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Analysis and Understanding of Fungal Tip Growth

Fungi cause devastating plant and human diseases. There is considerable evidence that much of the cellular machinery driving growth of invasive fungal hyphae is common across all fungi, including plant and mammalian pathogens, and involves localized tip growth. Furthermore, successful fungal infection is critically dependent on accurate perception of the host surface at the tip to control morphogenesis and trigger host invasion. This suggests that detailed investigation of these early morphogenetic and signalling events is crucial to a thorough understanding of virulence.

We are therefore developing high-throughput automated microscope-based multidimensional image analysis systems to segment and characterize fungal growth, and characterize the patterns of protein localization within the tip that control development. We propose a curvature-based approach to identify fungal cell tip and determine the growth direction, based on segmentation using local thresholding and mathematical morphology methods. The curvature of cell boundary is calculated and the boundary point with the highest curvature value defines the tip cell position. For cell expressing key GFP-tagged regulatory proteins, the image intensity profiles on the left and right side of the tip position are recorded to provide a map of the plasmamembrane protein distribution, and to determine the relationship between growth vector and asymmetric localization. This procedure is repeated for all images in the time-lapse.

We tested the performance of the proposed concept on fluorescence images of Neurospora crassa germlings expressing GFP-CRIB and GFP-tagged MAK2 kinase

during hyphal avoidance responses and conidial anastomosis tube fusion, respectively.

References

[1] K. Kvilekval, D.Fedorov, B. Obara, A.K. Singh, B.S. Manjunath, *Bisque: a platform for bioimage analysis and management*, Bioinformatics, **26**, 544–552, 2010

[2] J. Serra, *Image Analysis And Mathematical Morphology*, Academic Press, New York, 1982