Models of plant response to environment are needed for the design, operation and control of advanced life support systems incorporating biomass production. We developed completely empirical nonlinear models of plant response to demonstrate the novel ability of multivariate polynomial regression (MPR) to describe complex plant growth behaviors. In this work we developed approaches to compute confidence intervals on model predictions. The confidence intervals can be used to detect outliers in the data and to establish robustness in model-based control algorithms. Confidence intervals cannot be easily computed for the best-known competing empirical nonlinear modeling method, the artificial neural network.

Two crops of soybeans were grown in chambers. Data were collected at intervals ranging from 1 to 20 minutes at all three stages of crop growth, under different long-term and short-term CO₂ concentration and light intensity levels. Only data from steady-state conditions were used. MPR models were fitted to the data using cross-validation and a final validation performed using independent data.

Once an MPR model was developed, the confidence interval for both the model prediction and for the data as a function of the independent variables could be computed from the covariance matrix for the model fit. The confidence intervals were computed on the independent validation dataset. This work shows that it is feasible and easy to compute confidence intervals for MPR models.