

Simulation of Patterned Plant Growth in Extreme Environments

Jane Curnutt

Ernesto Gomez

Keith Evan Schubert

California State University, San Bernardino

USA

[*jcurnutt@r2labs.org*](mailto:jcurnutt@r2labs.org)

In resource limited environments, plants grow in patterns that are self-enforcing and exhibit hysteresis. Among the techniques that have been used to modeling these patterns are evolutionarily stable strategies in game theory and differential equations. While good results have been generated using differential equations, they require tuning of the parameters and experience in mathematical and numerical techniques to obtain good results.

In this paper we develop cellular automata that achieve similar predictions to the differential equation models, while preserving the rapid modeling and hypothesis testing of cellular automata. Similar models can also be applicable to group animal behavior. Our method for deriving rules for cellular automata from observed data in plant growth patterns accounts for soil nutrients, water, root growth patterns, and geology allowing scientists to easily examine the effects of modifying conditions without damaging the environment. We apply this model to identifying the factors of patterning in areas of growth, die-out, and stabilization in extreme environments. We compare the results of our model with those of the differential equations used to model plant behavior in the Negev Desert.