May 15th, 5:01 PM

An Algorithm of Aesthetics: the Mathematical Beauty of Type-B Turing Pattern Development in Monkeyflowers

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Development of novel phenotypes across generations is a core topic in evolution and genetics, and developing mathematical models can enhance understanding of their emergence. For example, second-generation hybrid offspring can display more extreme phenotypes than the most extreme parental phenotypes. This project explores a multi-generational Turing model for a reaction-diffusion system that gives rise to transgressive patterned phenotypes in hybrid monkeyflowers (Simmons et al., 2023). It is well-known that two types of Turing models can be distinguished by the sign of the interactions between activator and inhibitor. In both types of Turing bifurcation, the activator up regulates itself and the inhibitor down regulates itself. Simmons et. al. 2023 presents a multi-generation Turing model in which the activator up regulates the inhibitor and the inhibitor down regulates the activator, i.e., the qualitative Jacobian of the linearized reaction terms is J = [+ - ; + -]. This project examines the alternative case in which the activator down regulates the inhibitor and the inhibitor up regulates the activator (J = [+ + ; - -]). Results are compared with Simmons et al. 2023 to examine the differences in F2 patterning that emerge from these distinct Turing bifurcations.