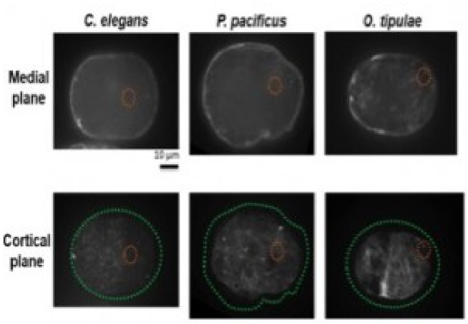
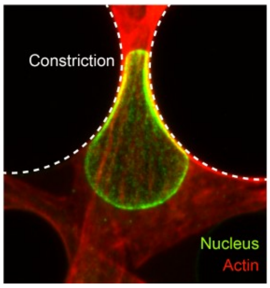
Project leaders: J. Plastino, C. Sykes, C. Campillo, K. Guevorkian

In our *in vivo* approach we examine the role of the acto-myosin cytoskeleton in cell movements, shape changes and collective cell reorganizations in cells, animals and embryos. We have developed imaging and genetics to study cell movements during the development of the embryo and the worm of *Caenorhabditis elegans* and other nematode species. We also study the role of actin and myosin networks in providing mechanical cues during somitogenesis in the chicken embryo. We have a collaboration with the Curie hospital to characterize the link between the nucleus and the cytoskeleton in metastasis.

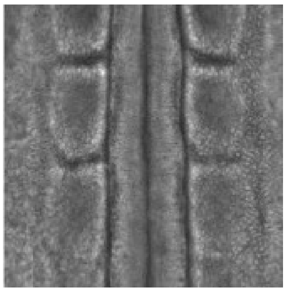
Current Projects



Acto-myosin cortex of the first asymmetric cell division in evolutionarily distant nematodes.
(Majdouline Abou-Ghali and Dureen Samander Eweis PhD students).
Many nematode species undergo a first asymmetric division like C. elegans, however they display enhanced cortical shape changes. Additionally in parthenogenetic species, which develop without fertilization, the initial cue for symmetry breaking is unknown. By comparing the first asymmetric cell division in different nematode species, we will reveal conserved mechanical and molecular principles of the cytoskeleton for achieving asymmetric cell division, in collaboration with Marie Delattre (ENS Lyon).

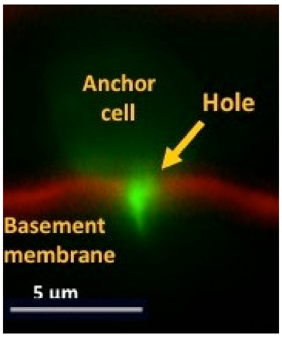


Mechanics of nucleus in cancerous and metastatic cells
(Patricia Davidson, Postdoc, Hanane El Manssouri, Research Engineer).
The nucleus is mechanically linked to the cytoskeleton through nesprins. These proteins are encoded by genes frequently mutated in tumors, although their link to cancer is not understood. In collaboration with Curie Hospital (A. Pinheiro, F. Reyal, E. Piaggio, S. Roman Roman), we characterize the mechanics of the nucleus from different metastatic and tumor cell lines using a microfluidic migration device.

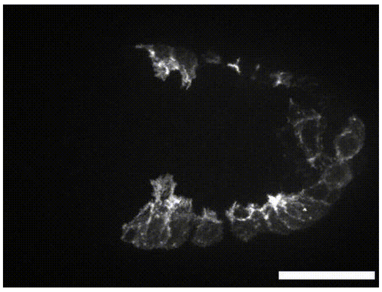


Mechanics of somite formation in vertebrate embryos
(Karine Guevorkian (CNRS)).
We study the role of cell cortex mechanics and tissue reorganization in the context of somitogenesis in a developing chicken embryo. Our objectives are to access the stresses related to the shaping and budding of a somite, identify the role of external forces in this process, and explore the role of the actin polymerization, network reorganization and myosin activity in formation of somites.

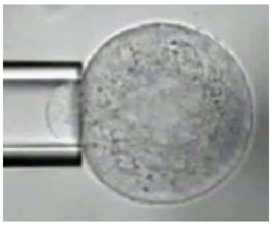
Past Projects



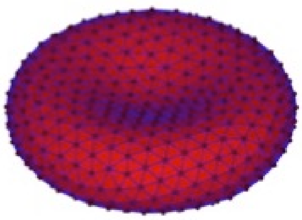
Forces drive basement membrane invasion in *C. elegans*
The anchor cell is an invasive cell involved in a developmental event in *C. elegans*. We observe that the anchor cell deforms the basement membrane just prior to invasion, exerting forces in the tens of nN range. Basement membrane deformation is driven by actin polymerization nucleated by the Arp2/3 complex and its activators. Force production emerges from this study as the central tool that invading cells use to promote BM disruption (R. Caceres and J. Plastino, 2017, D.R. Sherwood and J. Plastino, Genetics 2018).



Molecular coordination between the nucleating activity of the Arp2/3 complex and the elongating activity of Ena/VASP proteins in ventral enclosure in *C. elegans*
Using an in vitro bead motility assay, we show that WAVE directly binds VASP, resulting in an increase in Arp2/3 complex–based actin assembly. We show that this interaction is important *in vivo* as well, for the formation of lamellipodia during the ventral enclosure event of *C. elegans* embryogenesis. Our data are consistent with the idea that binding of Ena/VASP to WAVE potentiates Arp2/3 complex activity and lamellipodial actin assembly (S. Havrilenko et al., Mol. Biol. Cell 2015) in collaboration with Laurent Blanchoin (CEA Grenoble).



Cortical mechanics and asymmetric division of the mouse oocyte
Using micropipette aspiration, we show that cell tension decreases during meiosis I, resulting from myosin-II exclusion from the cortex, and that cortical F-actin thickening promotes cortical plasticity (A. Chaigne, *et al.,* Nat. Cell. Biol. 2013).



Active mechanics in living cells
Using an optical tweezer setup active mechanics of living cells is characterized either from the fluctuations of the membrane (red blood cells), or from the active microrheology of the actin network (WW Ahmed and T Betz, PNAS 2015, H. Turlier, et al., Nat. Phys. 2016).