

Using Deep Learning to Understand Dendritic Process-directed Cell Movement on Nanofiber Substrate

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Outline

- Motivation
- Methodology
- Results
- Discussion
- Future work

Motivation

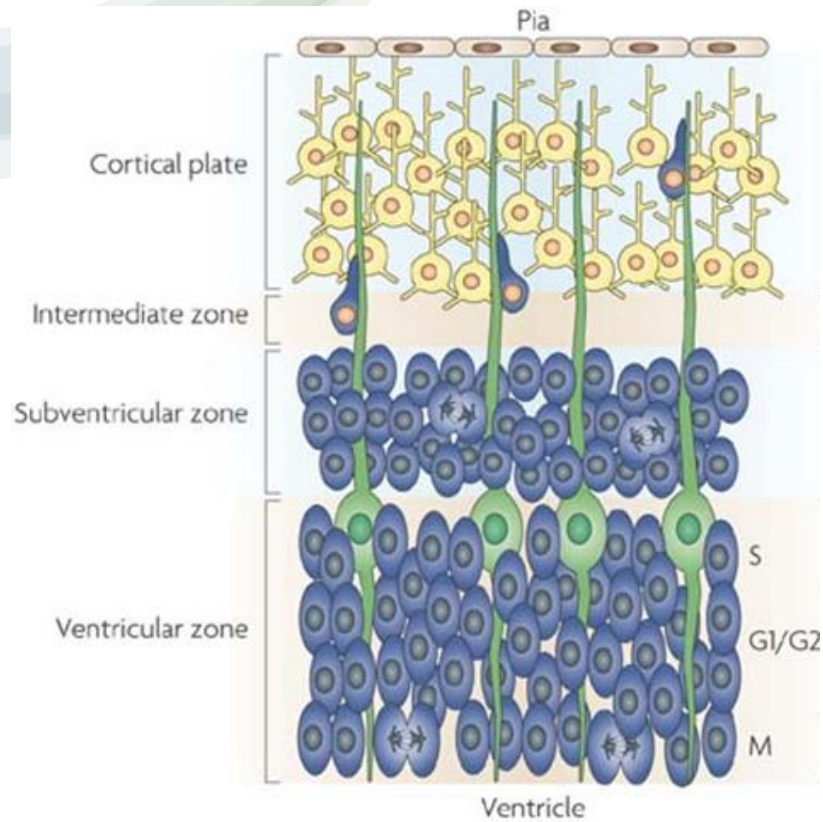


Fig: Brain Development[Herrup, K. et al., (2007). *Nat Rev Neurosci* 8(5)]

