Recurrent Neural Network Models for Prediction of the inside Temperature and Humidity in Greenhouse

Dae-Hyun Jung[1,2] Hak-Jin Kim[2] Soo Hyun Park[1*] Joon Yong Kim[2]

[1]Convergence Research Center for Smart Farm Solution,
Korea Institute of Science and Technology(KIST), Gangneung-si, Gangwon-do, Korea

[2]Department of Biosystems and Biomaterial Engineering, College of Agriculture and Life Sciences,
Seoul National University, Seoul, Korea

Abstract

Greenhouse have been developed to provide the plants with good environmental conditions for cultivation crop, two major factors of which are the inside air temperature and humidity. The inside temperature are influenced by the heating systems, ventilators and for systems among others, which in turn are geverned by some type of controller. Likewise, humidity environment is the result of complex mass exchanges between the inside air and the several elements of the greenhouse and the outside boundaries. Most of the existing models are based on the energy balance method and heat balance equation for modelling the heat and mass fluxes and generating dynamic elements. However, greenhouse are classified as complex system, and need to make a sophisticated modeling. Furthermore, there is a difficulty in using classical control methods for complex process system due to the process are non linear and multi-output(MIMO) systems. In order to predict the time evolution of conditions in certain greenhouse as a function, we present here to use of recurrent neural networks(RNN) which has been used to implement the direct dynamics of the inside temperature and inside humidity of greenhouse. For the training, we used algorithm of a backpropagation Through Time (BPTT). Because the environmental parameters are shared by all time steps in the network, the gradient at each output depends not only on the calculations of the current time step, but also the previous time steps. The training data was emulated to 13 input variables during March 1 to 7, and the model was tested with database file of March 8. The RMSE of results of the temperature modeling was 0.976℃, and the RMSE of humidity simulation was 4.11%, which will be given to prove the performance of RNN in prediction of the greenhouse environment.

Keywords

Neural Networks, Greenhouse modeling, MIMO, Microclimate

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* 교신저자 : Soo Hyun Park(ecoloves@kist.re.kr)