Q1. Write down your observations. Which method is 'superior'? How did you establish this? Report all quantifiable parameters (and be careful in reporting correct time). Use time per frame to quantify your answer

- In this task by observing the quality of videos after applying two methods, we found the quality of (detector, descriptor) method is good. Hence (detector, descriptor) method is superior. We have come to the conclusion by observing mainly two things, **'Speed'** and '**Stability'.** For the '**sparse'** method output is more stable than the **'dense'** method which one can witness by running the provided code. For practical purposes speed is an important parameter which we can ignore and the sparse method is faster than dense as can be seen by referring to below per frame calculated time.
- Time per frame :
    - Part-A: 0.10320568084716797
    - Part-B: 0.8375487327575684

Q2. Apply the program of Q1 on Q2. Provide your observations (in the context of the subsequent steps).

Use Question 2, subQuestion D, E

- In part-A: As in Q2 video apart from camera shake it also has an object moving in it, the video stabilization is poor
- In part-B: As in Q2 video apart from camera shake it also has an object moving in it, the video stabilization is poor
- Observations:
    - Since the object in the 2nd video is moving quite fast than the one in the 1st video, sudden movements cause a high difference between frames. If the difference can be too much and disturb the translation. Occlusions are also a big problem as the scenes behind the people is now visible.

Q3.

(a) Apply your code from Q1 to the videos in the folder Q3. You would notice that the stability comes at a "cost". Explain what is going on here.

Ans:-

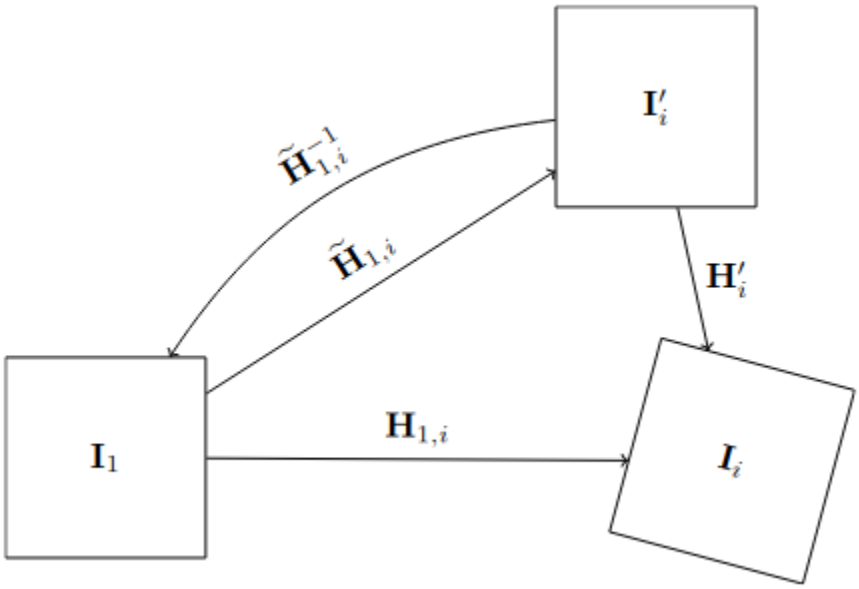
The stability assumes flow between two consecutive frames. In Q3 there are sudden movements resulting in many occlusions. Hence, we go out of the frame a lot and the result isn't smooth.

(b) In the previous questions, you used a simple Gaussian filter to smooth the motion. Can this simple smoothing introducing the problem? Propose a better temporal smoothing Technique.

Ans:- There are plenty of methods discussed in many papers. For smoothing arbitrary camera motions we have used Gaussian smoothing but robust L1 regularization strategies have also been proposed in literature to maximize the size of the

cropping window. Another way is to approximate the smooth camera path by fitting a polynomial curve or by segmenting the camera path to define an adaptive smoothing.

Another approach that we found interesting is **Compositional smoothing**. The idea of compositional smoothing is illustrated in the figure below. The objective is to find the transformations {H'i} that relate {Ii} to {I′i}, so that the smooth transformations { ˜H1,i} do not include the high frequency motion. The compositional smoothing approach is the process of calculating the transformations that simulate a smooth registration of the current frame with respect to a given reference frame.



(c) List other problems with amateur videos including this one. Provide ideas for solutions.

Ans:- Other problems that an amateur may face are proper focus, low light scene, sudden change in scenery which may add intensity change in the video. To tackle this problem we have many solutions like using **OIS (Optical Image Stabilization), EIS (Electronic Image Stabilization)** which takes care of the stabilization. Softwares like **Adobe, DaVinci Resolve** that provides full video stabilization solutions**.** Pose information can be used to get better results. Additional sensors like Gyroscope help collect information about orientation of the camera which definitely helps.