Adaptive Weed Growth Prediction for Mechanical Weeding Agbots

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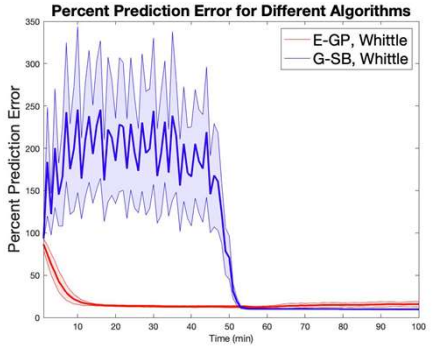
Our work has generated advances in predictive modeling of weed growth, as well as an improved planning index to be used in conjunction with these techniques, for the purpose of improving the performance of coordinated weeding algorithms being developed for industrial agriculture.

A crisis in agricultural weed management has resulted from the evolution of herbicide-resistant weeds, as well as the fact that new herbicide discovery has ceased in the past 30 years. Our work provides critical advances towards the development of collaborative low-cost and lightweight mechanical weeding robots repeated to control such weeds, which has many advantages over traditional weeding solutions.

Consider a team of such robots in any row-crop farm in the US. This team of robots needs to predict the weed growth across the whole farm in order to make intelligent decisions on robot coordination. However, none of the robots can observe the whole field, and even together, they can only observe a very limited part of the field at any given time.

We demonstrate that a variant of the Evolving Gaussian process (E-GP) method applied to measurements from the agents can predict the evolution of the field. This method also provides physical insight into the seed bank distribution of the field. We use an improved planning index, the Whittle index, which allows a balanced trade-off between exploiting a row or allowing it to accrue reward, and conforms to what we show is the theoretical limit for the fewest number of agents which can be used in this domain.

We compare this predictive approach with one that relies on known properties of the weed growth model, and show that the E-GP method can drive down the total weed biomass for fields with high seed bank densities using fewer agents, without assuming this model information.



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