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Elastic Coupling in Bipedally Crawling Cells[1] ALEX LOOSLEY, JAY TANG, Brown University — Periodic shape changes during cell migration are recorded in fast moving fish epithelial keratocytes where sticking and slipping at opposite sides of the cell's broad trailing edge generate bipedal locomotion and oscillatory lateral displacement of the nucleus. We use a two-dimensional finite element model to study the mechanical coupling, adhesion forces, and cell shapes that recapitulate the dynamics of these crawling cells. The model consists of elastically coupled point-like elements representing regions of the cell: leading edge, opposite sides of the trailing edge, and the nucleus. Based on simple assumptions, such as cell symmetry and localization of each element to a specific cellular region, we determine that there are only four viable permutations of elastic couplings between these four elements. We compare the four configurations and find that centralized elastic coupling to the cell nucleus and wide aspect ratio of the shape is necessary to mechanically generate realistic bipedal shape dynamics and lateral displacement of the nucleus. We suggest one configuration that is most realistic. The dynamics of this configuration are strongly dependent on the elasticity between peripheral elements, but not on the elasticity between these elements and the nucleus.

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