Design of Intelligent Energy Management Scheme for Stand-alone Wind-Battery system for an off-grid residential area

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1.Introduction

Wind power generation largely depends on the climate and is therefore intermittent. Energy storage systems are often integrated to improve reliability. Energy management system are then used to facilitate the process.

2. Aim

- Determine the loading of residential area.
- Determine the size and capacity of the wind power plant.
- Determine the wind resource availability of the residential area.
- Determine the size and capacity of the energy storage system.
- Design the intelligent energy management scheme. The scheme must maintain energy supply and demand. Cater to the charging and discharging of the energy storage system. Shed loads during periods of low wind resource and low state of charge.

3.Approach

- After Diversity Maximum Demand (ADMD) method was used to determine the load.
- Induction generator wind turbine was used to simulate the wind power plant.
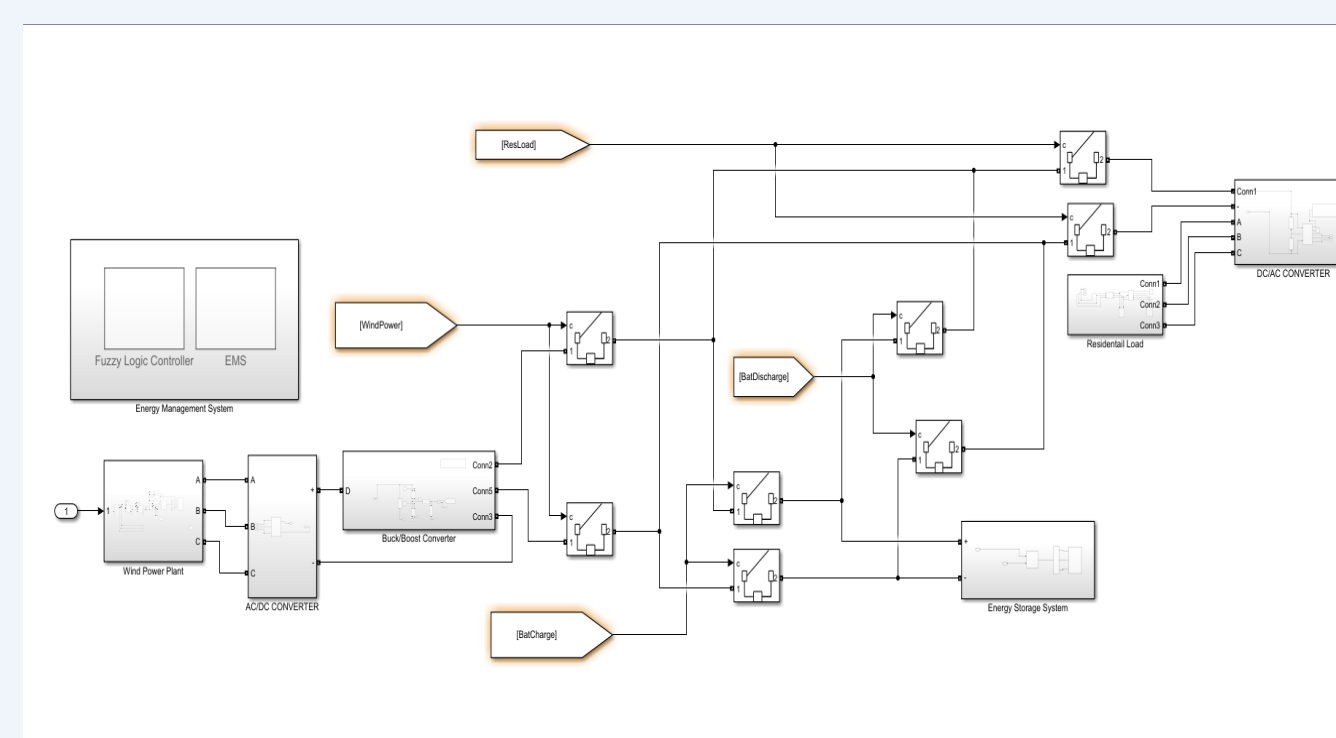- South African Wind Atlas was used to determine the wind resource availability.

