IBM Bayesian Optimization Accelerator

Build better products faster by identifying the ideal solution at lower cost.

Highlights

- Leverage massive parallelization of tasks to get results faster
- Scale to orders of magnitude more dimensions to tackle real world problems
- Obtain design points with fewer samples, finding the most optimum solution
- Ensure model traceability to build trust in your model design methodology
- Add easily and quickly to existing HPC and without any Bayesian priors
- Get more from your cluster by improving output of existing infrastructure

Researchers and scientists must perform more detailed analyses to capture higher order effects, leading to longer runtimes and additional resources required per job, while also increasing the number of design variables in their search to optimize the product for their discipline. The problem spaces that product innovators are working with are getting more complex. The market is demanding faster answers, forcing teams to re-examine current best practices and consider alternative methods. Internal stakeholders are demanding that solutions come faster, cost less and be more accurate than ever. Meanwhile, the budget isn't expanding to meet all the new needs.

In a perfect world, what would be needed to solve all these challenges?

- Better model quality and models that can be run without knowing anything about the problem beforehand.
- Ability to make the most of infrastructure by parallelizing efforts and spending less CPU and wall clock time getting to the ultimate answer.
- High dimensionality because the name of the game is optimizing real problems, not simple academic ones.
- Traceable and non-biased methodology, especially in regulated industries.

With IBM Bayesian Optimization Accelerator, a state-of-the art general parameter optimization tool created based on cutting-edge innovations from the IBM Research team, teams

only need to define design variables, objective and constraints to use one of the most powerful optimization engines available. This is an appliance and can be accessed as a full solution from IBM – including hardware, software and installation services.

Simply put, IBM Bayesian Optimization Accelerator finds the most optimal solution for complex, real-world design problems in less time and using less resources than its competition. Innovators can ensure better business outcomes and increase the productivity of experimental infrastructure without adding specialized data scientists.

- **Fast innovation**: Bayesian Optimization Accelerator finds solutions faster with easy, quick initial integration and methods that require fewer starting inputs and scale in parallel to decrease the time to result.
- **Superior results**: Bayesian Optimization Accelerator locates the most optimum solution 98% of the time with traceable, explainable optimization decisions that require no prior data, avoiding bias.[1]
- **Fewer resources**: These methods can be applied without specialized data science skills and make existing infrastructure more efficient, keeping costs down while still responding to business needs.

For design space exploration cases, the solution works by helping the HPC cluster know where to look. It sits outside of the traditional HPC cluster and is dedicated to running Bayesian Optimization methods only. The HPC cluster will send the values for constraints and objective functions to the appliance, which will send back new locations in the search space to find optimal solutions.

Solution application areas

IBM is pursuing application areas for this technology across many industries, such as aerospace, automotive, electronic design and oil and gas. Results with teams across the globe indicate that IBM Research's work in the lab is driving real results for businesses already and helping them deliver superior results faster and using fewer resources.

In aerospace, IBM Bayesian Optimization Accelerator can bring down simulation time in computational fluid dynamics (CFD), aeroelasticity, multi-disciplinary optimization and stochastic design. In automotive, both automotive manufacturers and Formula 1 teams alike can use Bayesian Optimization Accelerator to simulate computational fluid dynamics (CFD), crash and safety, noise, vibration and harshness (NVH), and advanced driver-assistance systems (ADAS).

For electronic design, signal integrity, synthesis and PCB design all benefit from these new methods. IBM's own signal integrity research team used Bayesian Optimization Accelerator to reduce the time required to reach results by 99.3%, from nearly eight days to just 80 minutes.

Finally, in oil and gas, researchers have sliced their time to reach results by 67% by using Bayesian Optimization Accelerator to identify the ideal mix of gases to inject into reservoirs to maximize their outputs. Researchers in this area are also pursuing seismic data processing and reservoir simulation using Bayesian Optimization Accelerator.

[1] - Metrics obtained when comparing IBM Bayesian Optimization Accelerator to greedy and random searches for an example drug discovery dataset.

Why IBM?

Bayesian methods are not new to the HPC industry. As borne out by our IBM Research team, unlike search methods such as Grid or Random search, Bayesian Optimization Accelerator selects the best, most optimum solution more frequently ensuring better business outcomes.

In fact, it delivers the solution with the least regret over 98% of the time.[1] To do this, it does not require any Bayesian priors and provides traceability to models to build trust in model design methodology. Scientists can always interrogate the optimizer about why it chose to evaluate suggested parameters.

Unlike open source Bayesian libraries, it can scale to orders of magnitude more dimensions which allows it to tackle real world problems instead of academic ones. And unlike search methods such as Grid, or Random search, it determines design points with much fewer samples required, which gets to results faster and cheaper. In fact, in comparison tests, Bayesian Optimization Accelerator reaches the least regret solution in the fastest time in over 80% of experiments.[1]

Next steps

→ IBM Bayesian Optimization Accelerator on IBM Marketplace

For more information

To learn more about IBM Bayesian Optimization Accelerator, please contact your IBM representative or IBM Business Partner, or visit ibm.biz/bayesian.

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