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Reaction-Diffusion Mixed Modes on a Spherical Cap

Patterns in cotyledon formation in conifer embryos can be modeled using reaction-diffusion systems for underlying chemical morphogens. In order to approximate the geometry of a flattening embryo tip we use spherical cap domains. Nagata, Zangeneh and Holloway described the transition from the patternless state to a single mode, noted by a pair of integers (m, n) , for a Brusselator system on such domains. We will use similar techniques to find the bifurcation diagram at the intersection of two single-mode transitions. In the simple case when both m values are non-zero we have a well documented double pitchfork bifurcation. If, however, one of the m is zero we have a more elaborate bifurcation diagram because we have to take into consideration the quadratic and cubic terms in the normal form. We present this codimension two bifurcation here and show solutions of a finite elements simulation that support our findings.