Real Time Simulation and Experimentation of Smart grid Control Using an FPGI based Controller

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Applications of Microgrid Control

Control of microgrids is essential to utilizing the full functionality of the emerging technology. Using a microcontroller to switch between microgrid modes of operation allows for engineers to program routines for automatically switching between power generation sources at optimal times of the day or when a fault has been detected in the transmission lines. Optimizing power source selection is critical to efficient energy use.

Motivations

The control design and development with possible experimentation set-up and validation will lead in significant energy security and economic benefits.

The area of control is a critical aspect in the basic research to commercialization and instantiation cycle. The design of controllers with possible experimentation and validation will lead in significant energy security and economic benefits.

The area of control is a critical aspect in the basic research to commercialization and instantiation cycle. Therefore, it is important to develop real time simulation via the utilization of control hardware in the loop (CHIL)-based strategies.

Objectives

- Establish connection between myRIO to OPAL-RT
- Run and control two-bus Simulink setup in RT Lab
- Use myRIO's GPIO capabilities to control fault and breaker switches in the two-bus simulation.

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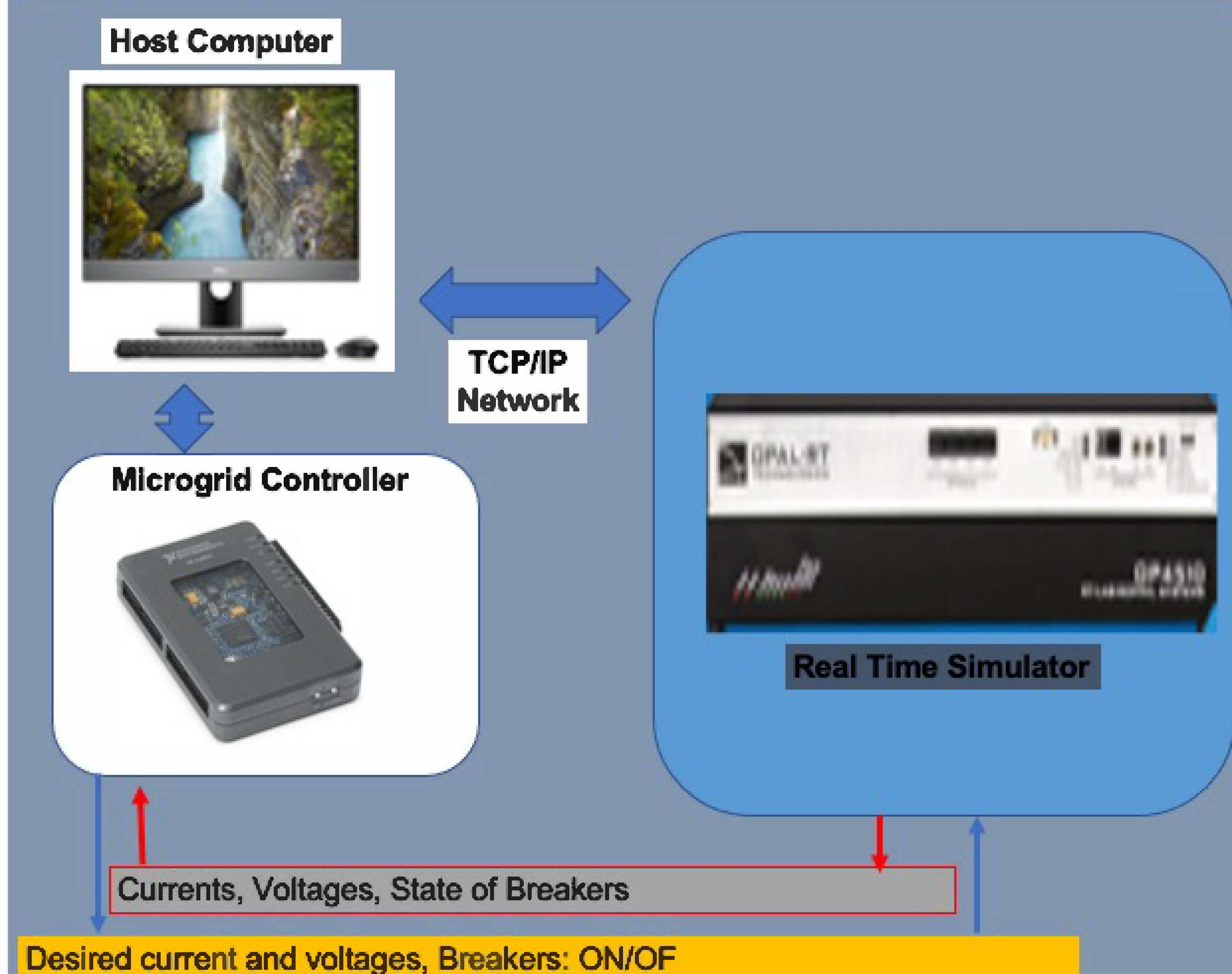
CHIL architecture

Control in-the-loop (CHIL) is a real time simulation that involves a real time emulated power systems via the utilization of Opal RT connected to hardware microcontroller that is NI myRIO. CHIL is a powerful technique for validation and demonstration of systems in a rigorous and dynamic manner that is not achievable with traditional simulation and testing methods.