- Ragone plot was used to select the best energy storage technology.
- Fuzzy logic controller was used to implement the energy management scheme.
- The EMS sends control signals to the circuit breakers.
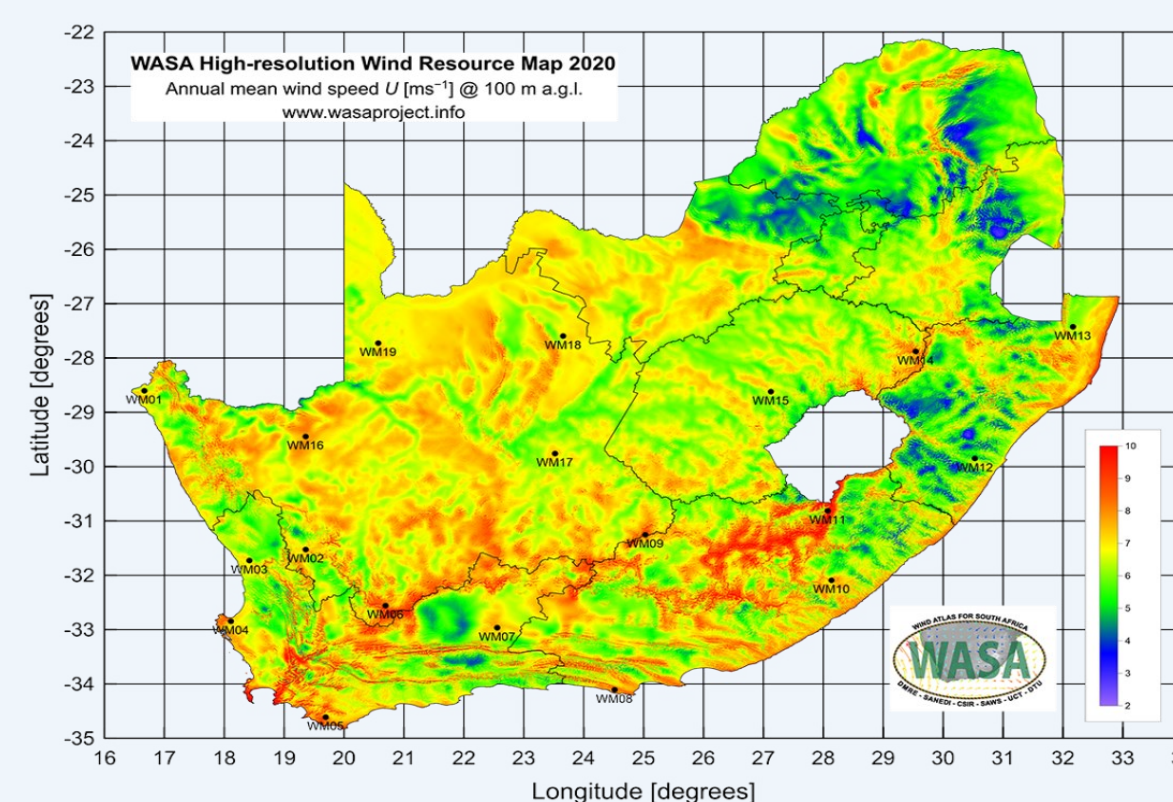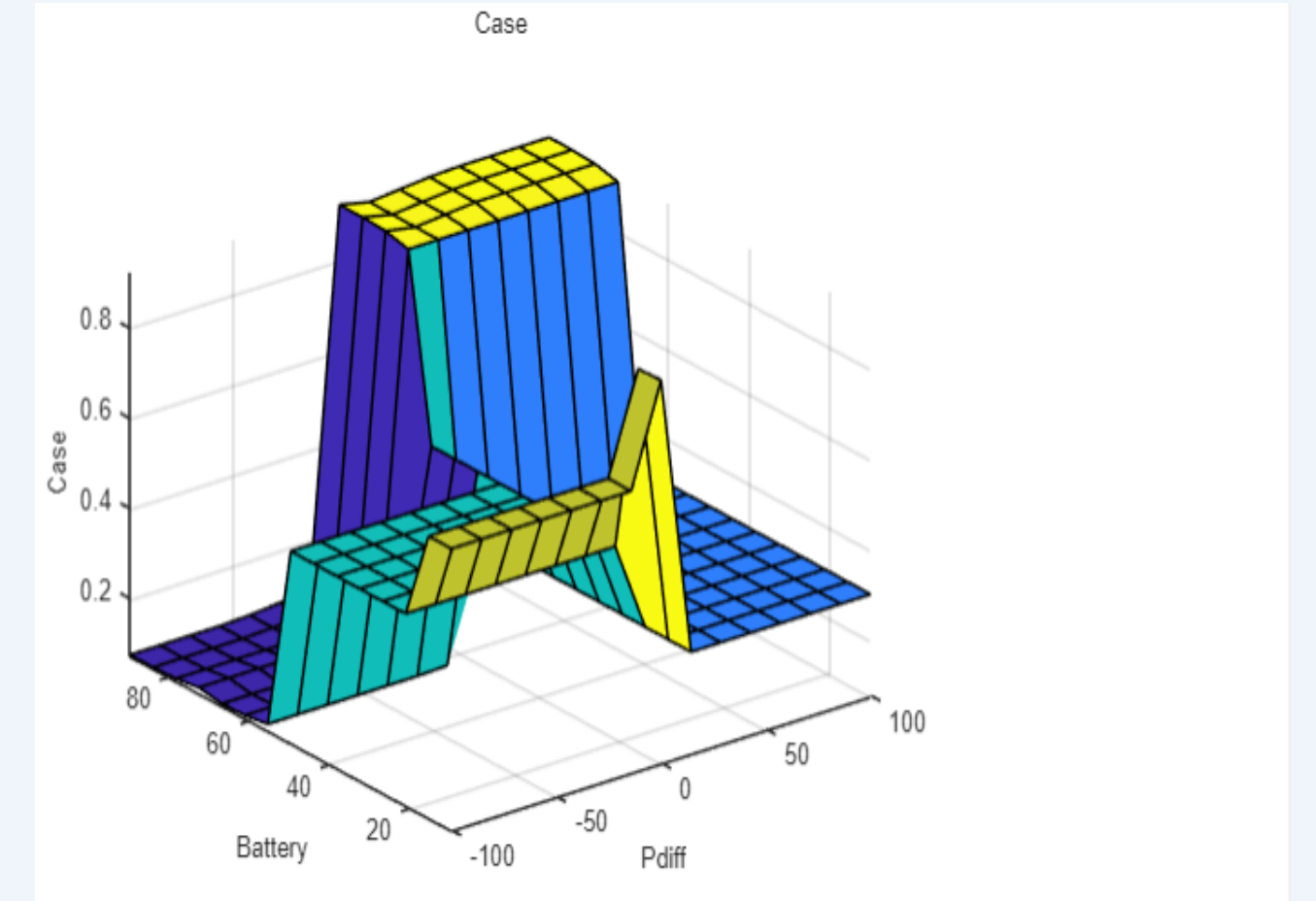
