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Prediction of Relay Settings in an Adaptive Protection System

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Introduction:

As inverter based resources(IBRs) in the distribution system continue to increase, the protection settings will have to change.

Adaptive Protection System:

A solution that has been purposed to handle the solar variability of IBRs in the power system.

An Issue With Adaptive Protection:

These system are highly reliant on communication networks if interrupted for an extended period, the protection scheme may not operate with the speed and selectivity intended.

A Solution To Loss of Communication To Protective Relays:

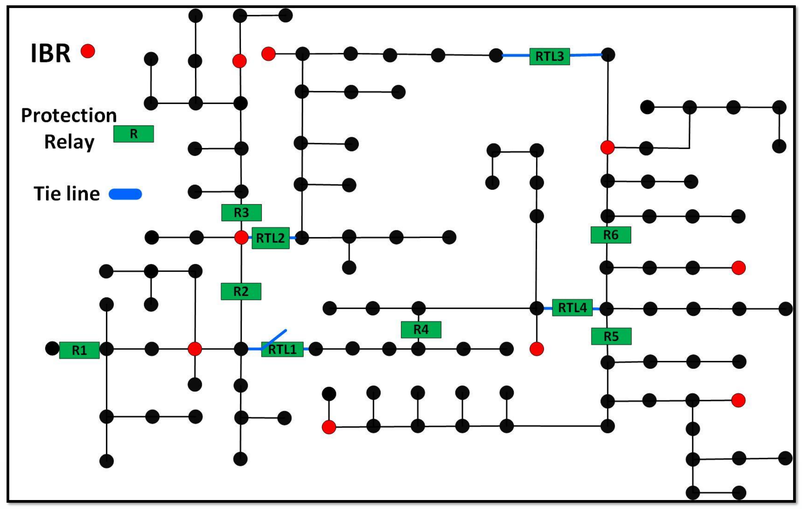
Use the Prophet machine learning algorithm to predict the Time-overcurrent settings for individual relays.

The Prophet Algorithm

Prophet models times series as a generalized additive model.

$y(t) = g(t)+s(t)+h(t)+e(t)$

System of Study



Data Generation Process

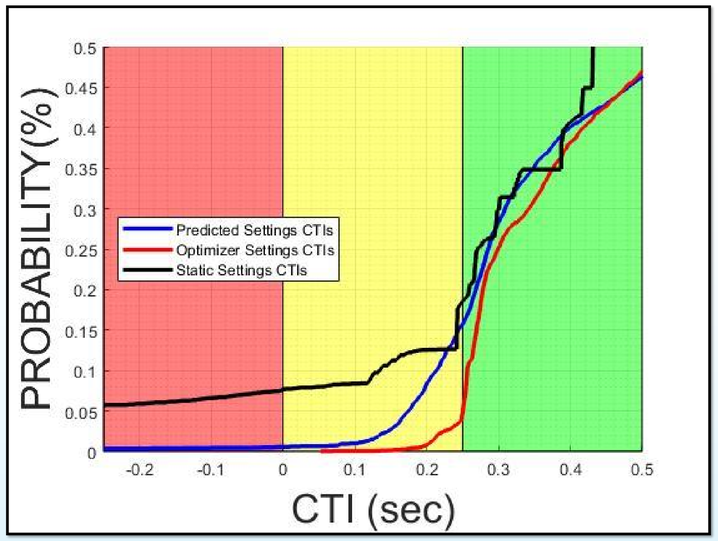
A year-long, hourly simulation with varying loads and PV profiles was used along with an optimal coordination algorithm to generate the optimized relay settings data set that was used to train the individual relay Prophet algorithms.

Results

	MAPE %		RMSE %	
	TDS	I_{PICKUP}	TDS	I_{PICKUP}
R1	3.216	0.041	0.320	0.127
R2	8.038	0.004	0.721	0.013
R3	0.427	0.040	0.007	0.019
R4	0.469	0.021	0.005	0.005
R5	16.810	0.033	0.150	0.049
R6	12.459	0.034	0.505	0.064
RTL2	3.647	0.049	0.347	0.141
RTL3	5.290	0.031	0.410	0.057
RTL4	0.702	0.094	0.026	0.052

Conclusions:

The Prophet algorithm was able to predict the TDS values with a average accuracy of 94.32% and I_{PICKUP} at 99.96%. This work provides a basis for future adaptive protection parameter prediction for individual relays either for the event of loss of communication or to verify settings communicated to the relays improving an adaptive protection system.



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