



City Research Online

City St George's, University of London

Citation: Reyes-Aldasoro, C. C. (2018). Shape Analysis and Tracking of Migrating Macrophages. Poster presented at the IEEE International Symposium on Biomedical Imaging (ISBI), 4-7 Apr 2018, Washington, D.C., USA.

This is the published version of the paper.

This version of the publication may differ from the final published version. To cite this item please consult the publisher's version.

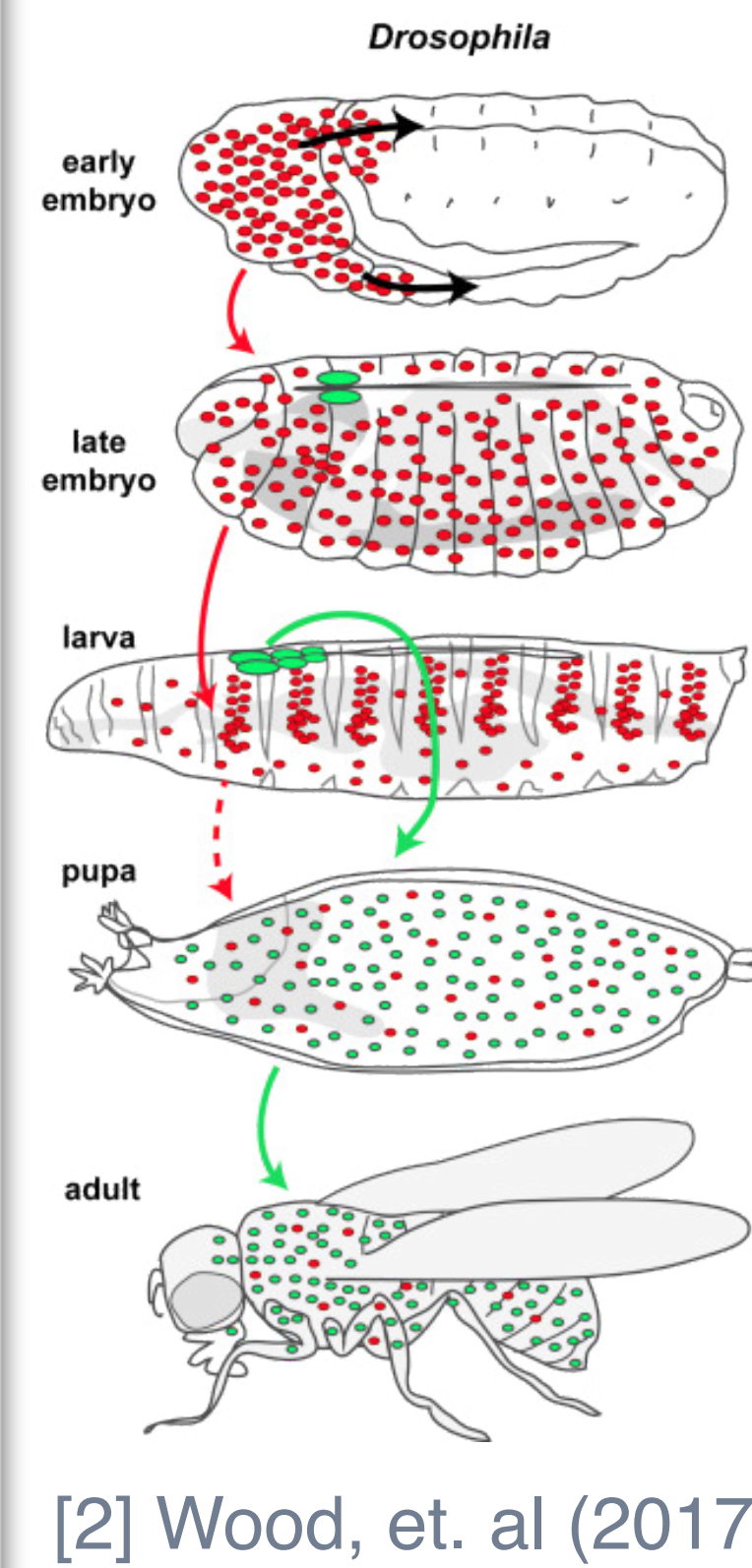
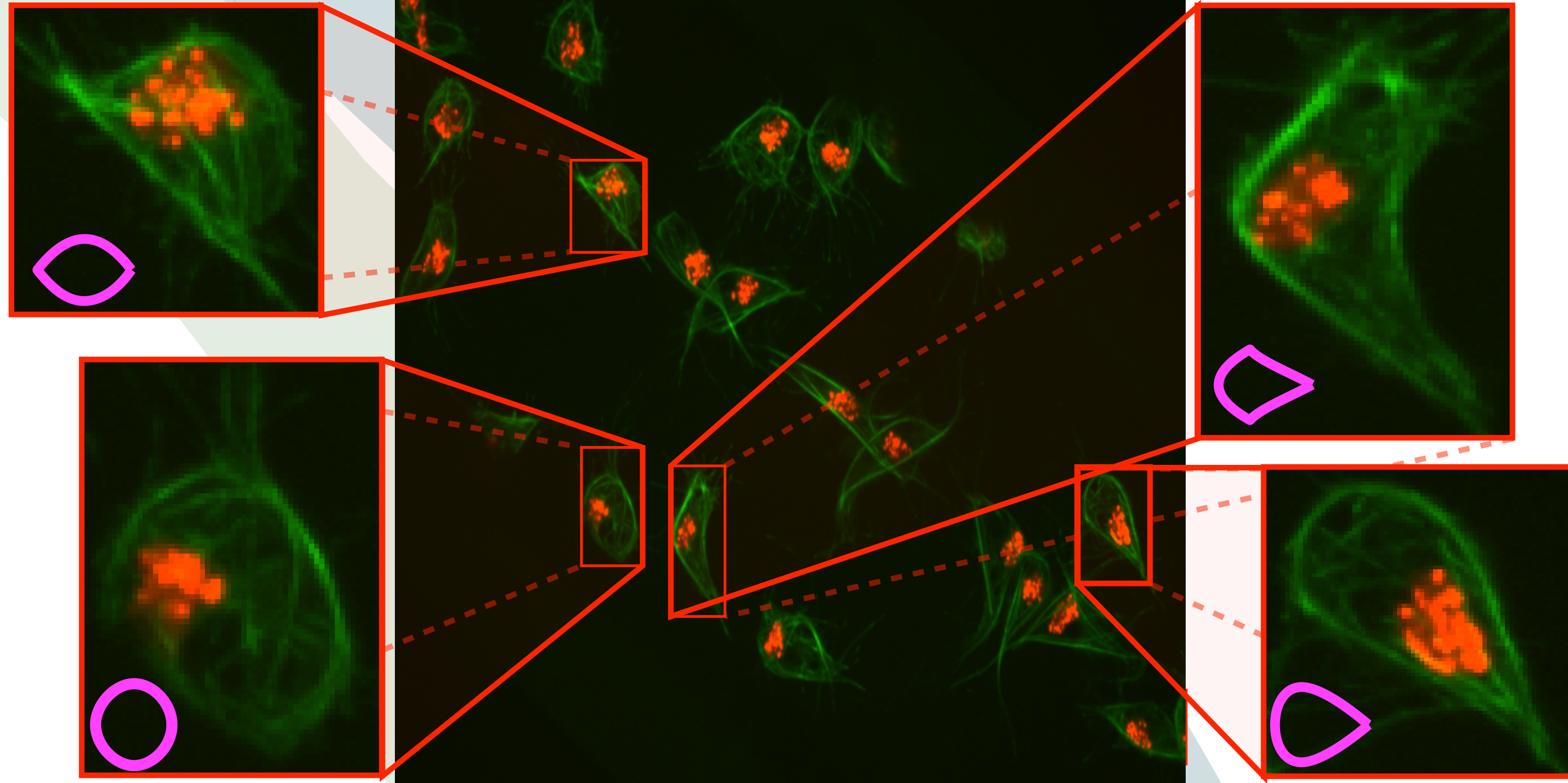
Permanent repository link: <https://city-ref-test.eprints-hosting.org/id/eprint/20035/>

