Evolutionary Modeling Using State-Conditioned L-Systems

Joseph Berleant[1], Daniel Ashlock[2] and Daniel Berleant[3]
[1]LRCH, Little Rock, AR;
[2]University of Guelph, Guelph, Ontario;
[3]University of Arkansas at Little Rock, AR

Plant modeling is used extensively in plant structure research and in creating virtual plants for virtual environments. Lindenmayer systems (L-systems), which consist of a set of replacement rules that iteratively modify a string, are an important tool in plant modeling, and have already been used to model the structures of plants like corn and soy. In this study, the L-system concept was combined with a finite state machine (FSM), a system consisting of a set of states with rules that dictate movement among the states. Each FSM state is associated with its own L-system. Although L-system and FSM hybrids have relatively rich and complex behavior, no method to create such hybrids that model specific plants exist. Effective use of these hybrids requires such a method. This study examined the potential of using a set of mutation strategies to change an L-system/FSM hybrid to model a predetermined plant. An initial hybrid that represented a single diagonal line reminiscent of a slanted stalk was the starting point, and four mutation strategies were specified. Twenty-five mutated hybrids were each produced by randomly applying one of the four mutation strategies to the parent hybrid, and the hybrid that best resembled the target plant was chosen by the user for our human-in-the-loop selection strategy. This was used as the basis to produce 25 more mutations. This process continued until further mutations were unable to produce a hybrid with a significantly greater resemblance to the chosen plant. The chosen mutation strategies successfully mutated the simple initial L-system/FSM hybrid into one resembling the target plant.

Corresponding Author: Joseph Berleant, berleant@gmail.com