases. These databases push the limits of the present techniques and expose where they fail, stir the inspiration of new techniques. Therefore well designed databases are essential for quantitatively evaluation of the new algorithm. For acceleration, it is difficult to find a proper database since previous research did not notice the higher order of motion flow contain different information. As far as we know, there are no databases designed for acceleration or even higher order motion flow algorithm evaluation. Therefore, we build a new database by our own for evaluating acceleration algorithm in this thesis. Before illustrating the results, it is worth to describe how these images datasets are created.

## Synthetic Images Database for Acceleration

The advantage of synthetic images is that the input signal is clean: without motion blur, specularity, rigid motion or other types of noise. Also, the motion field and scene properties can be manipulated as required. This enable us to test whether we can detect acceleration and ground truth can be obtained easily.

Firstly, we use five shape masks with different motion in a sequence of synthesised images as shown in Figure 2.1(a). These contain: one stationary shape; an upper circle which is moving with constant velocity along the x axis; the lower circle is also moving horizontally but with constant acceleration; the smaller triangle is rotating with constant angular velocity (rotation incorporates radial acceleration); and the larger triangle is a pendulum which undergoes different types of motion during a period (when the massive bob at equilibrium position, the pendulum has maximum velocity and zero acceleration; when it swinging to the sideways, the accelerating is increasing while velocity is decreasing until ceases to zero). Texture is essential for optical flow to detect motion so these objects and background are all randomly textured and the texture is fixed during the image sequence, as shown in Figure 2.1(b). The objects are not visible in the textured image but if we view the video composed of these synthesised images, we can perceive the objects as moving.

|  |  |
| --- | --- |
| ../Python/pendulum+circle+notexture/frame_31.png  (a) Shape mask | ../Python/frame_31.png  (b) Textured shapes |
| Figure 2.1 Synthesised images. | |

We selected three successive synthesised images as shown in Figure 2.2 to illustrate the artificial motion, the instantaneous velocity of the accelerating circle exceeded that of the circle in constant velocity. The simple pendulum is at the centre position between the resting equilibrium position (maximum velocity and zero acceleration) and its limit position (zero velocity and maximum acceleration). The rotating small triangle…

|  |  |  |
| --- | --- | --- |
| ../Python/pendulum+circle+notexture/frame_30.png |  |  |
| Figure 2.2 Selected synthesised image masks for experiment. | | |

The second image sequence involving linear motion is synthesized by using images from the Middlebury database [4]. A subpart of a frame from Mequon (the block of two figures in Figure 2.3) in Middlebury is embedded in a Wooden background. The Mequon sub-frame shifts along a linear trajectory to the lower right corner, both horizontally and vertically.

For evaluating acceleration’s “…” components decomposing algorithm, we use the same images to manipulate motion involving rotation for testing radial and tangential acceleration. The Mequon square rotates at the center of the background to ensure the motion is formed by both radial and tangential acceleration. Figure 2.3 illustrates both linear and circular motion of this set of image sequences, (a) is Mequon at the starting point, after moving to the left and right corner 32 pixels Mequon reach the position in (b). In (c) Mequon rotated 10 degree centred (d) is Mequon rotated 30 degree.

|  |  |
| --- | --- |
| testImg/8pixels-0.png  (a) | testImg/8pixels-3.png  (b) |
| testImg/rotating-10.png  (c) | **testImg/rotating-20.png**  (d) |
| Figure 2.3 Examples of artificial motion. | |

## Real-world Sequence

Apart from the synthetic images sequences, real world data is also important. A pool break video from an overhead view is used to evaluate the performance of acceleration detection in the real world. An overhead view can provide the best view to observe the motion of the objects during movement without normalize or visual angle issue, as shown in Figure 2.4 (a). In order to compare with the experimental data with an estimated value, we use the Hough transform to locate the position of snooker balls and one consistently detected ball along in all frames of the sequence was selected as the test data. The ground truth of selected ball positions was recorded manually.

|  |  |
| --- | --- |
| ../Test%20Img/PoolBreak/09.jpg  (a) Pool break video | ../Python/PoolBreakDetCirc/PoolBreak-09.jpg  (b) Detecting the snooker balls using Hough transform |
| Figure 2.4 Ground truth evaluation data[[1]](#footnote-1) | |

|  |
| --- |
| Screen%20Shot%202015-09-11%20at%2000.37.57.png |
| Figure 2.5 The trajectory and the acceleration of the object |

Figure 2.5 is the zoom-in trajectory and estimated acceleration (arrows) of the selected snooker ball and the positions (red dots) are sampled every three frames for visualisation. The ball begins to move at the left bottom of the image and decelerates until it is hit by another ball at frame 26 (the turning point). The collision changed the trajectory and acceleration of the object. The ball stopped at the top of the image at the end of the sequence. The direction of the arrows denotes the resultant acceleration of the snooker ball at that moment. If the arrow point forward, it denotes the snooker ball is accelerating and vice versa.

## Gait Databases

In Chapter 5 we suggest a new technique to detection heel strike for gait analysis. We evaluate our method on three benchmark databases: SOTON [5], CASIA [6], [7]and OU-ISIR [8]. The gait data used in this paper is collected with various controlled environments. Here we are going to introduce them.

Table 2.1 Database information.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Database | CASIA-A (45°) | CASIA-A (90°) | CASIA-B | SOTON | OU-ISIR |
| Lighting Control | NO | NO | Yes | Yes | Yes |
| Camera Visual Angle () | 45 | 90 | 54 | 90 | ~75 |
| Number of subjects | 13 | 25 | 15 | 21 | 15 |
| Number of heel strike | 96 | 98 | 126 | 114 | 120 |
| Frame size | 240×352 | 240×352 | 240×320 | 576×720 | 480×640 |

### SOTON

The SOTON gait database [5] was built at 2002 by the University of Southampton.

It

|  |  |
| --- | --- |
|  |  |
|  |  |
| Figure 2.6 Examples of inside data and processed silhouette that we used in this thesis. | |

### CASIA

[6]

|  |  |
| --- | --- |
|  |  |
|  |  |
| Figure 2.6 Examples of inside data and processed silhouette that we used in this thesis. | |

### OSAKA

[7]

|  |  |
| --- | --- |
|  |  |
|  |  |
| Figure 2.6 Examples of inside data and processed silhouette that we used in this thesis. | |

## Conclusion

In this Chapter, we have introduced the synthetic databases that we built to evaluate acceleration. In the next Chapter, we are going to introduce the previous research of Optical Flow.

# A new chapter

## Adding new sections

The template has 6 chapters and 2 appendices. Find out how to use [Page Layout](https://guides.soton.ac.uk/uni/isolutions/lg-office-2013/start/default.htm?A3C076D6-ADAA-44C5-AC9F-C8CFF551A08F) features to add

* New chapters
* New appendices
* Landscaped sections

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# Chapter 5 awaits content

## Chapter 5 subheading

# Finishing

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1. Your first appendix
2. Your second appendix

Glossary of Terms

List of References

Bibliography

1. Video is taken from: <https://www.youtube.com/watch?v=XpPbrLiSMCY> [↑](#footnote-ref-1)