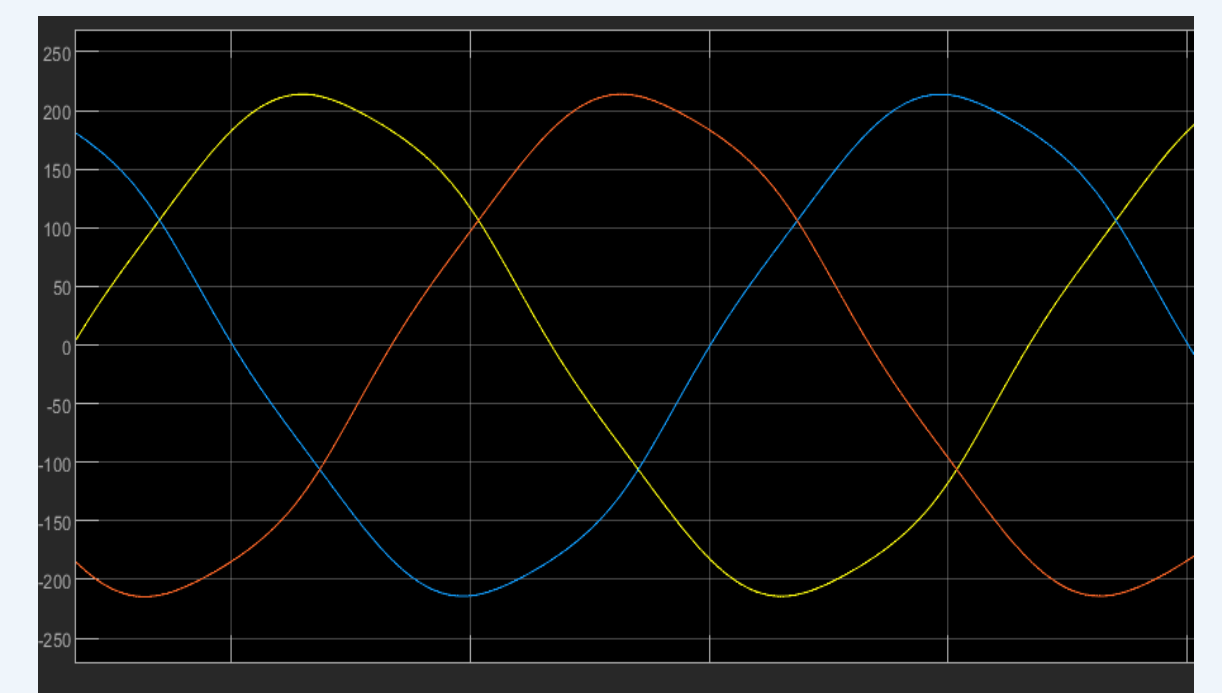*South African wind atlas*
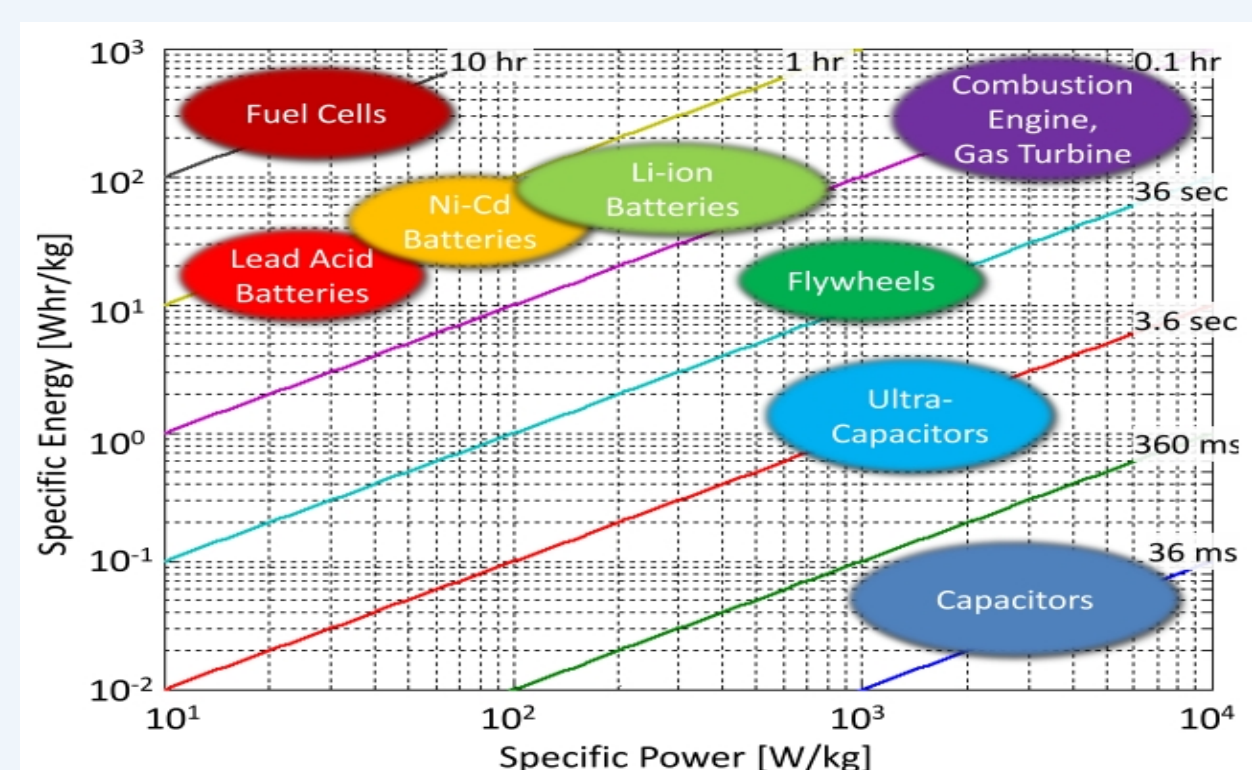
Ragone plot

