DSP 2 - Team Taylor

Anant Tripathi

Andrew Durden

Sumer Singh

Feature Extraction

- As data was videos (changing w.r.t to time and space), we can make use of spatial as well as temporal features.
- Variance Fluctuations
- Beat Frequency
- Optical Flow

Variance Fluctuations

- Since cilia are relatively mobile in the videos, a higher variance of pixel values should denote higher likelihood that a pixel is cilia.
- Method:
  - Input is a 3D matrix of the video.
  - Variance function is then applied on the frame (first) axis.
  - Returns a 2D matrix, with each element's value is that pixel's variance.

Beat Frequency

- Cilia are continuously oscillating. They beat at a frequency of around 10-12Hz. Therefore extracting the beat frequency of each pixel could help us find the Cilia.
- Method:
  - Input is a 3D matrix of the video.
  - Fast Fourier Transform is then applied on the frame (first) axis.
  - Returns a 2D matrix, with each element's value is that pixel's dominant frequency.

Optical Flow

- As the Cilia are continuously moving, calculating their movement between two frames can be very informative.
- Method:
  - Input is a pair of 2D consecutive frames.
  - Optical flow is calculated between these two frames.
  - Returns a 2D matrix of vector magnitudes.
  - This process is repeated for all the image pairs (99), and the final matrix is a sum of all the vector magnitudes.

UNET

- Unet is a type of convolution neural network (CNN).
- An advantage of UNET is that it is a fully convolution network (i.e. it does not contain any fully connected layers)
- Therefore we can use images of varying dimensions. This eliminates the need to pad or crop the images.

Results

Features Used	IOU
Beat Frequency + 1 frame	15%
Optical flow	24.5%
Variance Fluctuations, Beat Frequency, Optical Flow + 1 frame	34.4%