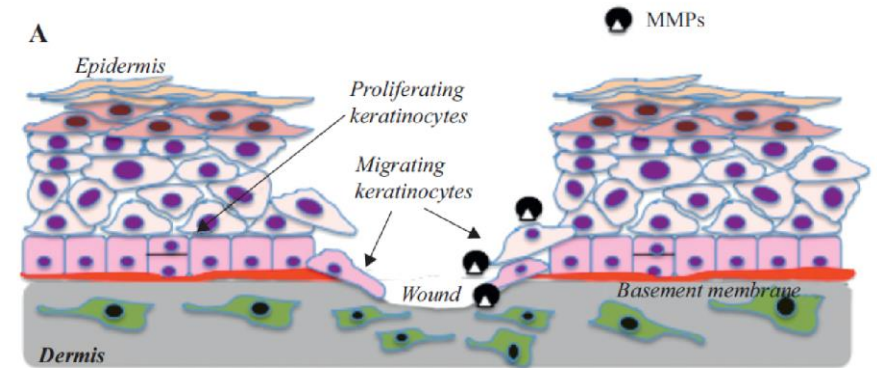


Fig: Wound Repair

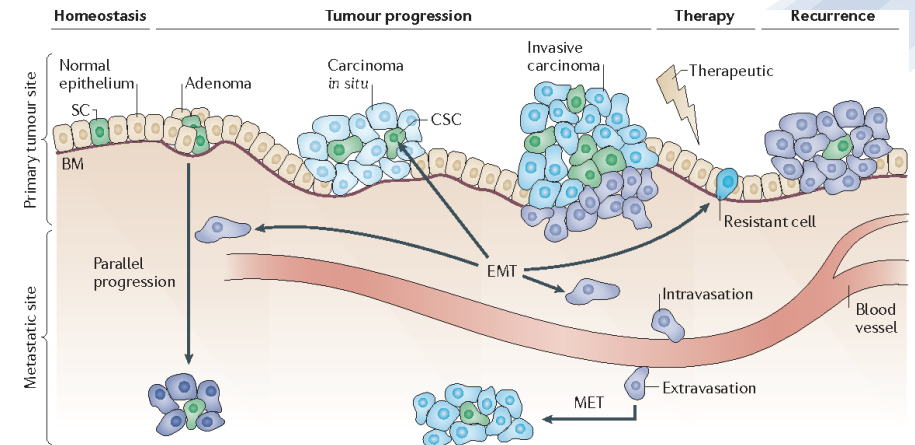


Figure 11 | Role of EMT during cancer progression. In tumour cells, epithelial to mesenchymal transition (EMT)-inducing

Fig: Cancer Invasion[Craene, B., Berx, G., *Nature Reviews Cancer* (2013)]