Copyright and Reuse: Copyright and Moral Rights remain with the author(s) and/or copyright holders. Copies of full items can be used for personal research or study, educational, or not-for-profit purposes without prior permission or charge, unless otherwise indicated, provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way. For full details of reuse please refer to [City Research Online policy](#).

Shape Analysis and Tracking of Migrating Macrophages

(1) School of Mathematics, Computer Science and Engineering, City, University of London (2) Randall Division of Cell & Molecular Biophysics, King's College London, UK

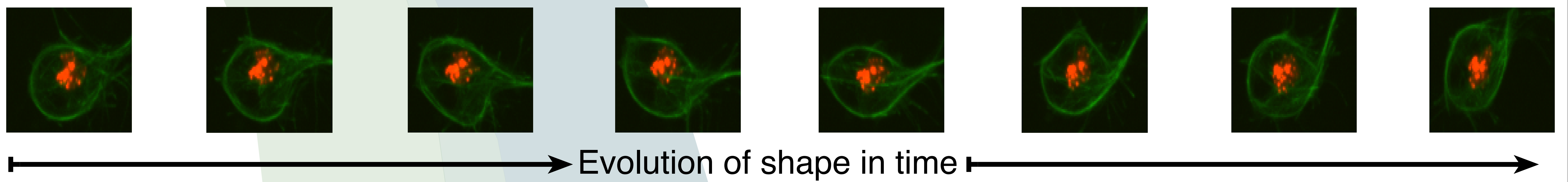
Basic shapes identified in the data



Abstract

This work describes an algorithm to observe **cell** shape variation **associated with migration**. The algorithm iteratively segments, tracks and analyses the shape of macrophages in ***Drosophila melanogaster* embryos**. Analysis of shape, including the number of **corners or pointy edges**, rely on a novel approach to finding *junctions*, the **anglegram matrix**.

