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

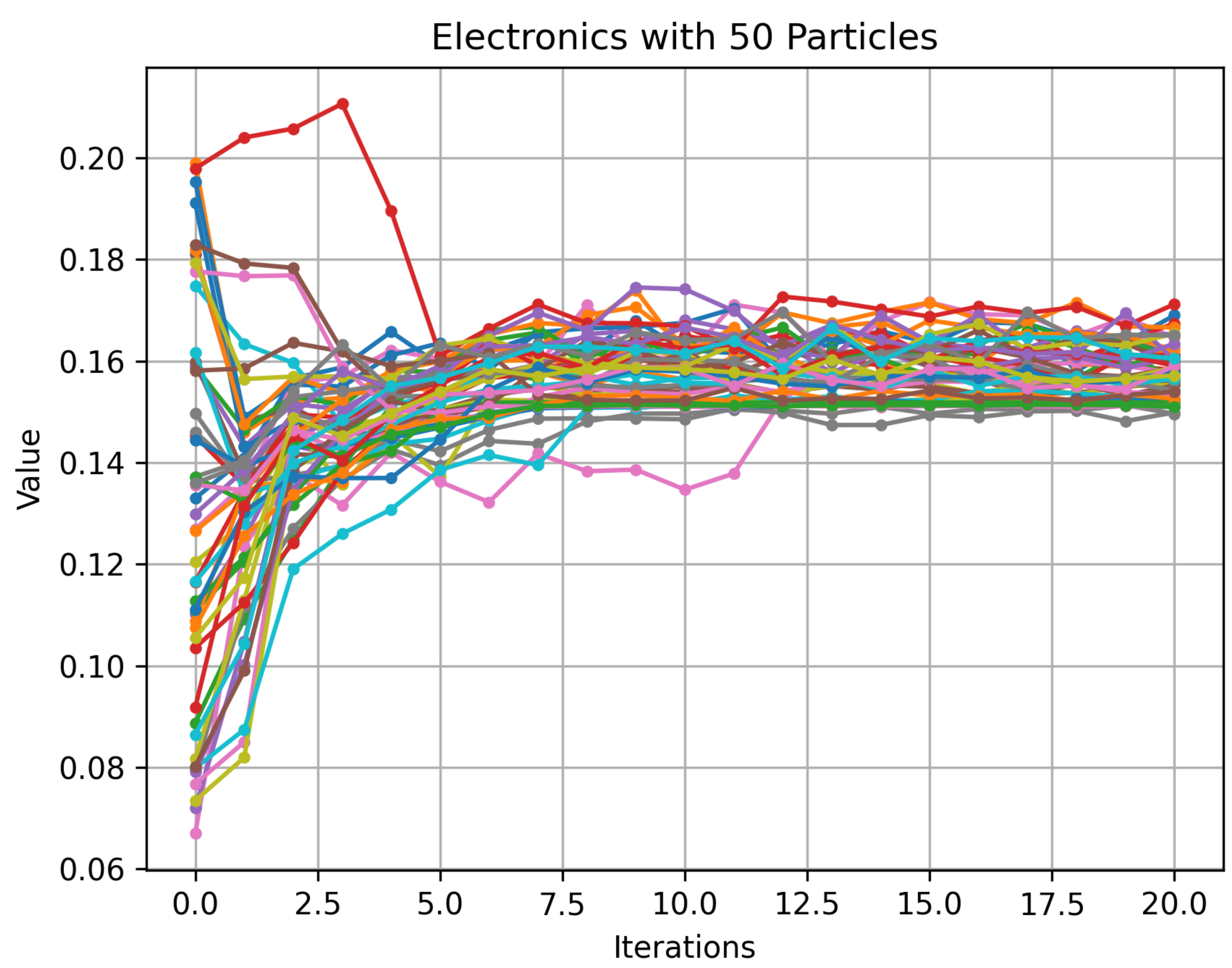

Fig. 1 Particles converging to determine electronic load of CMLD (example).

