Plant. Growth Models using Artificial Neural Networks*

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The goal of the Advanced Life Support S ystems (AI .SS) is to provide self-sufficiency in life support for productive research and exploration in space, for benefits on Earth and to provide a basis for planetary explorations. Part of this objective is to be able to grow crop plants in one or more controlled environments for the purpose of providing life essentials to a human crew. To do this reliably and efficiently, it is necessary to achieve control of the rates of various plant physiology processes.

"To develop an efficient control system that will be able to manage, control, and opt imize plant-based life support functions, system ident ificat ion and modeling of plant growth behavior must first be done. We have developed a plant growth (physiology) model using artificial neural networks. Neural networks are very suitable for both steady-state and dynamic modeling and identification tasks, since they can be trained to approximate arbitrary nonlinear input-output mappings from a collection of input and output examples. in addition, they can be expanded to incorporate a large number of inputs and outputs as required, which makes it simple to model multivariable systems. "Thus, unknown nonlinear functions in dynamical models and controllers can easily be parameterized by means of multilayer neural network architectures.

]n this paper, we will describe our approach to developing these models, the neural network architecture, and the results, With the use of neural networks, these complex, nonlinear, dynamic, multimodal, multivariable plant growth models will be able to better interpolate between all the various environmental conditions and parameters and be able to simulate both short-term (day-to-day) and lollg-term (plant life cycle) growth of various plants.