Maximizing Power Coefficient Output of a Vertical Wind Turbine

Multidisciplinary System Analysis and Design Optimization Graduate Research Project

Problem Statement & Goal:

- Maximize a wind turbine's power coefficient (Cp) by changing blade geometric parameters (Outside Radius of the Blade, Tip Speed Ratio, Root Chord, Tip Chord, Root Alpha, Tip Alpha, Aerofoil) while satisfying the given constraints: (allowed chord length, the maximum possible value of the power coefficient, convergence threshold, and number of iterations) at the given parameters: (Wind speed, Number of Blades, Inside radius of the blade, Number of elements along the blade length, Density of air, Dynamic viscosity of air, mutationChance, mutationAmount).

Concepts learned while working in this project:

- Product development process of complex, **multidisciplinary engineered systems** using MSADO.

- Rationalize and quantify a **system architecture & product design problem by selecting appropriate objective functions, design parameters, and constraints.**

- Subdivide a complex system into smaller disciplinary models, manage their interfaces, and reintegrate them into an overall system model.

- Usage of **gradient-based numerical optimization algorithms**, e.g., sequential quadratic programming and various modern heuristic optimization techniques such as simulated annealing or genetic algorithms and **select the ones most suitable to the problem** at hand.

- Performing a **critical evaluation** and interpretation of analysis and optimization results, including sensitivity analysis and exploration **of performance, cost, and risk tradeoffs.**

- Conditions for optimality and Pareto front computation techniques.

- Critical **reasoning skills to validate the fidelity of a** MSADO **model**