

## Literature Review: Multi-Fidelity BO

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## Optimization

Tinkle Chugh and Endi Ymeraj. “Wind Farm Layout Optimisation Using Set Based Multi-Objective Bayesian Optimisation”. *Proceedings of the Genetic and Evolutionary Computation Conference Companion*. 2022.

- **Overview:** Applies multi-objective BO with objectives of wind farm power output and turbine cost, using expected hypervolume improvement as the acquisition function. Formulates the problem as a *set-valued* search space, defining a custom kernel over collections of turbine location coordinates and enabling search over variable numbers of turbines.
- **Strong points:**
  - Allows for *variable numbers of turbines*, with a novel set kernel function
  - Considers *variability in wind speed and direction*. Models power output as an expectation over  $p(v, \theta)$ , a joint distribution over wind speed and direction taken from historical data, estimated using Kernel Density Estimation.
- **Weak points:**
  - Only considers the Jensen model, with *no large-eddy simulations*.
  - Discretizes the space of possible turbine locations in the acquisition function to a 20x20 grid.
- **Interesting details:**
  - Maximizes EHVI using a genetic algorithm.
  - Sets minimum distance between turbines as 3 times rotor diameter.

Daan van der Hoek et al. “Predicting the Benefit of Wake Steering on the Annual Energy Production of a Wind Farm Using Large Eddy Simulations and Gaussian Process Regression”. 2020.

- **Overview:**
- **Strong points:**
  - Incorporates a *time-varying* wind direction, defining power output as the weighted average over the mean direction  $\mu$ , as well as  $\mu \pm 3^\circ$  and  $\mu \pm 6^\circ$
- **Weak points:**
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- **Interesting details:**

## LES

S. Stipa et al. “TOSCA – an Open-Source, Finite-Volume, Large-Eddy Simulation (LES) Environment for Wind Farm Flows”. *Wind Energy Science*. 2024.

- **Overview:**
- **Interesting details:**
  - Notes that industry primarily uses analytical, "reduced-order wake models,"

## References

- [1] Tinkle Chugh and Endi Ymeraj. “Wind Farm Layout Optimisation Using Set Based Multi-Objective Bayesian Optimisation”. In: *Proceedings of the Genetic and Evolutionary Computation Conference Companion*. Boston Massachusetts: ACM, July 2022, pp. 695–698. ISBN: 978-1-4503-9268-6. DOI: 10.1145/3520304.3528951. (Visited on 11/12/2024).
- [2] Daan van der Hoek et al. *Predicting the Benefit of Wake Steering on the Annual Energy Production of a Wind Farm Using Large Eddy Simulations and Gaussian Process Regression*. Mar. 2020. arXiv: 2003.12153. (Visited on 11/16/2024).
- [3] S. Stipa et al. “TOSCA – an Open-Source, Finite-Volume, Large-Eddy Simulation (LES) Environment for Wind Farm Flows”. In: *Wind Energy Science* 9.2 (2024), pp. 297–320. DOI: 10.5194/wes-9-297-2024.