The **anglegram** [1] IS a multiscale angle variation 2D matrix. It is constructed by calculating inner point angles alongside the boundaries of an object.



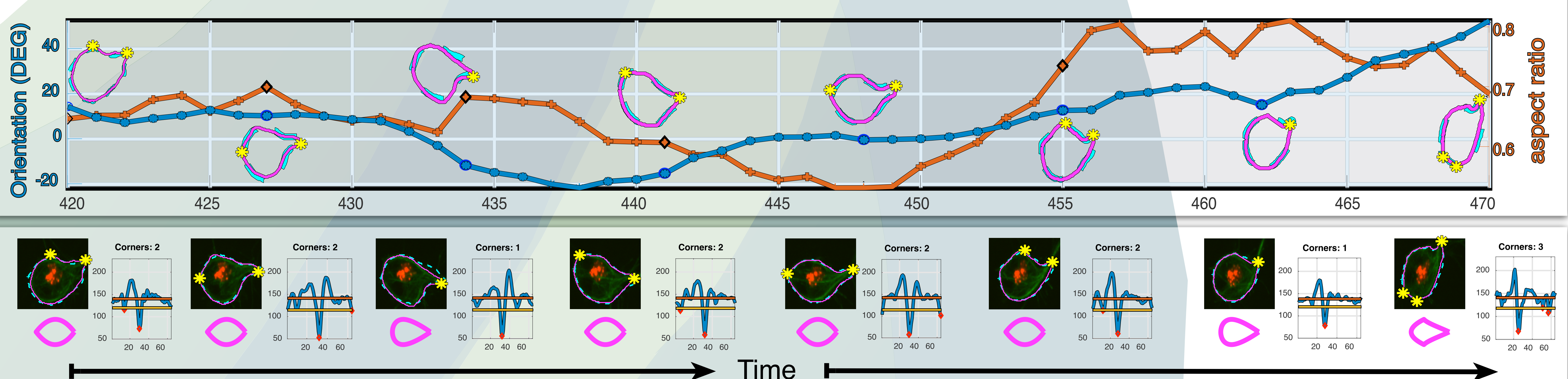
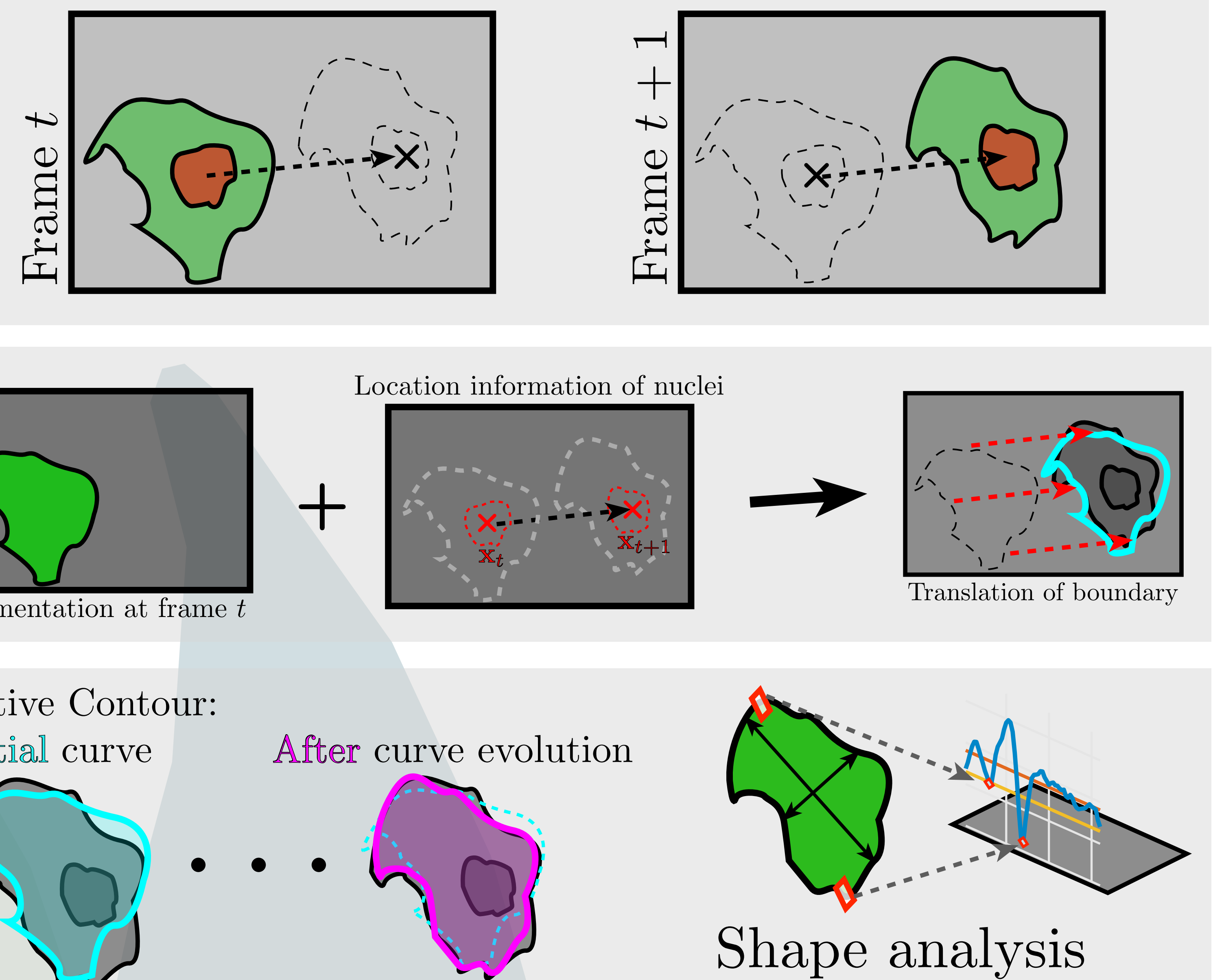
Data & Methodology

