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Optimization Techniques in Greenhouse Cultivation

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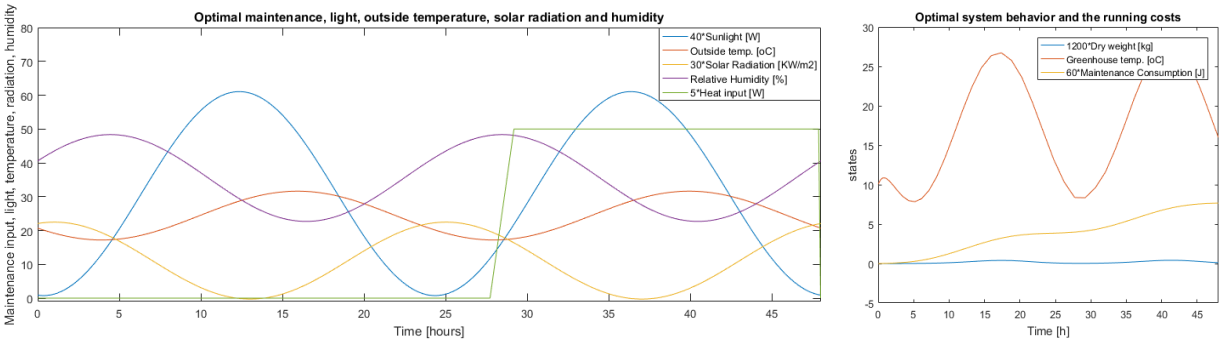
Abstract: In today's era, greenhouse cultivation is a massive success, for it ensures the proper growth of any particular crop in a controlled and ambient environment despite the harsh climatic impacts outside the greenhouse. However, this incorporates various cost for maintenance and the profit margin reduces. In this paper, the cost function of greenhouse is optimized such that it reduces the consumption of energy as well as increase the dry weight of crop, which is to be sold and made profit with. The maintenance cost is reduced by optimal use of overall electrical consumption, like heating devices and de-humidifiers to maintain ambient environment.
The crop considered here is cucumber as the parametric data were widely available for the crop and the location is selected as Nagpur city of Maharashtra State. This data, with some slight variations can reflect the climatic conditions of most of the parts of India.
Foremost task is modelling of system, for this, there are three state variables considered viz. dry weight of crop, greenhouse internal temperature and maintenance cost. Apart from these, there are external inputs considered, like sunlight intensity, external temperature, radiation intensity and relative humidity, these data are obtained from meteorological website, the data is for 192 consecutive hours, which is fitted into appropriate mathematical functions with the help of necessary tools. Based on these, the following graphs are observed:



The graphs represent modelled external parameters, internal parameters, respective optimal maintenance cost, and dry weight. The latter two forms cost function for profit, which is to be maximized. The above paradigm can be used to warrant a better economical outcome, and provide an efficient way to design control systems for sustainable greenhouses of the future.

References: 1. Optimal Greenhouse Cultivation Control: Survey and Perspectives - *G. van Straten & E. J. van Henten.*
2. Plants on Earth and in Space – *Louis D. Albright, Richard S. Gates, Kostas G. Arvanitis & Alan E. Drysdale.*
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