BLG453E
Homework-4

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The doll was so utterly devoid of imagination that what we imagined for it was inexhaustible. For hours, for weeks on end, we must have been content to lay the first fine silk of our hearts in folds around this immobile mannequin, but I have to believe there were certain abysmally long afternoons when our twofold inspirations petered out and we suddenly sat in front of it, expecting some response. (...) It remained silent then, not because it felt superior, but silent because this was its established form of evasion and because it was made of useless and absolutely unresponsive material. It was silent, and the idea did not even occur to it that this silence must confer considerable importance on it in a world where destiny and indeed God himself have become famous mainly by not speaking to us. (...) That we did not then make you into an idol, you brat, and perish from fear of you, was because —I must tell you— it was not you we had in mind. We were thinking of something quite different, invisible, something we held at arm's length from you and from ourselves, furtively, with vague anticipation, something for which both of us were in a way only pretexts. We were thinking of a soul, the soul of the doll.

Some Reflections on Dolls, Rainer Maria Rilke

Ja, ich reiß' der Puppe den Kopf ab
Und dann beiß' ich der Puppe den Hals ab
Es geht mir nicht gut, nein!

Till Lindemann, Puppe

- You should write all your code in Python language.
- Cheating is highly discouraged.
- Ninova only stores files under 20 MB. If you could not upload your results, you can share them with me via Dropbox.

1 - Part 1: Hand tracking (30 pts.)

Both Rilke and Lindemann were angry with the dolls, and you will be angry with them too. However, instead of a toy doll, in this homework we will work on a ragdoll which is used for character animation. With the homework document, I uploaded three video files: *biped_1.avi*, *biped_2.avi* and *biped_3.avi*. The first file is a 4 seconds long video containing a walking ragdoll animation with a black backgorund. In the second video, a checkerboard ground plane and a checkerboard wall plane are added. In the last video, the camera is shaking up and down. Some example frames from the videos are given in Figure 1.

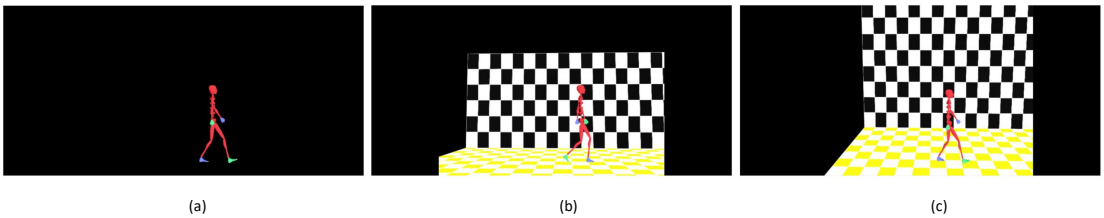

Figure 1: Exampole frames from the ragdoll videos

To read the videos frame by frame you can benefit from the *moviepy* library. An example for reading frames is given below.

```
import moviepy.video.io.VideoFileClip as mpy
import cv2

biped_vid = mpy.VideoFileClip("biped_1.avi")

frame_count = biped_vid.reader.nframes
video_fps = biped_vid.fps

for i in range (frame_count):
 walker_frame = biped_vid.get_frame(i*1.0/video_fps) #To get frames by ID
```

In this part, you will use "*biped_1.avi*". First, define coordinate points for right hand of the ragdoll (green one). Then, for consecutive frames, implement Lucas-Kanade algorithm locally to find the OF vector of the hand. Using cv2.arrowedLine function, place **one** arrow on the hand according to the OF vector[1]. You should not misplace the arrows in any frame. Along the walking sequence they should remain on the hand.

[1]For each part of the homework, you can use another frame from the sequence to make a better prediction if you want (e.g. to predict the motion vectors of Frame *n*, instead of only using Frame *n+1*, you can also use Frame *n+2*. It is not necessary but it may increase your findings.)

2 - Part 2: Wall Tracking (30 pts.)

In this part, you will use "*biped_2.avi*". It contains the same sequence but now, there is a wall and ground. Here the OF vectors for five areas will be calculated.

- Think of an imaginary region between (x:210, y:183) and (x:308, 7:315) as given in Figure 2. You should create and place OF vectors for each corner of this region. Do not translate the region to another place according to OF vectors. These vectors will be useful for analysing the movement of the wall. Since our camera's focus is centered on the walking ragdoll, while the camera follows the ragdoll, it also moves up and down slightly.

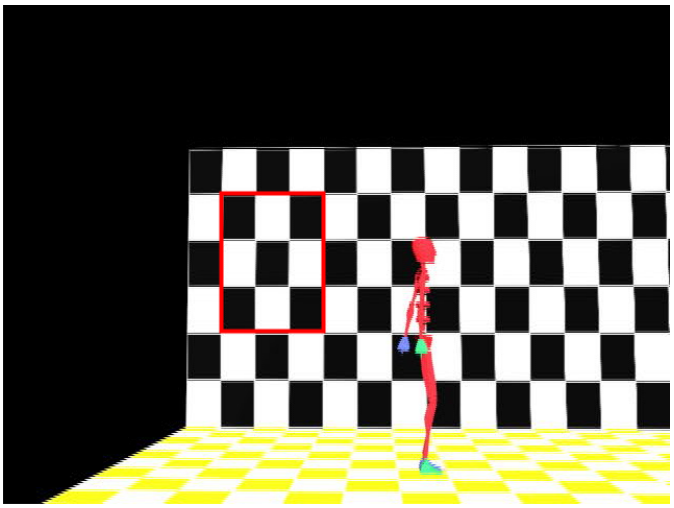

Figure 2: The region to analyse the wall

- You should also create the OF vectors as in the first part. Your code should not be effected by the pattern on the wall.

3 - Part 3: Camera Motion (40 pts.)

In this part, you will use "*biped_3.avi*". As it is mentioned before, the main problem for this part is the camera's vertical motion. We want to decrease the effect of this motion to obtain a better vision of what the ragdoll is doing. Thus,

- Import the OF data you have calculated in Part 2. This will act as our **ground truth.**
- Calculate the hands' OF vectors for each frame as in Part 2. Now, the vectors are highly different than the vectors obtained in the previous part. Calculate the MSE error between this two.

- Considering the effect on the walls, calculate corrected OF vectors. MSE error between these OF vectors should be lesser.

Report the MSE scores.