Dataset

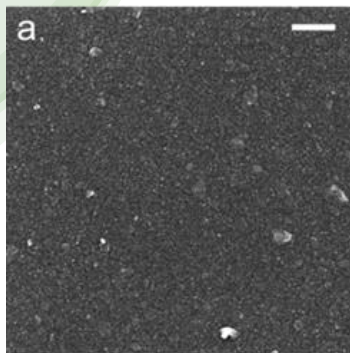


Fig: Glass Surface

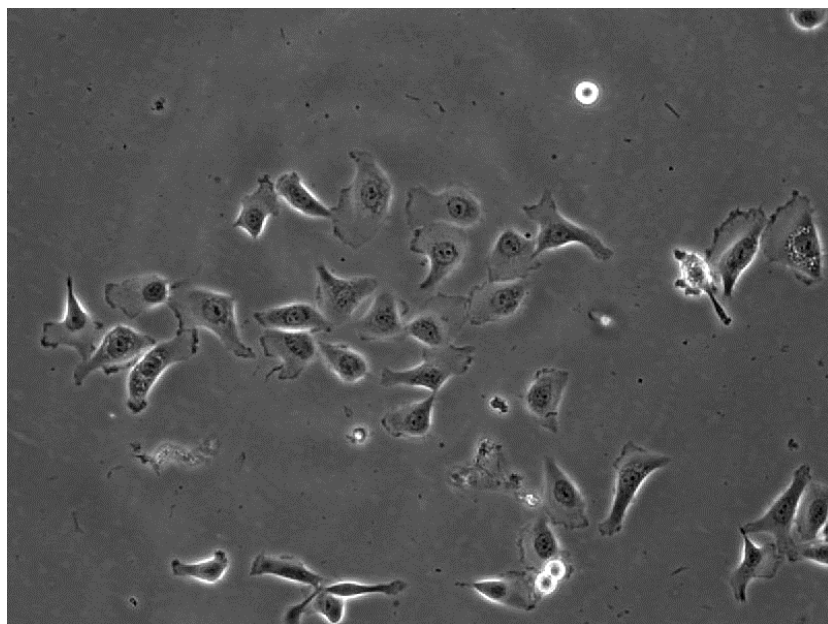


Fig: Cell on Glass Surface

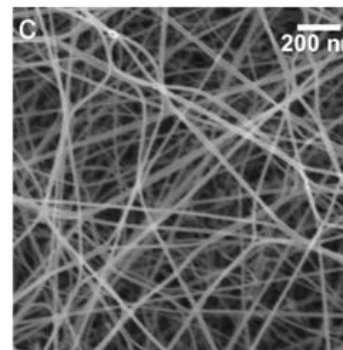


Fig: PA(*Peptide amphiphile*) Coated Surface

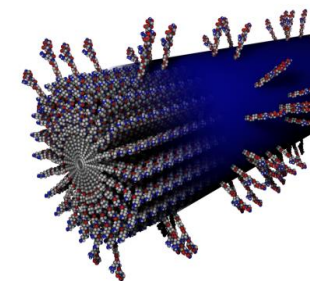


Fig: PA with RGDS epitope

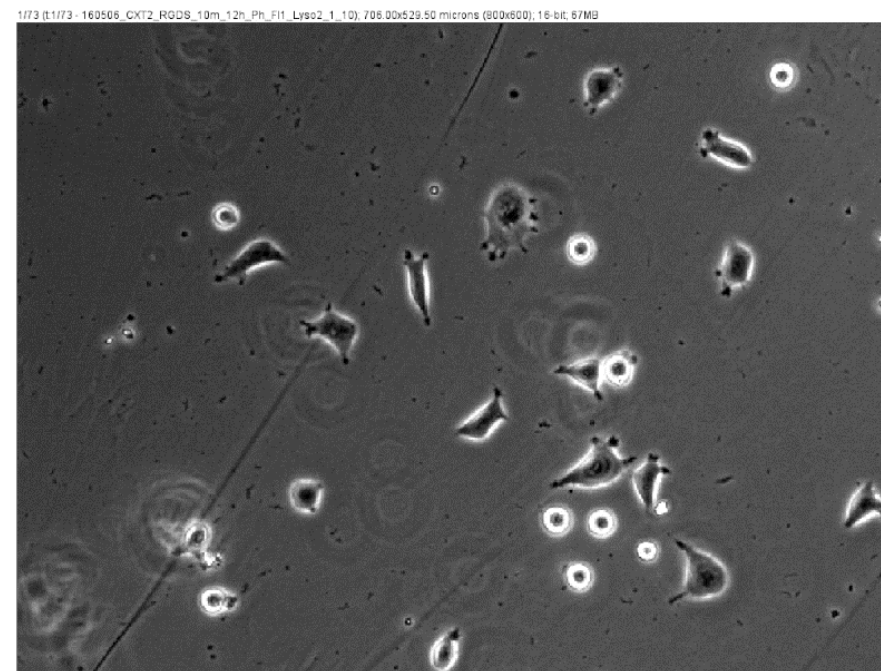


Fig: Cell on PA Coated Surface

Methodology

