Summary Report

Project Title: Artificial Intelligence Controlled Variable Capacitor for Wind Generator Stabilization.

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Summary: This research was conducted as an undergraduate design project, where five undergraduate students registered for the Senior Design course (EECE 4280) in the Spring 2024 semester at the University of Memphis. Wind turbines, a cornerstone of renewable energy, harness wind power to generate electricity. Despite their potential for sustainable energy production, current market options are costly- particularly with technologies like Static Synchronous Compensator (STATCOM) or Static VAR Compensator (SVC) used for grid support, which poses a challenge. Intense research is underway to enhance their efficiency and affordability, aiming to propel wind energy as a viable, sustainable solution for our energy needs. The goal of this project is to design an efficient, cost-effective transient stability device for wind turbine generators. This artificial intelligence (AI)-controlled device regulates voltage and power with proportional-integral (PI) controller and Thyristor Switched Capacitor (TSC), and alerts users of electrical faults. The device is scalable and expected to enhance the economy and reliability of wind turbine generator.

Design Testing and Results: For this design project, the wind turbine generator simulation model shown in figure 1 was considered. The Matlab/Simulink software was used to build the simulation model. Figures 2 and 3 show the developed PI controller and thyristor switched capacitor (TSC) model for the proposed design.

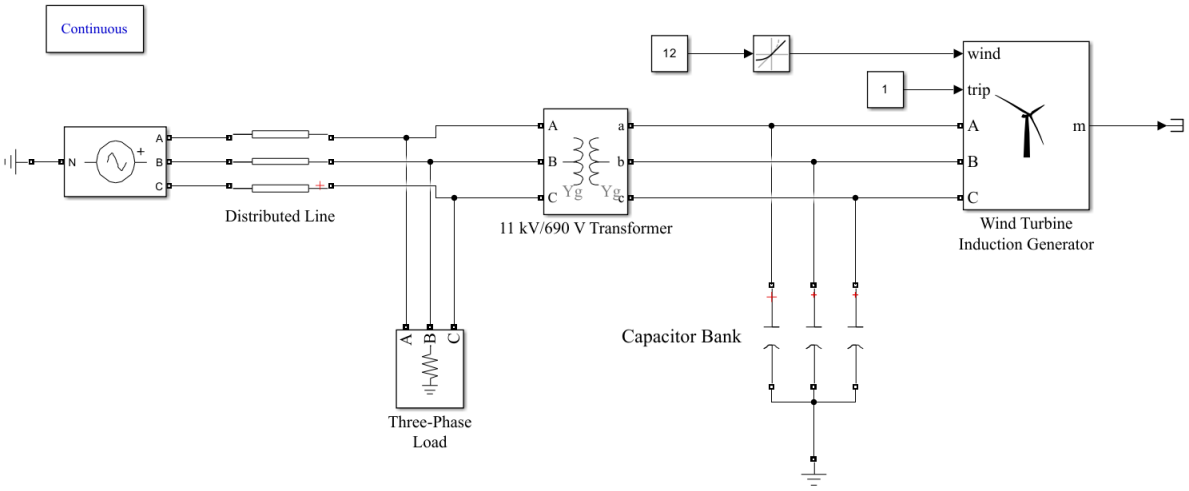

Figure 1: Wind turbine generator connected to power grid.

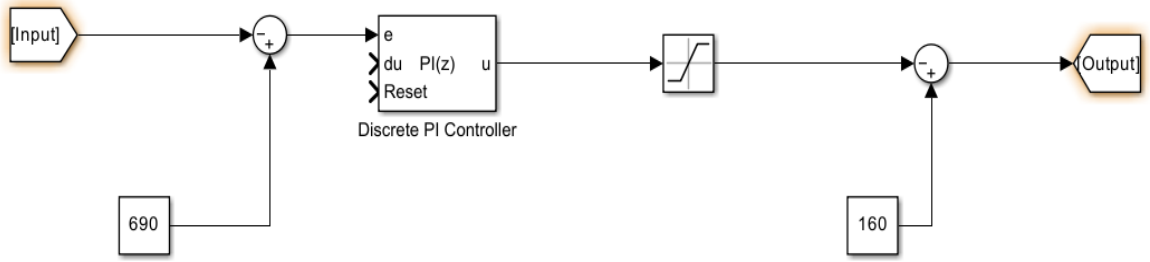

Figure 2: PI controller.

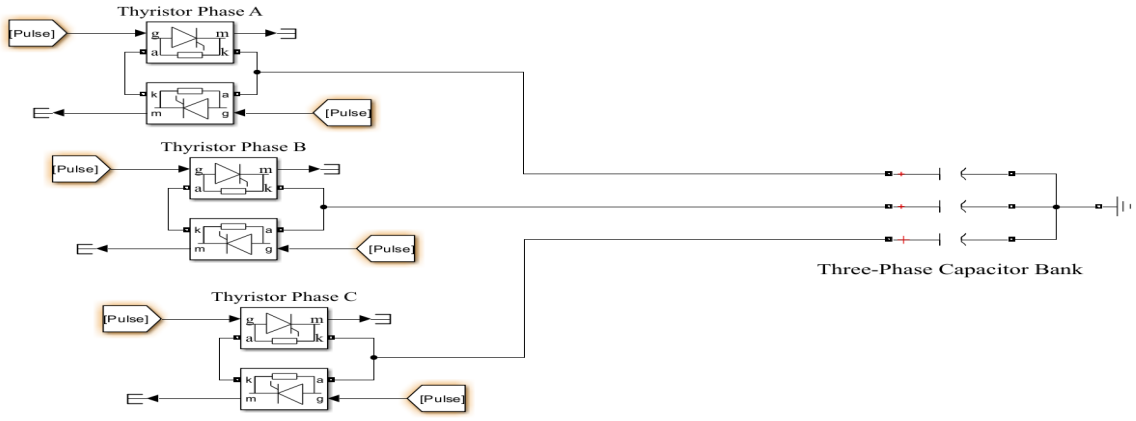

Figure 3: TSC (Thyristor Switch Capacitor) circuit model.

Conclusion: The proposed project has potential impact on the relevant field and application. The designed controller could monitor the digital signal input for faults. Detected faults would trigger the TSC to stabilize the signal, ensuring signal stability of the wind turbine generator during faults. Thus, the proposed AI controlled capacitor is an effective method for wind generator stabilization.