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A hyperbolic curvature flow for biological tissue growth and its application to determine cell behaviour during the infilling of irregular pores

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The growth of several biological tissues is known to be controlled by local geometrical cues, such as the curvature of the tissue interface. Geometry modulates cells collectively through the evolving space available to the population of cells, but it may also modulate the individual behaviours of cells. In this contribution, I will first present how the influence of curvature on the collective crowding or spreading of cells growing new tissue leads to a new type of hyperbolic curvature flow (with curvature-dependent normal acceleration) for the evolution of the tissue interface. Depending on the strength of diffusive damping, the model exhibits complex growth patterns such as undulating motion, efficient smoothing of irregularities, and the generation of cusps. Insights into these growth patterns are provided by analysing the shock structure in the zero-diffusion and infinite-diffusion limits. In a second part, I will present how this model can be used with experimental data on the infilling of irregular bone pores to single out the collective influence of geometry, and gain access to the geometric regulation of individual cell behaviours.

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