Bayesian

1-Recent Advances in Bayesian Optimization

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Abstract

Bayesian optimization has emerged at the forefront of expensive black-box optimization due to its data efficiency. Recent years have witnessed a proliferation of studies on the development of new Bayesian optimization algorithms and their applications. Hence, this article attempts to provide a comprehensive and updated survey of recent advances in Bayesian optimization that are mainly based on Gaussian processes and identify challenging open problems. We categorize the existing work on Bayesian optimization into nine main groups according to the motivations and focus of the proposed algorithms. For each category, we present the main advances with respect to the construction of surrogate models and adaptation of the acquisition functions. Finally, we discuss the open questions and suggest promising future research directions, in particular with regard to heterogeneity, privacy preservation, and fairness in distributed and federated optimization systems.

Keywords
Author Keywords
Bayesian optimizationGaussian processacquisition function

Keywords Plus
EFFICIENT GLOBAL OPTIMIZATIONMULTIOBJECTIVE EVOLUTIONARY ALGORITHMSEXPECTED-IMPROVEMENT CRITERIAGAUSSIAN PROCESSCOMPUTER EXPERIMENTSKNOWLEDGE-GRADIENTENTROPY SEARCHDESIGNMODELIDENTIFICATION

Bayesian

2-Sparse Bayesian Learning-Based Hierarchical Construction for 3D Radio Environment Maps Incorporating Channel Shadowing

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Abstract

The radio environment map (REM) visually displays the spectrum information over the geographical map and plays a significant role in monitoring, management, and security of spectrum resources. In this paper, we present an efficient 3D REM construction scheme based on the sparse Bayesian learning (SBL), which aims to recover the accurate REM with limited and optimized sampling data. In order to reduce the number of sampling sensors, an efficient sparse sampling method for unknown scenarios is proposed. For the given construction accuracy and the priority of each location, the quantity and sampling locations can be jointly optimized. With the sparse sampled data, by mining the sparsity of the spectrum situation and channel propagation characteristics, a SBL-based spectrum data hierarchical recovery algorithm is developed to estimate the missing data of unsampled locations. Finally, the simulated three-dimensional (3D) REM data in the campus scenario are used to verify the proposed methods as well as to compare with the state-of-the-art. We also analyze the recovery performance and the impact of different parameters on the constructed REMs. Numerical results demonstrate that the proposed scheme can ensure the construction accuracy and improve the computational efficiency under the low sampling rate.

Keywords

Author Keywords

Three-dimensional displaysRadio frequencySensorsOptimizationAccuracyFading channelsBayes methods3D radio environment mapsparse Bayesian learningsampling optimizationpropagation channel model

Keywords Plus

SENSOR SELECTIONCOMPLETIONPLACEMENT

Bayesian

3-Fault diagnosis of hydro-turbine via the incorporation of bayesian algorithm optimized CNN-LSTM neural network

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By Dao, F (Dao, Fang) [1] ; Zeng, Y (Zeng, Yun) [1] ; Qian, J (Qian, Jing) [1] Source ENERGY Volume 290 DOI 10.1016/j.energy.2024.130326 Article Number 130326 Published MAR 1 2024 Early Access JAN 2024 Indexed 2024-02-21 Document Type Article

Abstract

The hydro-turbine is the core equipment of the hydropower station, and it is essential to diagnose and identify its faults. A fault diagnosis model based on Bayesian optimization (BO), which incorporates convolutional neural network (CNN) and long short-term memory (LSTM) methods for the hydro-turbine, is proposed (BO-CNNLSTM). CNN adaptively extracts and down-scales fault features, fed into the LSTM model for feature learning and training. The BO algorithm is employed to address the challenge of model hyperparameter selection. A hydroturbine fault experiment bench is constructed to train and validate the model. Experimental results demonstrate the superior performance of the proposed BO-CNN-LSTM model in hydro-turbine fault diagnosis, achieving accuracies of 92.7 %, 98.4 %, and 90.4 %, respectively, surpassing CNN, LSTM, and CNN-LSTM models. The BOCNN-LSTM model improves accuracy by 5.5 %, 6.3 %, and 9.0 %, respectively, Compared to the unoptimized CNN-LSTM model. The BO algorithm is introduced to optimize CNN-LSTM from the perspective of acoustic vibration signals, which can be a beneficial supplement to the existing hydro-turbine fault diagnosis.