RT Lab Simulation

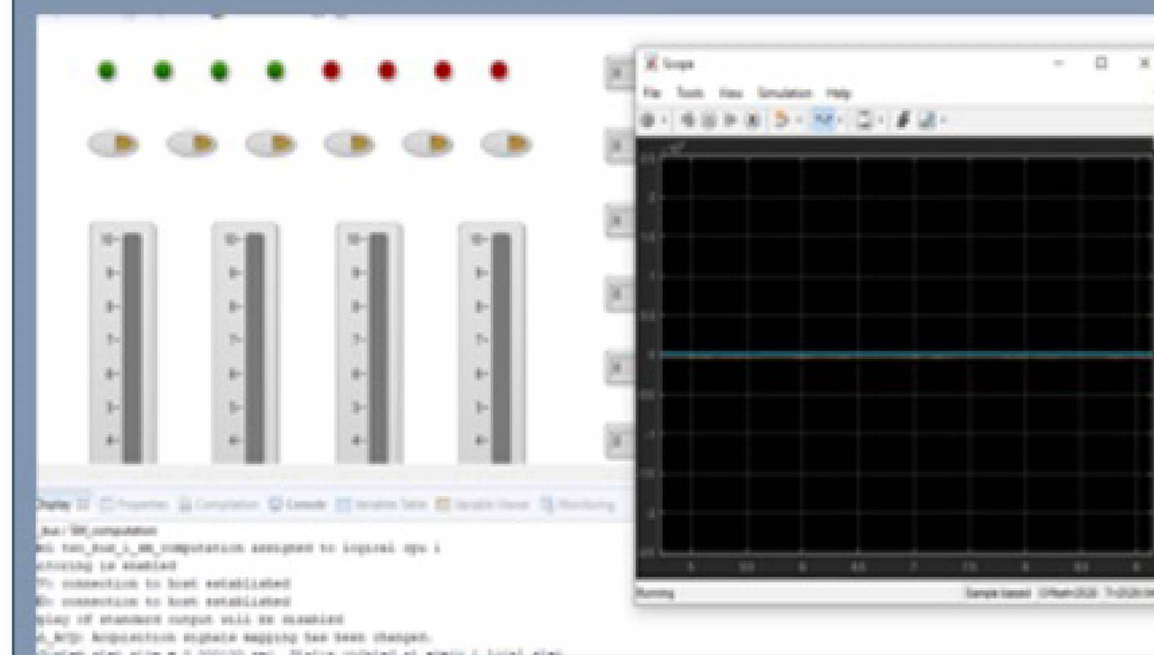


Figure 1: Fault and Breaker Deactivated

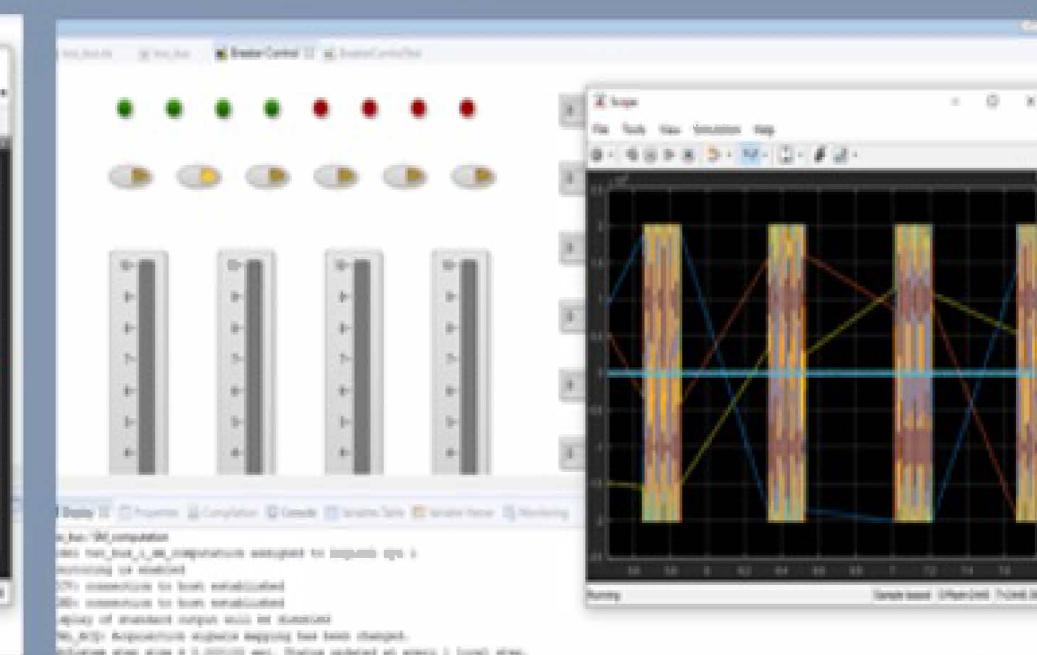


Figure 2: Fault Deactivated, Breaker Activated

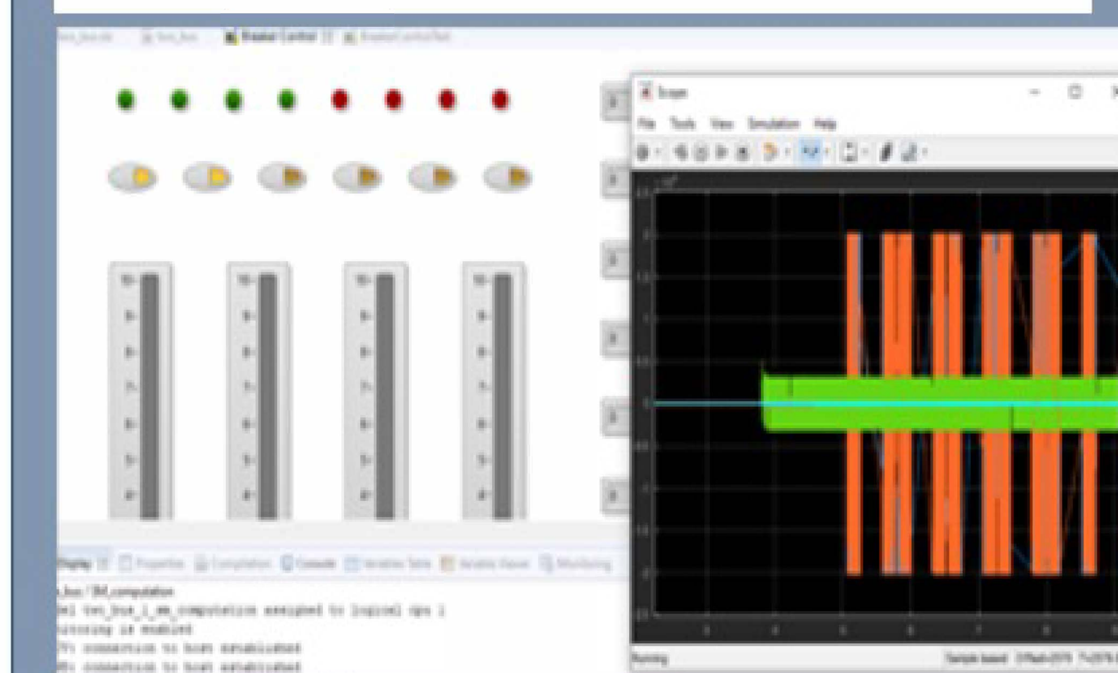


Figure 3: Fault Activated, Breaker Deactivated

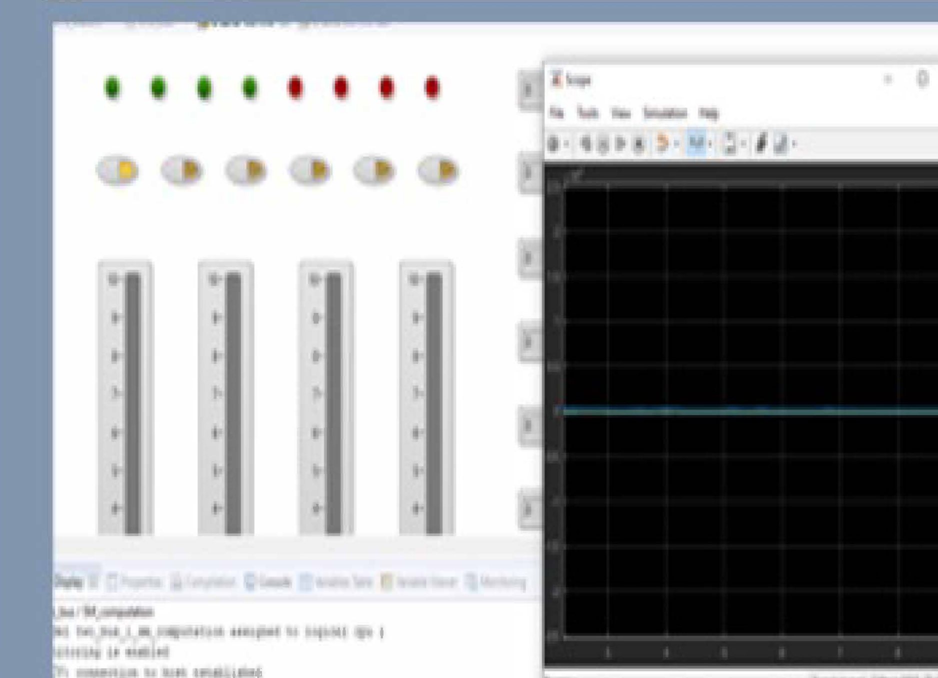