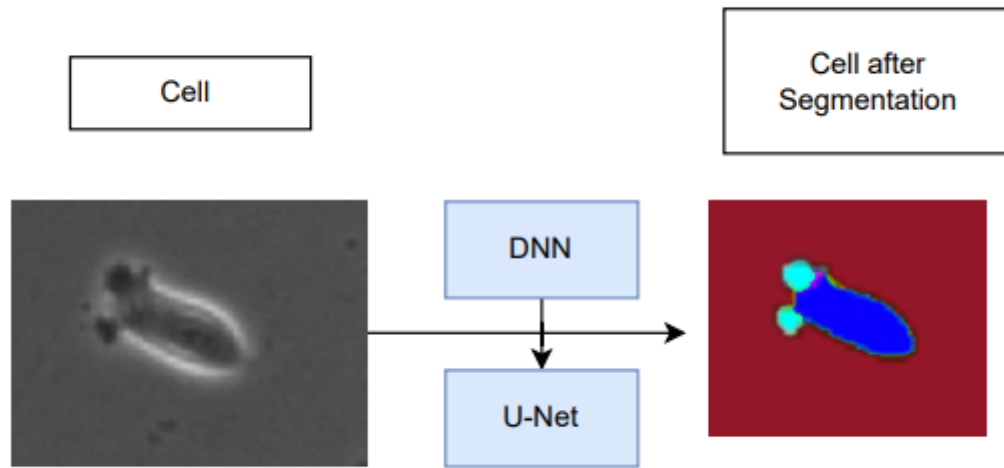


Fig: Cell Segmentation

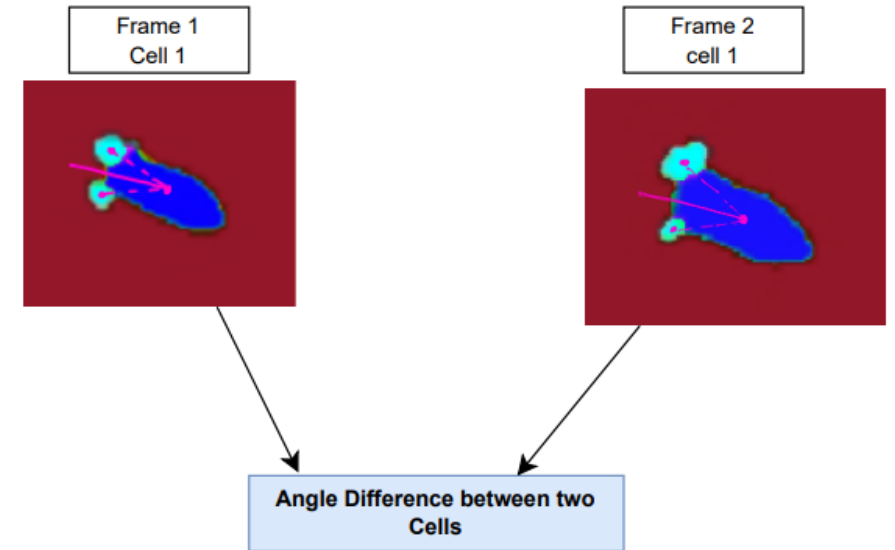


Fig: Cell Movement Tracking

Methodology

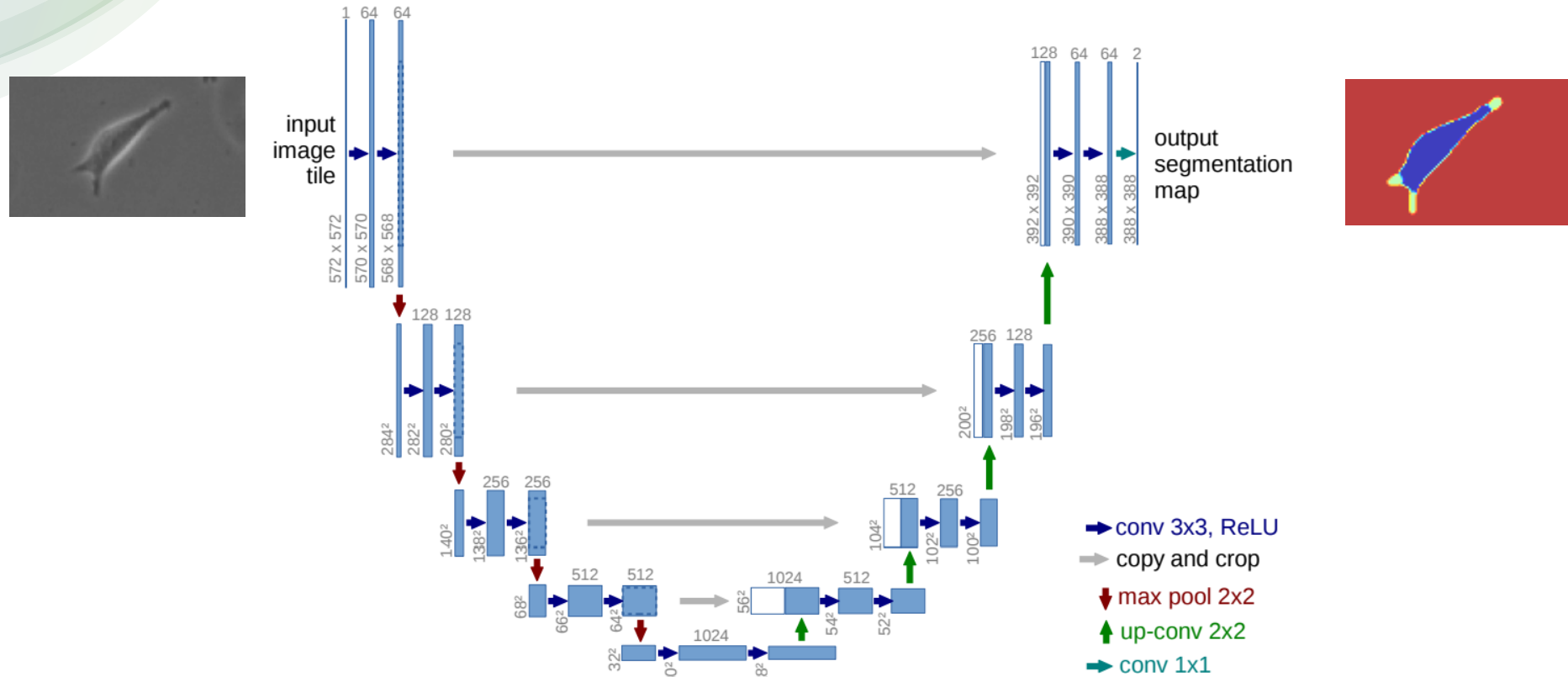


Fig: U-Net architecture[<https://arxiv.org/pdf/1505.04597.pdf>]

Segmentation Accuracy

Accuracy Matrix	Accuracy
IoU Accuracy	86.76%
Background accuracy	99.33%
Cell accuracy	90.58%
Dendritic Process accuracy	70.37%

