2015 DISCOVERY SUMMIT
EXPLORING DATA INSPIRING INNOVATION

NC State University

Using JMP to find predictive model of Electrochromic window behavior for future optimization

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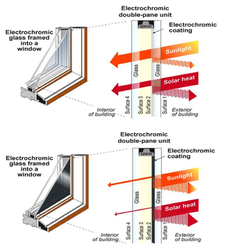
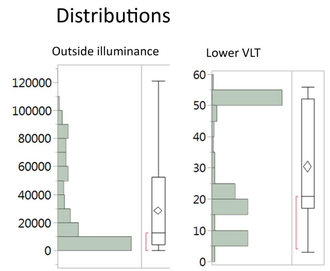
jmp

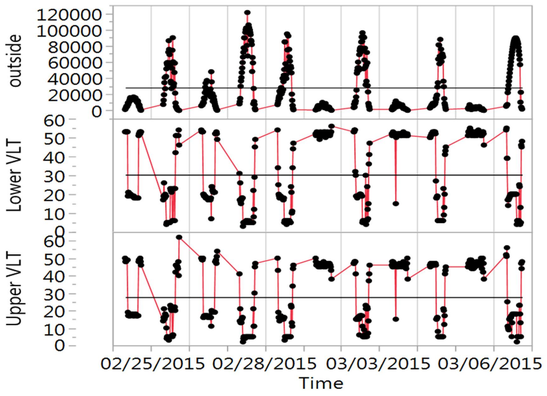
Abstract

Electrochromic (EC) glazing, which varies it's visual and thermal properties by electric field, has the potential to be the next major advance in energy-efficient window technology, helping to transform windows from an energy liability to an energy source for the building sector.
EC is controlled using input from an interior light sensor to maintain a comfortable level of daylight in the space. A configurable range of light entering is defined by giving an upper and lower acceptable lighting range.
When the illuminance set-point is crossed for a configurable amount of time the glass will tint to the brighter or darker available levels. EC glazing can switch from clear to fully darkened state and can be held at an intermediate tinted state.

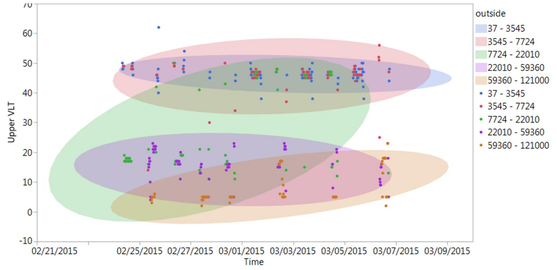
Experimental data reveals that EC behavior does not precisely correspond to the control algorithm. This paper uses PCA and fit model platforms in JMP to evaluate the effect of different control parameters on EC behavior and defines an accurate prediction model. Predicted models can be used for energy analysis and EC window performance optimization.



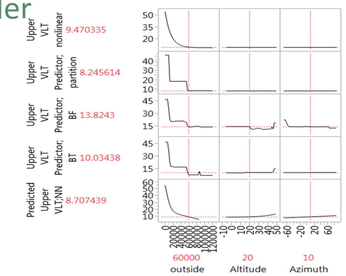




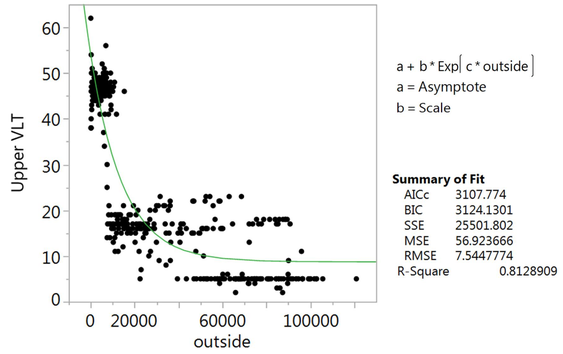
Upper VLT vs. Time



Prediction Profiler



Non linear fit Prediction Model



a + b * Exp(c * outside)
a = Asymptote
b = Scale

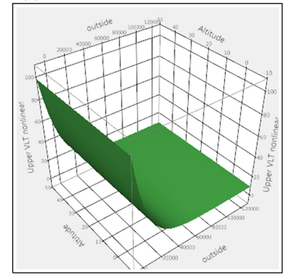
Summary of Fit

AICc	3107.774
BIC	3124.1301
SSE	25501.802
MSE	56.923666
RMSE	7.5447774
R-Square	0.8128909

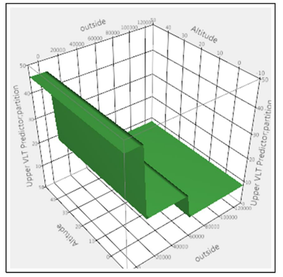
Measures of Fit for Upper VLT

Predictor	Creator		RSquare	RASE	AAE	Freq
Upper VLT nonlinear	Fit Curve Exponential 3P		0.8129	7.5196	6.1740	451
Upper VLT Predictor;partition	Partition		0.8608	6.4850	3.8490	451
Upper VLT Predictor;BF	Bootstrap Forest		0.8861	5.8674	4.1456	451
Upper VLT Predictor;BT	Boosted Tree		0.9040	5.3851	3.5802	451
Predicted Upper VLT	Neural		0.8986	5.5359	3.6622	451

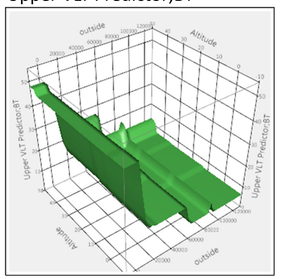
Upper VLT nonlinear



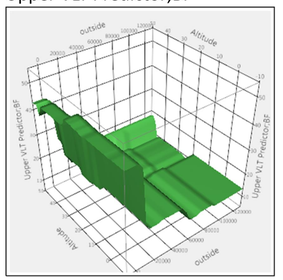
Upper VLT Predictor;partition



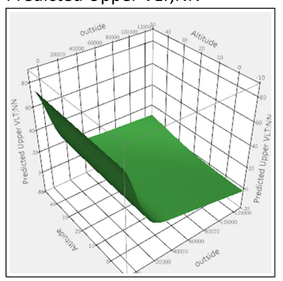
Upper VLT Predictor;BT



Upper VLT Predictor;BF



Predicted Upper VLT;NN



Conclusion

Electrochromic (EC) glazing, which varies it's visual and thermal properties by electric field, is controlled using input from an interior light sensor to maintain a comfortable level of daylight in the space.

Even though EC window are programed to be tinted based on outside light level measurement, in real application does not accurate follow the control algorithm. The goal of this study is to find a predictive model for EC behavior. For this aim field test data has been used for creating predictive model for EC VLT variation based on outside illuminance and solar angle. Among different methods of prediction model, Fit Curve Exponential with lowest R Square create the most accurate prediction model.