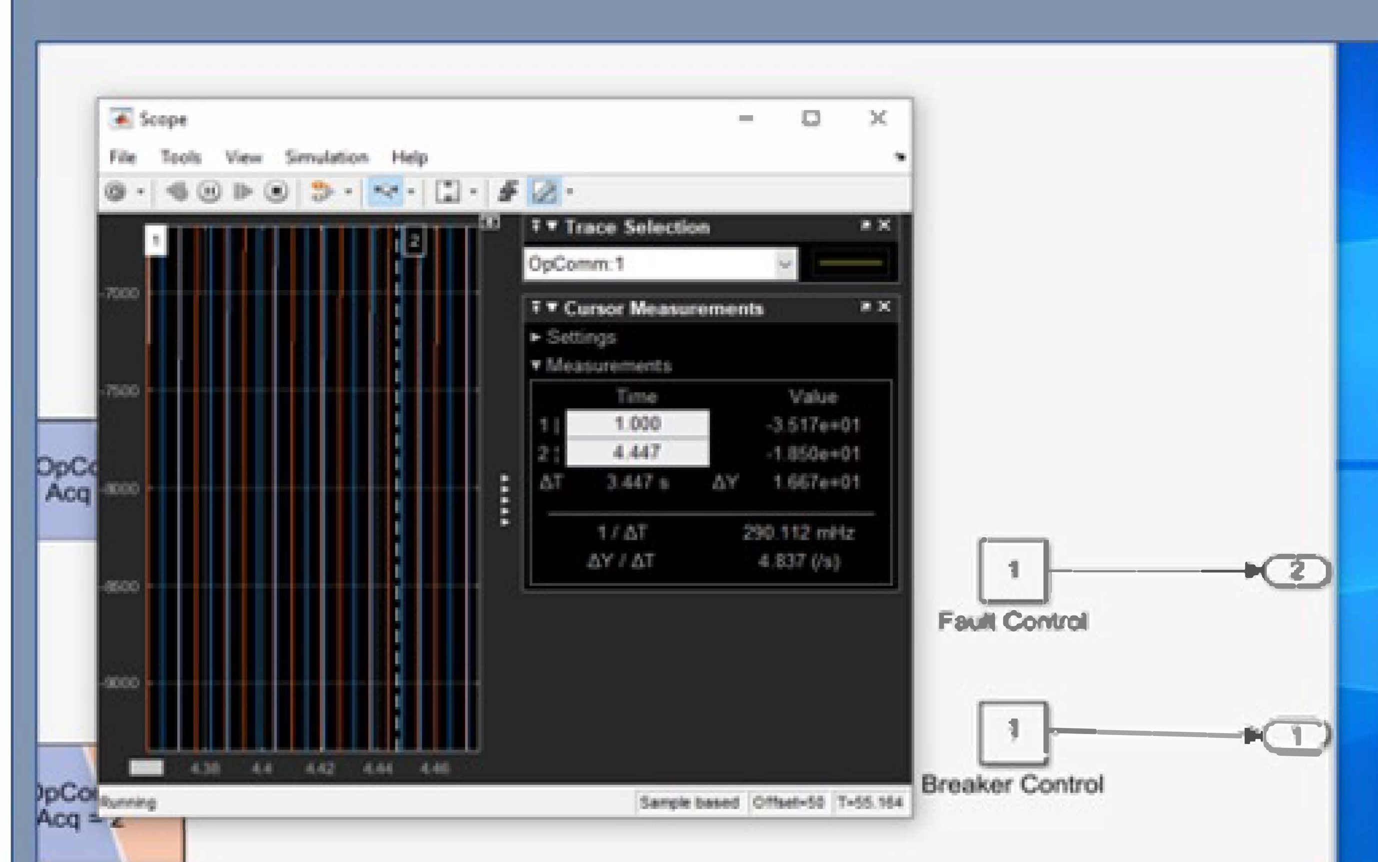
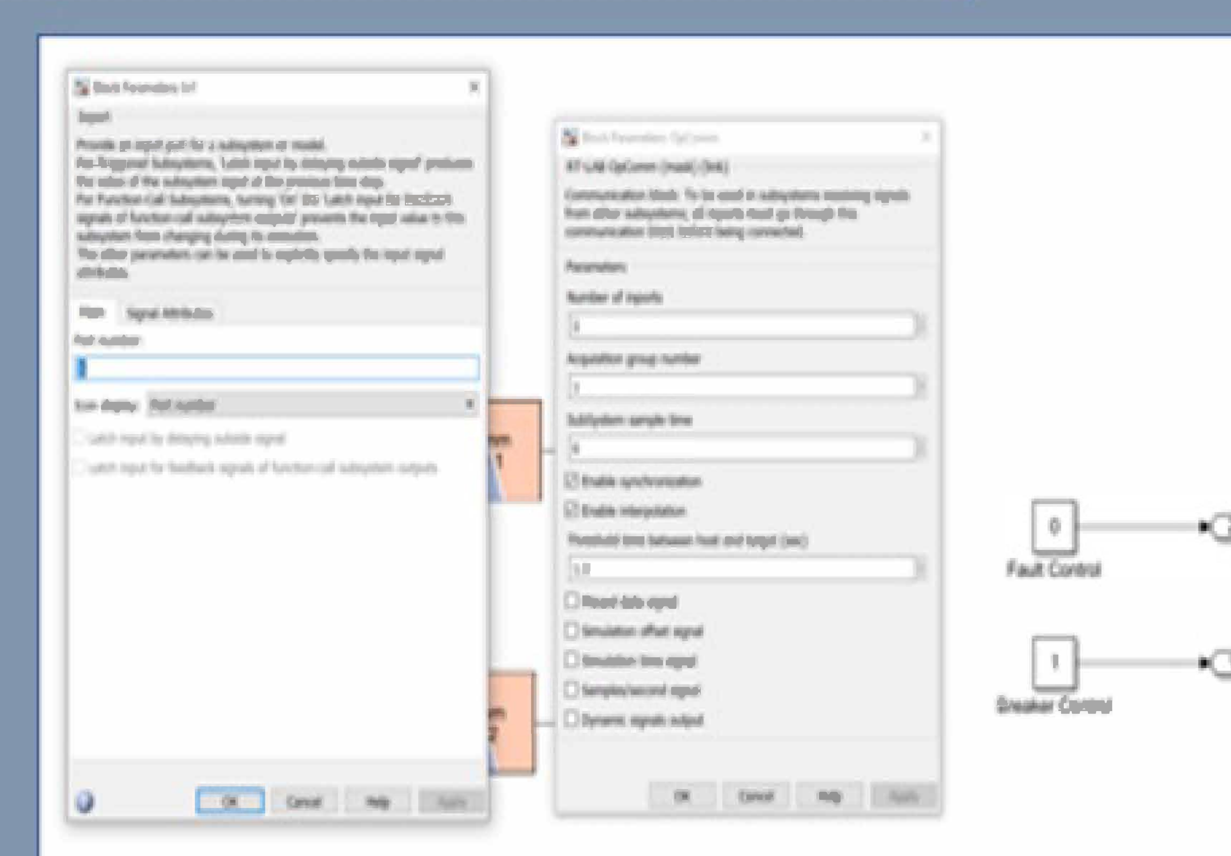


Figure 4: Fault and Breaker Activated

Simulated Model using MATLAB/Simulink





Conclusion

There are several challenges present in the use of microcontrollers to directly manipulate OpalRT simulations, the first of which is establishing communication between the board and the OpalRT computer. The computer has limited capabilities for commanding external devices; the myRIO microcontroller faces a similar issue. The process of programming the OpalRT computer to directly take GPIO and data commands from the myRIO requires a high degree of proficiency with computer networking. Another significant obstacle lies with providing the myRIO an adequate power supply when directly connected to the OpalRT computer, as the board traditionally requires a 120VAC to 12VDC converter.

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