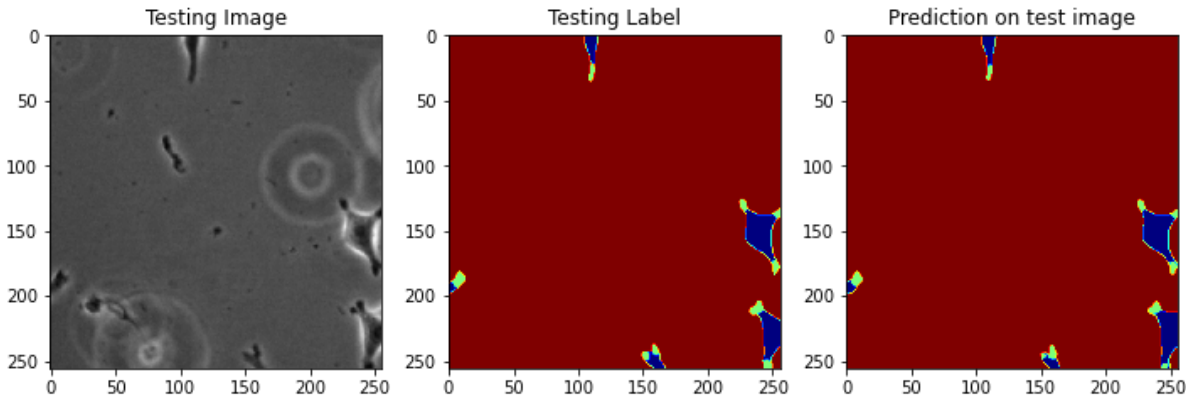


Fig: Result of Segmentation(Red is background, Blue is cell, Green is dendritic process)

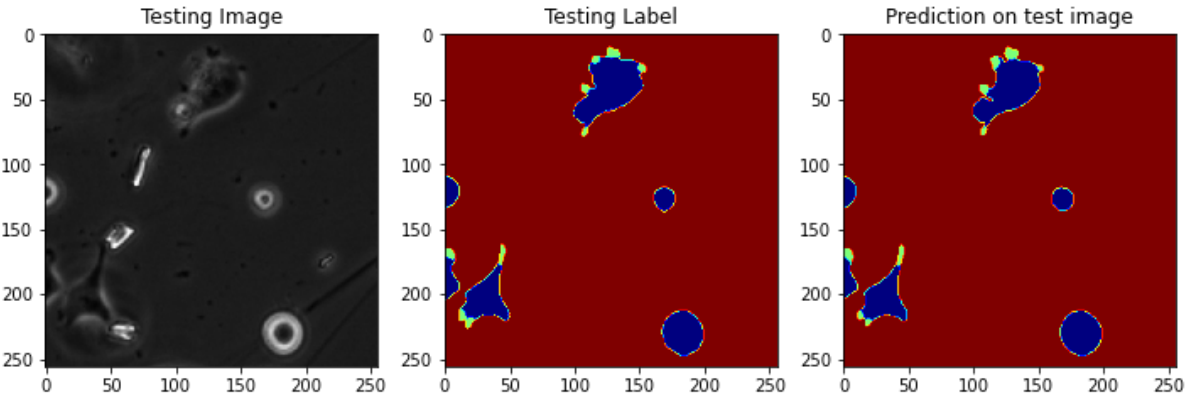


Fig: Result of Segmentation(Red is background, Blue is cell, Green is dendritic process)

