Review: Adaptive stratified importance sampling: hybridization of extrapolation and importance sampling Monte Carlo methods for estimation of wind turbine extreme loads

This paper proposes an approach for estimating wind turbine extreme loads by integrating the importance sampling method and extrapolation technique. In the past, extrapolation has been widely used for estimating extreme loads, but existing extrapolation methods do not consider the unequal importance of different wind speed bins on the estimation accuracy. Built on the importance sampling, the authors propose to use unequal sample sizes in different bins according to their importance in terms of variance minimization. The proposed approach is interesting in that it improves existing extrapolation methods through the adaptive sampling procedure. I have some comments to improve the methodology, notations and presentations.

1. First of all, notations are confusing. The quantity to be estimated (e.g., $P(Y < l)$) is different from its estimator. For the estimator, "hat" is conventionally used above the quantify (e.g., $\hat{P}(Y < l)$).

2. For clarity, I suggest that the estimator to estimate POE needs to be explicitly defined in a mathematical form. Here, the authors use the iterative method, so the estimator needs to incorporate the iteration index.

3. Even though the summary of the procedure is given in Section 3.2, this procedure does not contain the detailed information to implement the approach. For example, in Step 4, how to update the empirical estimates and extrapolation estimates? For extrapolation, will the data from the last iteration be used, or will data obtained from all iterations used?

4. The goal of this paper is to develop methods that make unbiased estimates while minimizing variance. But extrapolation cannot guarantee the unbiased estimation, as it approximates the conditional density with statistical models (3 parameter Weibull distribution in this paper). Even though the statistical models can be improved throughout iterations, the models are still surrogate models. Therefore, it should be discussed/justified how the proposed approach can provide a unbiased estimation.

5. It is not clear how $g(x_i)$ becomes $\frac{N_i}{N_{tot}} \frac{1}{\Delta x_i}$. Because $g(x_i)$ is a density, $\int g(x)dx$ should be 1, which is not in the proposed form. The authors might consider $g(x_i) \propto \frac{N_i}{N_{tot}} \frac{1}{\Delta x_i}$.

6. The most important question is what is the benefit of the proposed approach over the stratified sampling and importance sampling. Stratified sampling provides the closed-form of optimal N_i's. So, it is not clear why one needs to use the stochastic optimization approach combined with the importance sampling in Sec. 3.2. Also, what is the benefit of the proposed approach over the method proposed in Choe et al. (2016) (or their prior study) that uses importance sampling only?

7. In the implementation results, the relative standard deviations are presented. To show whether the estimates are unbiased or not, the POE estimates (or extreme load estimates) from the approach should be compared with those from crude Monte Carlo (e.g., authors may compare the estimates with those in the following paper: Barone, M., Paquette, J., Resor, B., and Manuel, L., 2012, "Decades of Wind Turbine Load Simulation," AIAA Paper No. 2012–1288.)