Eulerian based Video Acceleration Magnification:

Significance:

A video sequence reveals more than is visible to the naked eye. Subtle changes, such as the slight jerk on the head during blood flow[1], the change in colour of person's face due to blood ,the mild dwindling of a crane in the construction site and the expansion and contraction of the abdomen during breathing are such examples. These small changes can be used to reveal important information about the scene.

Eulerian Video Magnification techniques, [2],[3]seeks to amplify small changes, by a combination of spatial and temporal filtering of a frequency band of interest.

Objective:

To implement Eulerian Video Magnification on a Video Sequence using a Temporal Bandpass filter.

Methodology:

The Linear Eulerian Video magnification approach assumes that temporal variations are linear on the spatial scale. The output is obtained by temporally filtering the image, and adding an amplified version of it to the input.

The implementation involves the following steps:

ButterWorth Bandpass Filter:

- Create a laplacian pyramid of the original image to obtain the image at different scales.
- Filter the difference using a temporal bandpass filter in a desired frequency range.
- Add an amplified version of the filtered signal to the original image.

Ideal Bandpass Filter:

- Create a laplacian pyramid of the original image to obtain the image at different scales.
- Create a stack of the laplacian pyramid of the input video sequence
- Filter the stack by using an ideal bandpass filter mask and Fourier decomposition
- Reconstruct the Final Video by adding an amplified version of filtered frames to the original frame.

Final Results:

1. Implementation of Eulerian Video Magnification using a butterworth filter applied between two frames obtained for different values of frequency bands.

2. Implementation of Eulerian Video Magnification with a temporal ideal filter on the entire video sequence for different value of frequency bands

3. Live Video Magnification of incoming frames using Eulerian Motion Magnification and butterworth filter. The output is displayed as a grayscale image to preserve the frame rate.

Observations :

1. In case of **'face.mp4'** the ideal filter performed better giving a more significant magnification in the narrower frequency range(0.833-1Hz). However, in the wider frequency range both methods gave significant magnification. (0.5-1Hz)

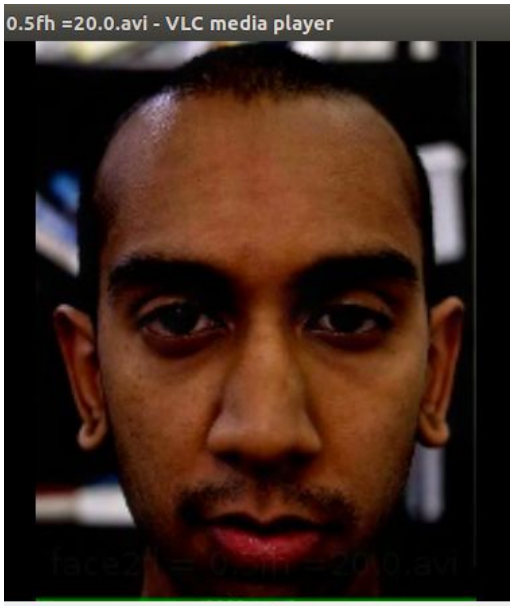
ButterWorth 0.5-1Hz

Ideal 0.5-1Hz

2. In case of ‘**face2.mp4’** , I have kept a narrow frequency range and a broad frequency range. The narrow frequency range, both methods do reasonably well. However the ideal filter gives more significant magnification. (0.833 - 1Hz)

In the larger frequency range (0.5-20Hz) the ideal filter performs better as it magnifies high frequency motion with little noise. The butterworth filter on the other hand gives significant amount of noise amplification.

Butter Filter(0.5-20Hz)

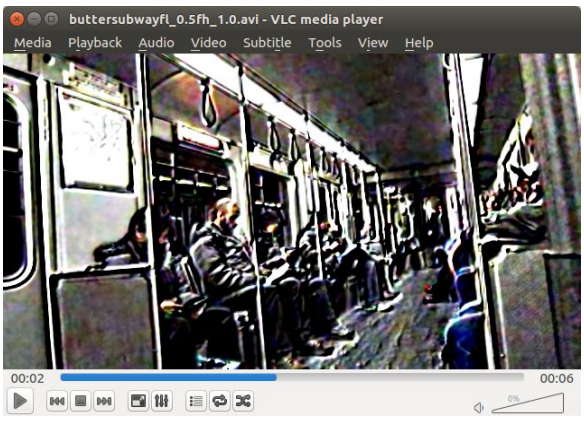


Ideal Filter(0.5-20Hz)

3. In case of **'subway.mp4'** for higher frequency both methods perform significantly well.

In lower frequency range both algorithms fail to perform very well (0.5-1Hz). Artifacts are more significant in the butter filter.

Ideal Filter (0.5-1Hz)

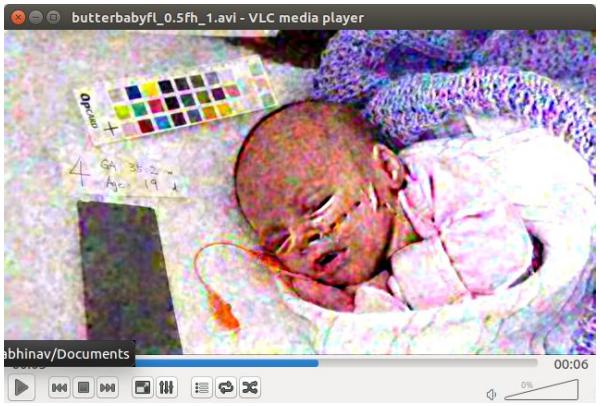


Butter Filter (0.5 - 1Hz)

4. In case of **‘baby.mp4’** the performance is excellent using the ideal filter for a higher frequency range. The results of the butter filter are not as good as the one obtained with the ideal filter. (2.333-2.666Hz).

In lower frequency range(0.5-1Hz) both algorithms fail to perform significantly well leading to noise amplification.

Ideal Filter 0.5Hz - 1Hz



Butter Filter 0.5Hz - 1Hz.

Conclusions:

1. The Ideal Filter is in most cases a better option than the butterworth filter in terms of output quality . It can operate on narrower ranges of frequency.

This can be explained by the global nature of its operation on all frames of the video leading to better quality filtering. However, it is computationally quite expensive.It involves the calculation of the fourier transform of the video stack. It cannot be used for live video magnification.

2. The butterworth filter on the other hand renders the filtered frame only using subsequent frames. It cannot operate on very narrow frequency ranges.

However, despite giving significantly poorer output quality, it finds its use in Live Video Magnification.