Particle Swarm Optimization of Dynamic Load Model Parameters using Measurement-based Approach

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Background
• Summer load models must account for high levels of induction motors for cooling which can exacerbate fault-induced delayed voltage recovery
• Tuned load models are crucial for transmission planning and assessments
• Conservative assumptions in the load model can lead to greater confidence in voltage stability of the system
• Load models have interdependent parameters which makes tuning difficult

Conclusion
• High amount of induction motors significantly slows down simulation time
• Tuning to a single event may lead to reduced generalizations of the parameters
• More events are beneficial for tuning but difficult to obtain due to rarity of 3-phase faults
• PSO accuracy relies on objective function formulation
• The load model was validated with a second event and performed with similar accuracy as in Fig. 3

Approach
• Particle swarm optimization (PSO) can process a high-order interdependent parameter estimation problem
• 8 CMLD and 8 CLOD parameters are tuned to a 3-phase fault starting from default values
• The event has ~18 measurement locations
• PSO initializes candidate solutions (particles) randomly about the default value
• Particles have a social and cognitive coefficient which determines how well particles share information
• Several objective functions are tested to evaluate the solution
• The best-known solution is shared with all particles
• Subsequent iterations update particles until the maximum number of iterations (Fig. 1)
• Several runs of 50-200 particles are used to create average load models for both CLOD and CMLD

Results
• PSO tuned CLOD model performs better than previously used CLOD load models (Fig. 2)
• Tuned CLOD model captures settling voltage while the PSO CMLD model captures recovery voltage
• Fault impedance is not tuned but has a significant impact on the overall simulation results and accuracy