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

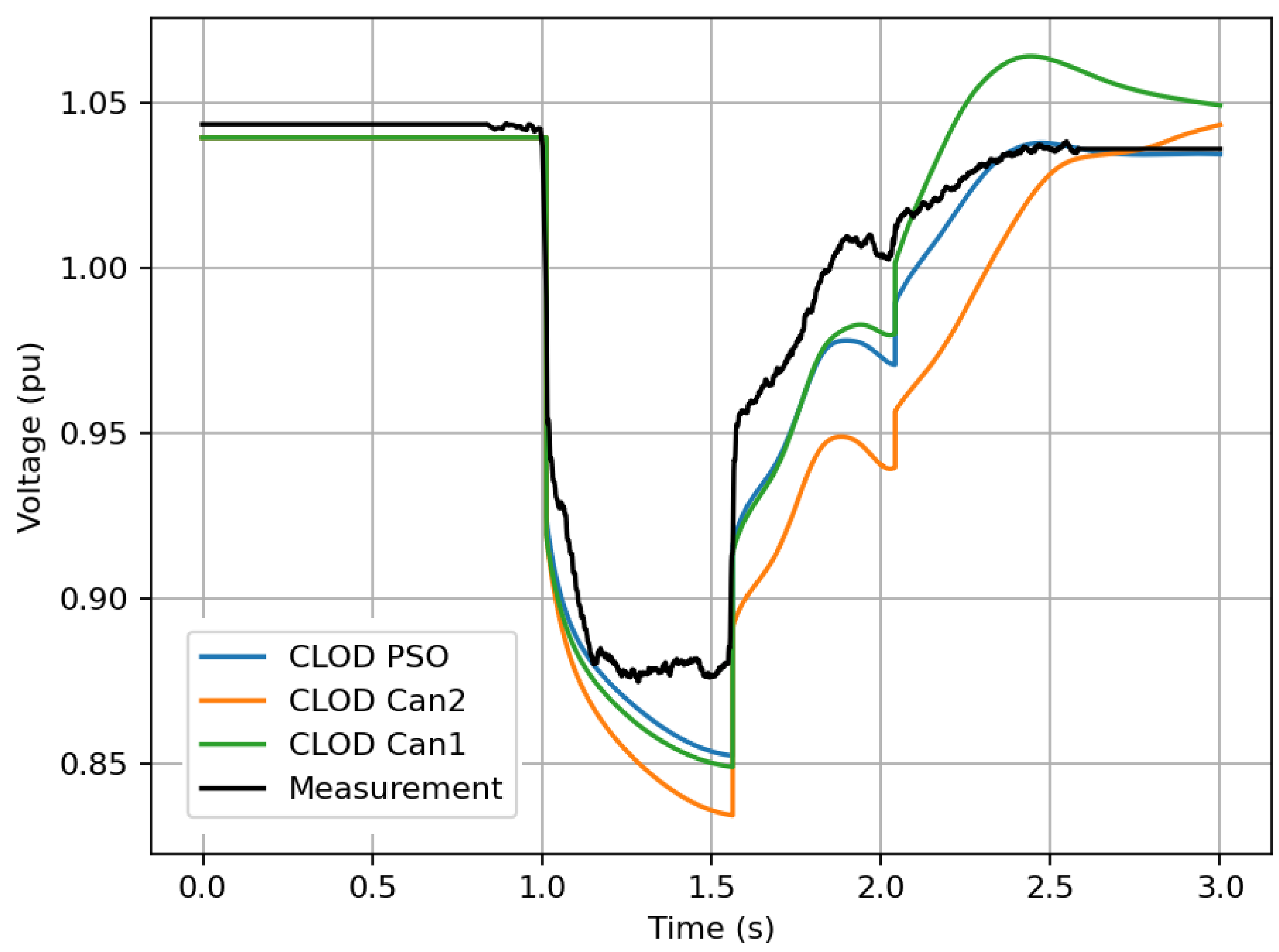

Fig. 2 Comparing tuned PSO CLOD model to previously used CLOD models.

