**INTRODUCTION**

- **Motivating Scenario:** Recent major attacks on the electric grid necessitate domain-specific formal security monitoring solutions for cyber-physical system operations. Detecting unsafe states aids mitigation measures, but preventing unsafe states provides more beneficial and significant impact for recovery.
- **Just-Ahead-of-Time Controller Recovery:** Parallel, on-the-fly model checking using symbolic execution for pruning unreachable states to determine unsafe states before execution on PLC.

**NEURAL NETWORK APPROXIMATION**

- Trained neural network has the same semantics with the original code.
- Reconstructed code obtains faster running speed but lower accuracy.
- Approximated implementation provides alert comparison for vulnerabilities.

**CODE VERIFICATION**

- JCR uses hybrid symbolic execution to eliminate the unreachable states, thus increasing the speed of verification.
- JCR performs parallel, on-the-fly model checking and informs the operator well in advance about the future unsafe states.
- JCR avoids exploration of the states that are not reachable from the system's current concrete state.
- With this in-advance warning, the operator can take necessary actions to prevent the unsafe state.

**REFERENCES**