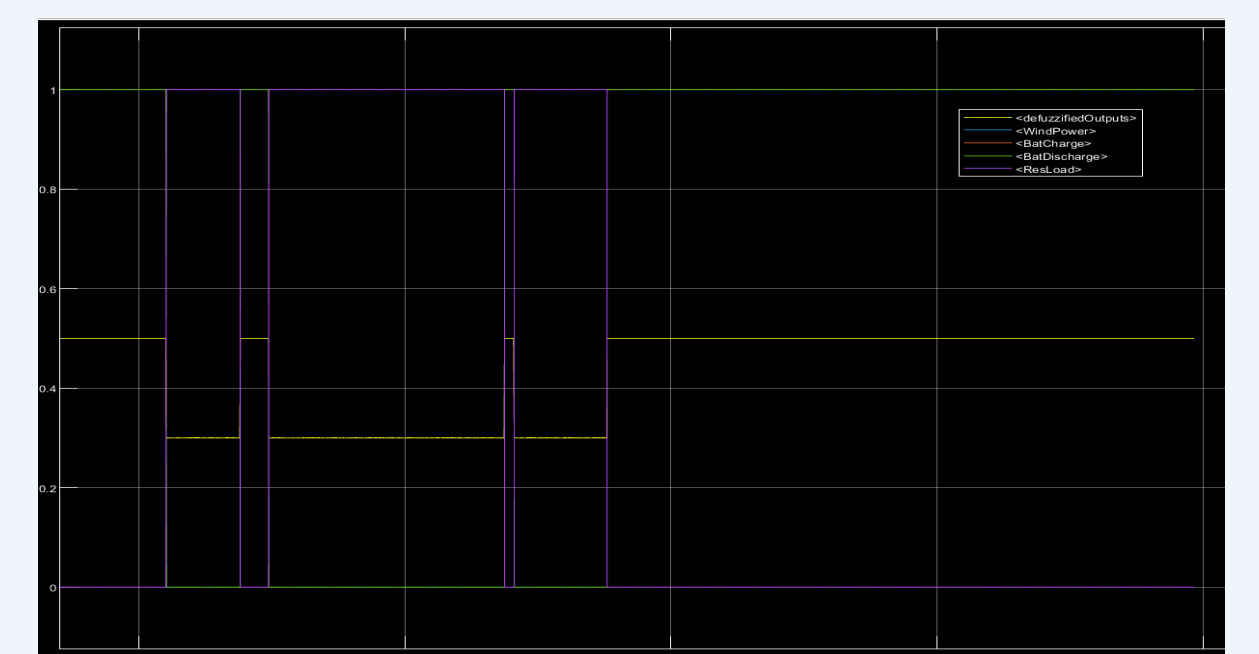*Full integrated system*

4.Results

Output of the fuzzy logic controller. The plot shows the operation case given the power difference and state of charge.

The Stand-alone wind-battery system provides 230V AC to the residential area.

The circuit breaker control signals from the energy management system.

5.Conclusion

The Stand-alone Wind-Battery system was successfully designed and met the residential area load demand. The intelligent energy management system was operational but there were limitations that prevented a full test of the system. The MATLAB and Simulink simulation ran slowly and ultimately freezing without providing any conducive results.