Sample-efficient inference for simulators: complex noise models and time-series

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Abstract
Simulators are becoming more complex, with their parameter inference requiring as few simulations as possible. This talk will go over two likelihood-free inference (LFI) challenges for computationally intensive simulators. The first challenge is modeling complex simulator noise, which is frequently oversimplified by existing methods or needs far too many simulations. I will discuss how LFI can handle multimodal, non-stationary, and heteroscedastic noise distributions in Bayesian Optimization by using deep Gaussian processes as surrogate models. The second challenge involves simulators in time-series settings, in which the observed time-series data is generated by an unknown stochastic process of simulator parameters. Modern LFI methods, in such cases, either require an accurate model of parameter transition dynamics (e.g. available for sampling) or assume it to be linear. In the last part of the talk, I will discuss the challenges and solutions for performing LFI in such time-series settings, which involve learning the unknown transition dynamics of simulator parameters.

References

[1] Aushev A, Pesonen H, Heinonen M, Corander J, Kaski S. Likelihood-free inference with deep Gaussian processes. Computational Statistics & Data Analysis. 2022 Oct 1;174:107529.

[2] Aushev A, Tran T, Pesonen H, Howes A, Kaski S. Likelihood-Free Inference in State-Space Models with Unknown Dynamics. arXiv preprint arXiv:2111.01555. 2021 Nov 2.