

Modelling oscillatory behavior in asymmetric division of *C. elegans* embryo

Anca Caranfil^{1,2,3}, Yann Le Cunff^{1,2}, Charles Kervrann³, and Jacques Pécrcéaux¹

¹INRIA Rennes Bretagne Atlantique; ²Institute of Genetics and Development of Rennes; ³University of Rennes 1

Asymmetric cell division is a complex process that is not yet fully understood. A very well-known example of such a division is *C. elegans* embryos first division. To improve our understanding of this process, we used mathematical modelling to study *C. elegans* embryos first division, both on wild type cells and under a wide range of genetic perturbations. Asymmetry is clearly visible at the end of the anaphase, as the mitotic spindle is off-center. The study of the mitotic spindle dynamics is, thus, a useful tool to gain insights into the general mechanics of the system used by the cell to correctly achieve asymmetric division. The overall spindle behavior is led by the spindle poles behavior. We proposed a new dynamic model for the posterior spindle pole that explains the oscillatory behavior during anaphase and confirms some previous findings, such as the existence of a threshold number of active force-generator motors required for the onset of oscillations. We also confirmed that the monotonic increase of motor activity accounts for their build-up and die-down. By theoretically analyzing our model, we determined boundaries for the motor activity-related parameters for these oscillations to happen. This also allowed us to describe the influence of the number of motors, as well as physical parameters related to viscosity or string-like forces, on features such as the amplitude and number of oscillations. Lastly, by using a Bayesian approach to confront our model to experimental data, we were able to estimate distributions for our biological and bio-physical parameters. These results give us insights on variations in spindle behavior during anaphase in asymmetric division, and provide means of prediction for phenotypes related to misguided asymmetric division. This model will be instrumental in probing the function of yet undocumented genes involved in controlling cell division dynamics.

Keywords: asymmetric cell division, spindle dynamics, spindle oscillations modelling, Bayesian statistics.