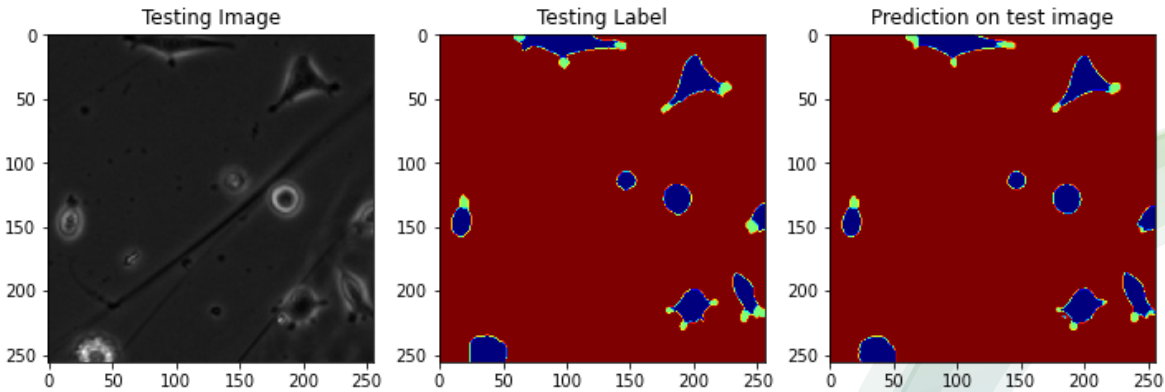
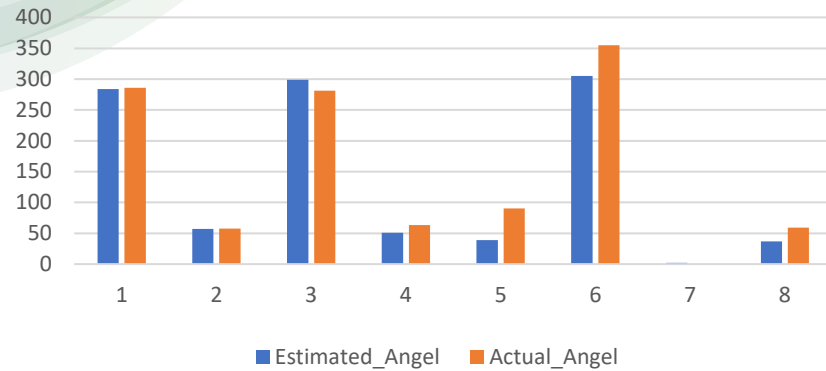


Fig: Result of Segmentation(Red is background, Blue is cell, Green is dendritic process)

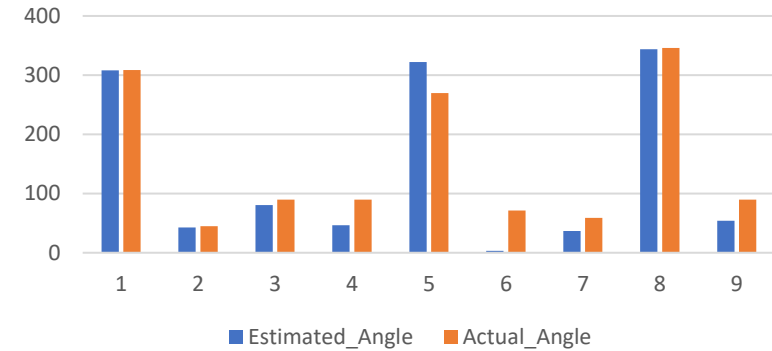
Cell Movement Accuracy

We have tracked total forty frames for thirty cells. Here is the result of eight frames:

