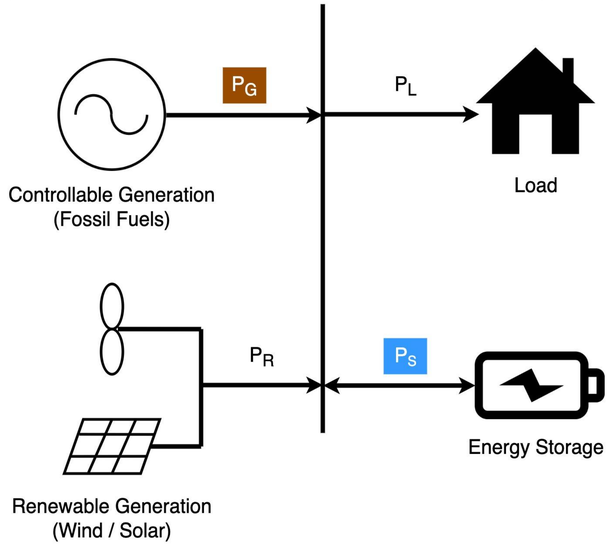
SA Grid Energy Storage Requirements

Background and Motivation

- Energy Transition: Fossil → Renewable
- Issue: Intermittent Renewable Sources, Wind & Solar
- Solution: Energy Storage

Method

- Use Supply/Demand Model & Genetic Algorithm to find an optimal solution
- This includes a renewable generation source $\mathbf{P_R}$, controllable generation source $\mathbf{P_G}$, load $\mathbf{P_L}$ and an energy storage $\mathbf{P_S}$



$$\mathbf{P_G + P_R + P_S = P_L}$$

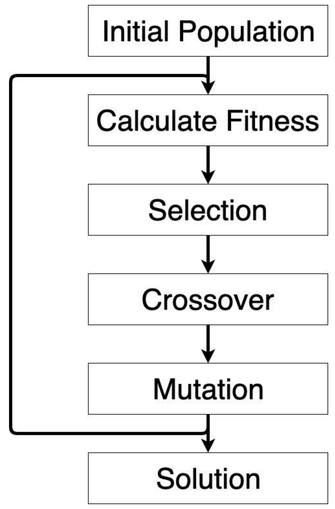
- Aim: Optimise P_S to minimise P_G

Techniques Used

- Code Vectorisation: Serialised Code → Vectorised Code
- Convergence Theorem: Better Method for Measuring Fitness
- Continuous Genetic Algorithm: Discrete Code → Continuous Code

Genetic Algorithms

- Search based algorithm.
- Use the concept of “Survival of the Fittest”.
- Find an optimal solution through a set of processes.
- Repeatedly modifies population of individual solutions.



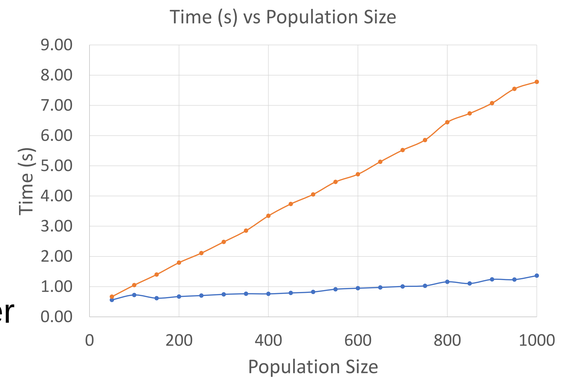
Results

- Time vs. Population Plot

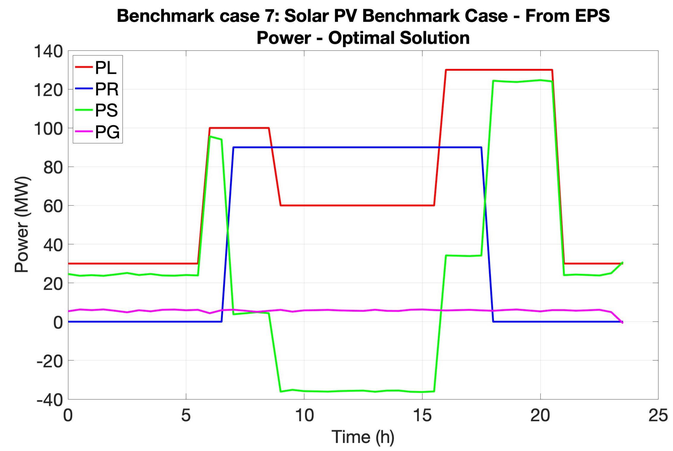
Traditional Method (Slow)

Updated Method (Fast)

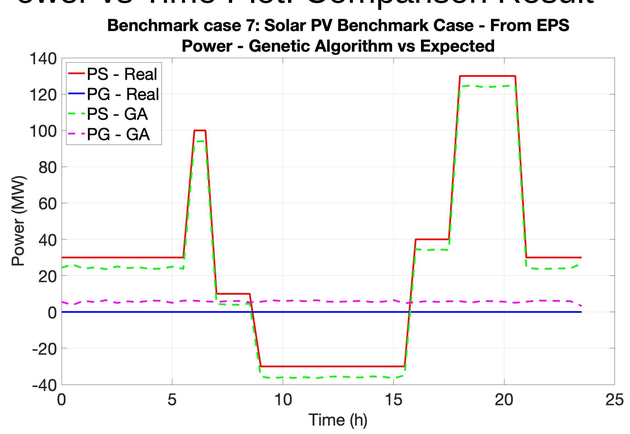
- Updated Method: 8x faster



- Power vs Time Plot: Genetic Algorithm



- Power vs Time Plot: Comparison Result



Conclusion

- Genetic Algorithm is faster & more accurate.
- Provides an estimate for storage needs.

References

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2. R. Haupt, S. Haupt and R. Haupt, Practical genetic algorithms. New York: J. Wiley, 2004.
3. D. Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, SSReading, Massachusetts: Addison-Wesley Publishing Company, Inc., 1989.

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