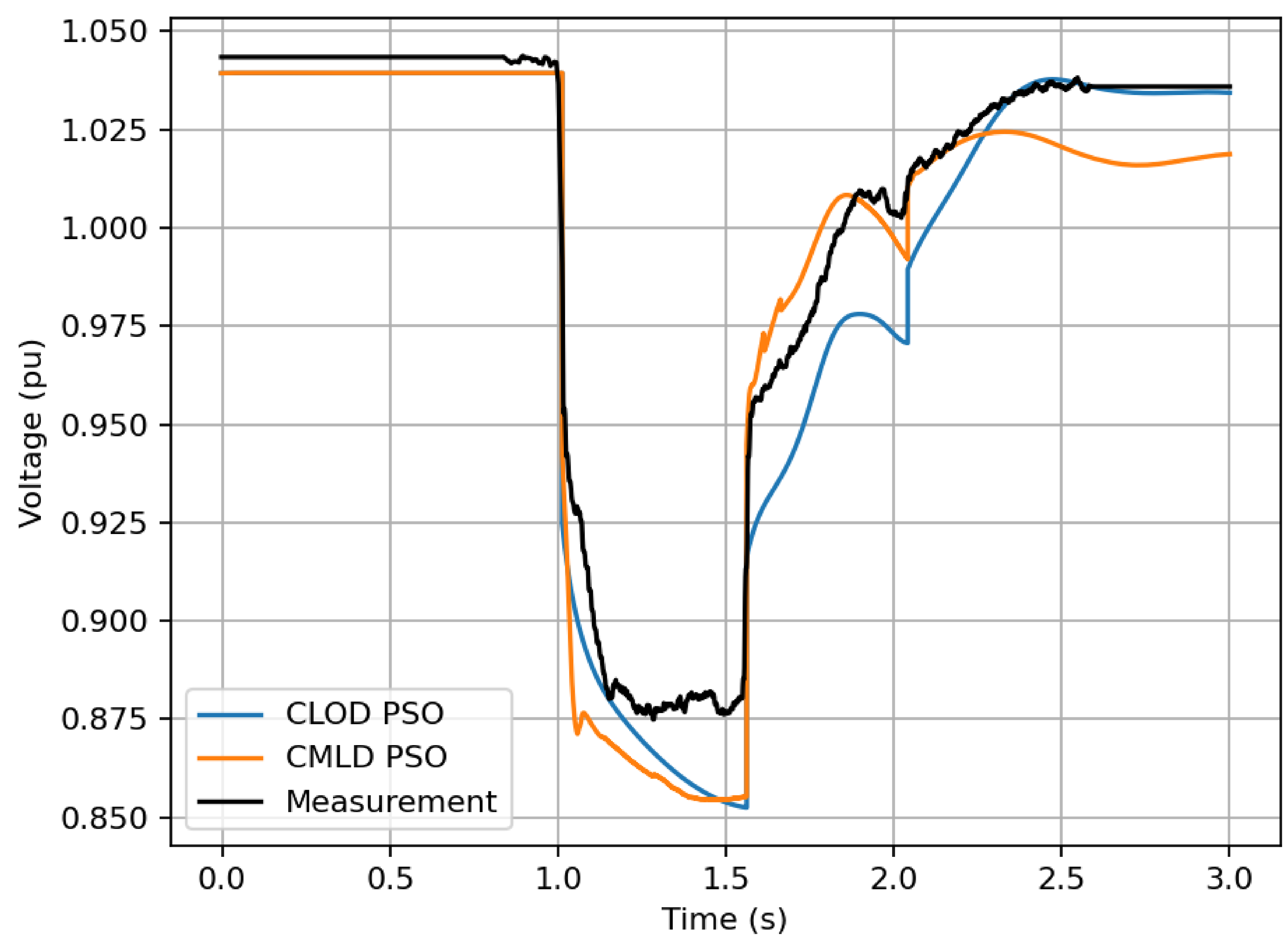

Fig. 3 Comparing tuned PSO CLOD model to PSO CMLD.

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