- **Synthetic data** was generated to test the corner detection algorithm and fluorescently labelled **images of macrophages** were used.
- The **methodology** allows observation of shape variations as the cells migrate. The **main functionality** is a framework in which the algorithm identifies and separates overlapping and non-overlapping cells. Then for the **non-overlapping** cases, it extracts and tracks the shape with and custom implementation of the Active Contours algorithm [5,6].
- Finally, shape measurements are collected from each extracted shape, including calculation of corners with the

Results & Future Work

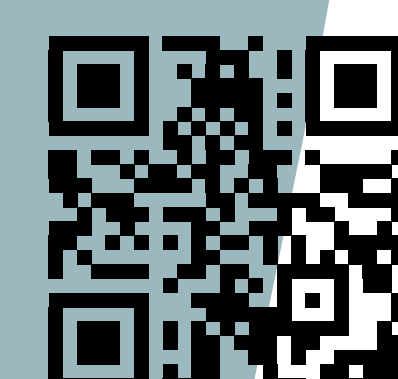
The **main contribution** was to provide a framework for the **consistent tracking of the shape of a cell** and evolution of the shape's parameters. A new implementation of the **anglegram** matrix allowed for the analysis of a single cell with a straightforward identification of corners in the shapes.

Future developments: extending the shape tracking into overlapping cells to disambiguate them; and use the patterns of the anglegrams corresponding to the basic shapes, to classify cells into basic shapes.



Evolution of Cell Shape Analysis throughout multiple frames. Top: Evolution of orientation of segmented cell and aspect ratio of the shape. At eight points in the graphs, the segmented shapes of cells are displayed. **Bottom** Eight instances out of 50 consecutive frames where previous frame segmentation (cyan -) and evolved current frame segmentation (magenta -) are shown. The detected shape is highlighted and the minimum intensity projection of the anglegram is displayed to present the detection of corners.

SELECTED REFERENCES: [1] Solís-Lemus, José Alonso, Brian Stramer, Greg Slabaugh, and Constantino Carlos Reyes-Aldasoro. 'Segmentation and Shape Analysis of Macrophages Using Anglegram Analysis'. Journal of Imaging 4, no. 1 (21 December 2017): 2. [2] Wood, W., et. al: Macrophage functions in tissue patterning and disease: New insights from the fly. Developmental Cell 2017 [3] Stramer, et. al: Clasp-mediated microtubule bundling regulates persistent motility and contact repulsion in *Drosophila* macrophages in vivo J Cell Biology 2010 [4] Henry, et. al: PhagoSight: An Open-Source MATLAB Package for the Analysis of Fluorescent Neutrophil and Macrophage Migration in a Zebrafish Model. PLoS ONE 2013 [5] T Chan et al., "Active contours without edges," IEEE Trans Imag Proc, vol. 10, no. 2, pp. 266–277, jan 2001. [6] R Whitaker, "A level-set approach to 3d reconstruction from range data," Int J Computer Vision, vol. 29, no. 3, pp. 203–231, Sep 1998.



city.ac.uk/biomedical-engineering-research-centre
alonsojasl.github.io/
alonsoJASL, phagosight
@jalonsitwo