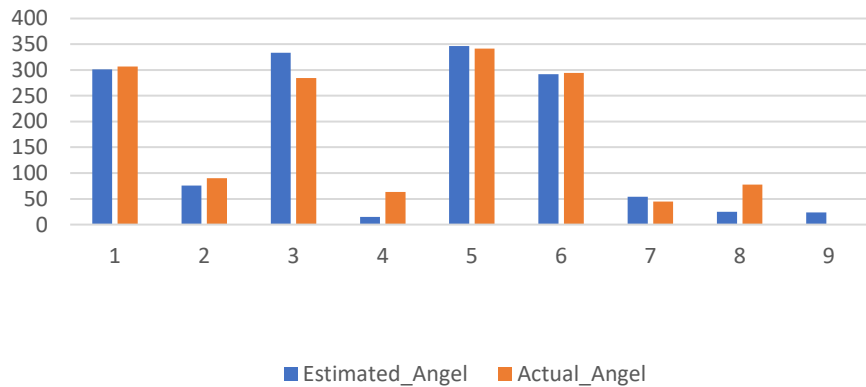
Frame 1



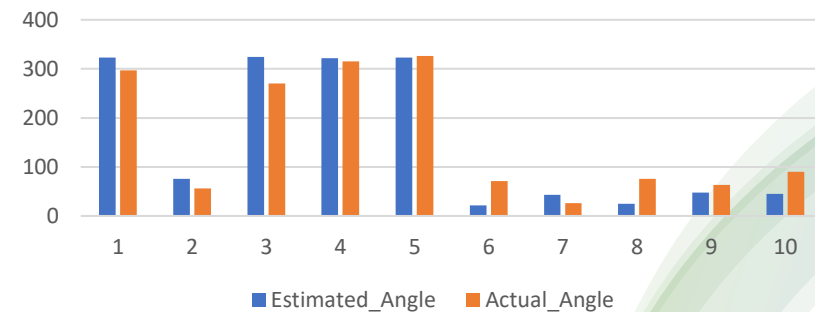
Frame 2



Frame 3

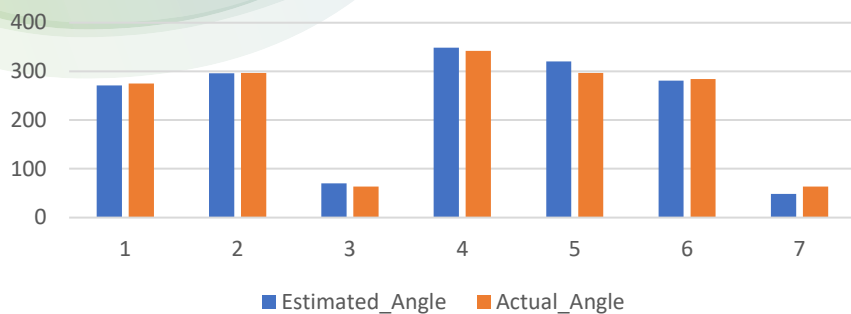


Frame 4

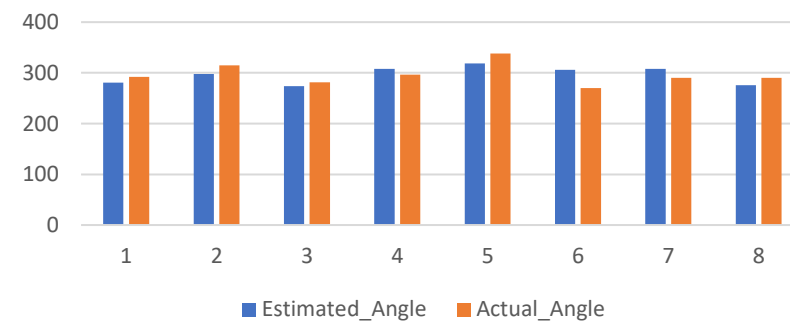


Cell Movement Accuracy

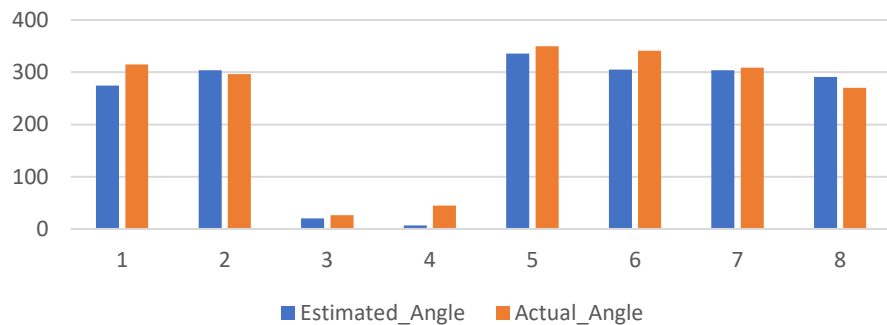
Frame 5



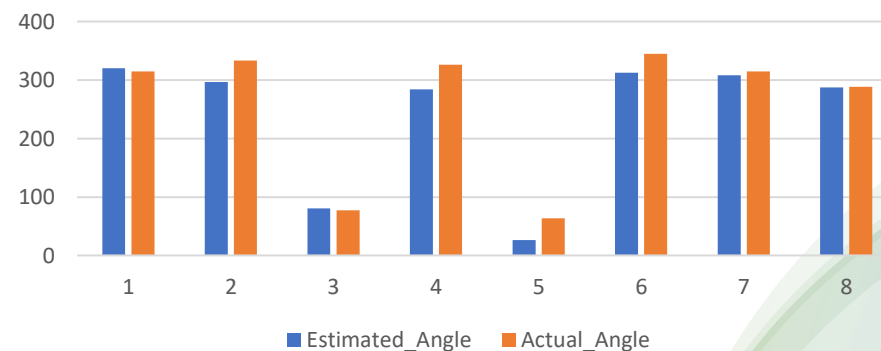
Frame 6



Frame 7



Frame 8



Discussion and Future Work

We have found on average 20-30 degree angle difference for all cases. So, we can conclude that there is a connection between cell movement and dendritic process.

The dynamics of dendritic process changes continuously. In future, we will look more into the dynamics and its importance on cell movement.

Thank you
Any Question?