Keywords
Author Keywords
Hydro -turbineFault diagnosisCNN-LSTMBayesian optimizationDeep learning

Keywords Plus
MODELSYSTEM

Bayesian

4-Improved hyperparameter Bayesian optimization-bidirectional long short-term memory optimization for high-precision battery state of charge estimation

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By Wang, SL (Wang, Shunli) [1] , [2] , [4] ; Ma, C (Ma, Chao) [1] , [3] ; Gao, HY (Gao, Haiying) [1] , [3] ; Deng, D (Deng, Dan) [1] ; Fernandez, C (Fernandez, Carlos) [5] ; Blaabjerg, F (Blaabjerg, Frede) [6] **(provided by Clarivate) Source ENERGY Volume 328 DOI 10.1016/j.energy.2025.136598 Article Number 136598 Published AUG 1 2025 Indexed 2025-06-12 Document Type Article**

Abstract

At a time when new energy sources are constantly developing, mitigating the safety hazards of lithium batteries and prolonging their lifespan. In this paper, we take a ternary lithium-ion battery as an experimental object and carry out research based on the fusion method of deep learning and modeling for its high-precision state of charge (SOC) estimation requirements. This paper explores the construction of a battery dynamic model and hyperparameter optimization method based on a neural network. It also incorporates Kalman filter to investigate the noise correction strategy of a neural network model. Experimentally verified that the BO-BiLSTM-UKF fusion algorithm in this paper has a maximum error of only 0.113 %, which verifies the accuracy and strong robustness of the model. Its MAE and RMSE are reduced by 96.13 % and 95.73 % compared with the LSTM network model, which has better adaptability and estimation ability. In this paper, a network dynamic prediction fusion method based on the equivalent model is constructed and experimentally verified by different temperatures, complex working conditions and step-by-step simulation.

Keywords
Author Keywords
New energy lithium-ion batterySOCNoise reduction

Keywords Plus
LITHIUM-ION BATTERIESKALMAN FILTERPOWERENERGYMODEL

Bayesian

5-A Physical-Constrained Decomposition Method of Infrared Thermography: Pseudo Restored Heat Flux Approach Based on Ensemble Bayesian Variance Tensor Fraction

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Abstract

In this study, we propose a new post processing algorithm, using a stable low-rank decomposed pseudo restored heat flux based on the ensemble variational Bayes tensor factorization (EVBTF-RPHF) algorithm for performing periodic square wave thermographic nondestructive testing (thermographic NDT). Previous studies have shown that both RPHF and EVBTF can separately improve the detectability of thermography by enhancing some defect features. However, both methods are limited by their particularly constraints: RPHF are heavily degraded by noises and missing data due to the assumptions under which the physical models are derived while efficiency of EVBT reduces when the lateral heat diffusion weights out. By embedding RPHF into the stable low-rank decomposition EVBTF, the proposed algorithm allows to improve the detectability of defects in thermographic NDT using a periodic heat flux with low-rank spatial distribution. The study verifies the capacity of the proposed method by theoretical analysis. Then, experiments were conducted on a carbon fiber composite panel with foreign inserts buried up to 5 mm deep. The sampled data are processed by the proposed method. The results are compared with existing methods such as phase-locked RPHF and EVBTF. The experimental results demonstrated that defects with normalized diameter-to-depth ratios as small as 0.9, barely detected with other available techniques, can reliably be detected by EVBTF-RPHF. The signal to noise ratio and the contrast is used as figure of merit to quantitatively compare the capacity of the proposed method with existing methods. However, the computation efficiency of the proposed algorithms needs further improvement.

Keywords
Author Keywords
Carbon fiber reinforced plasticdelaminationensemble variational bayes tensor factorizationimaging inspectioninfrared thermography