Quantifying the Activity of the Roundworm (*C. elegans)*

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Background and Motivation

- The roundworm is widely used in medical research; however efforts have historically been painstaking, with scientists manually recording the movements of hundreds of worms.
- In response, the WormWatcher software has been designed to analyze worm activity, enabling researchers to study greater numbers at a time.
- In order to quantify worm activity, WormWatcher uses a “pixel difference” based approach, described below.
- A weakness in this approach has been an inability to compare worms of different sizes; if two worms of differing lengths move one inch, the larger worm causes many more pixels to change than the smaller worm.
- Our solution involved quantifying the locomotion rate of the worms

Pixel Difference method for activity calculation

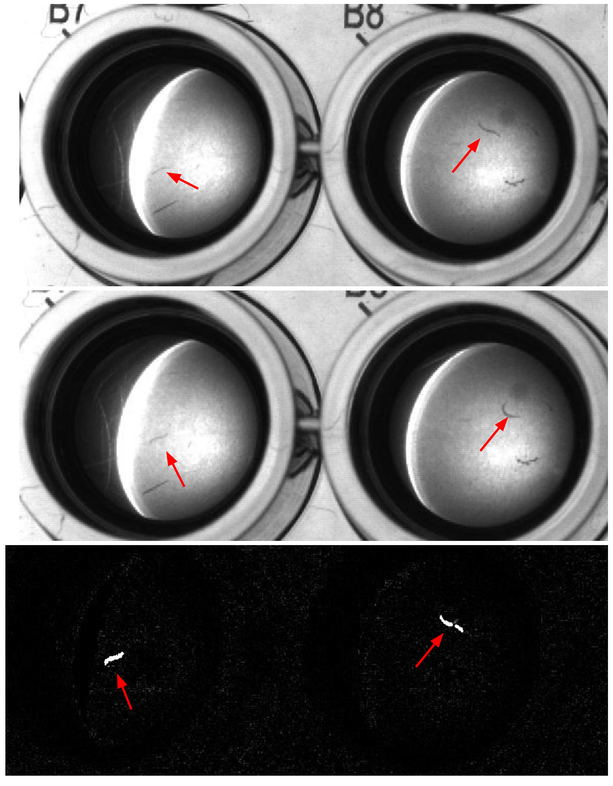


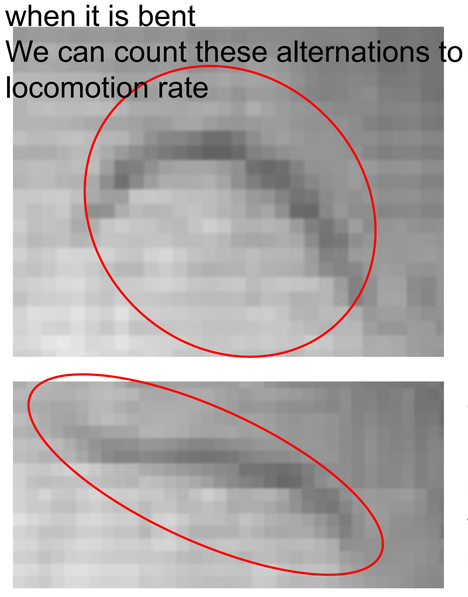
Image at time t=0

Image at time t=60 s

Count pixels that have changed in intensity to quantify movement

Eccentricity

- One way to quantify the locomotion rate of the worms using the eccentricity of an ellipse that we fit around them
- Eccentricity is defined as the ratio of the long axis of an ellipse to the short one
- Worms swim by alternating between a bent and a straight posture
- This causes the eccentricity of an ellipse fit around the worm to alternate as well. It is high when the worm is straight and slightly lower when it is bent
- We can count these alternations to get the locomotion rate

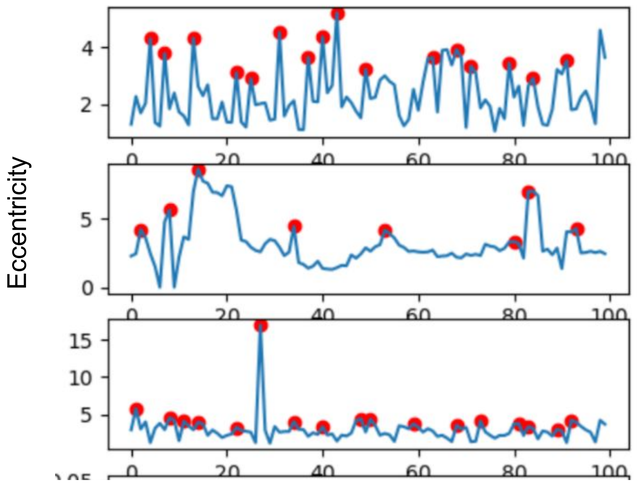


Low eccentricity bent worm

The same worm but straightened out, and therefore with higher eccentricity

Data Analysis

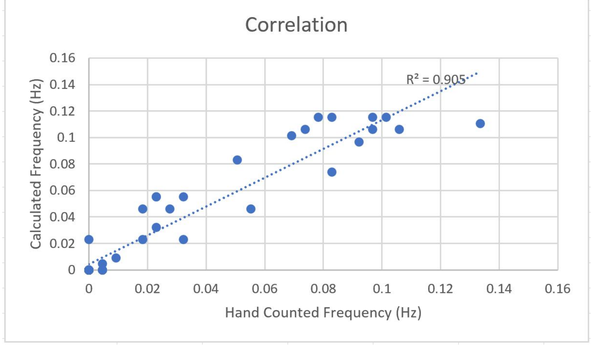
- First the program identifies the worms using the pixel difference approach described above
- It then fits an ellipse around it and record its eccentricity
- Finally, it plots the eccentricity over time and by calculating the frequency of the “peaks” of this graph it determines how much the worm was moving



Graph of the eccentricity (peaks shown in red)

Conclusions

Frequencies measured by my software correlated closely with hand counted data.



However, there is no correlation between the computed frequency and the size of the worms.