

A numerical study of pattern formation in Barrio-Varea-Aragon-Mani model

T.D. Gunasingha^{*} and J.A. Weliwita

Department of Mathematics, Faculty of Science, University of Peradeniya, Sri Lanka
^{}td.gunasingha@gmail.com*

The Barrio-Varea-Aragon-Mani (BVAM) model has been widely used to study the pattern formation on the skins of various fish species due to the fact that the patterns obtained from this model are very similar to the patterns on skin of various fish species. We performed a stability analysis to obtain the parameter relationship of the stable states of the model and to investigate the sensitivity of model parameters to the stability of the stripe pattern. Numerical simulations were performed to explore the different solution states categorized as swelled stripes with bends, defects and stripes with different orientation. The BVAM model was simulated in a MATLAB for a very long time ($\sim 10^6$) than in the literature in a 2D domain using Finite different methods and modified Euler method for time integration. The stable stripe pattern was obtained for the parameter values according to the conditions derived. This pattern becomes unstable for two system parameters: parameter that governs the changes in the reaction rates with respect to the concentrations and reaction rates that are counted by ratio between diffusion coefficients. We established a relation of the parameters with different solution states. Our extensive numerical work depicted that the stable state becomes unstable with stripes with bends followed by the stripes with bulges. When the parameter is further increased, the solution state further becomes unstable with different oriented stripes. We analyzed local wave vector of these solution states and when stripes are swelled forming bulges, the local wave number becomes very high and in the evolution, topological defects interact with the pattern and contribute to the subsequent formation of it. The critical wave number for the formation of the bulges is to be found as future work with the instability causing the defects.