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AA222: Engineering Design Optimization

Date of Submission: 05/26/2023

**Project 3:**

**Part 1: Noiseless Gaussian Process Fitting:**

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Figure : Noiseless Gaussian Process Fitting for characteristic length = 0.5

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Figure : Noiseless Gaussian Process Fitting for characteristic length = 1.0

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Figure : Noiseless Gaussian Process Fitting for characteristic length = 2.0

**Part 2: Noisy Gaussian Fitting:**

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Figure : Noisy Gaussian Process Fitting for characteristic length = 0.9

**Part 3: Exploration Strategies**

|  |  |  |
| --- | --- | --- |
| **Method** | **Design Point** | **Predicted** |
| Prediction Based |  |  |
| Error Based |  |  |
| LCB Based |  |  |
|  |  |

Table : Function Predictions per different strategies

**Comparison:**

Various methods can guide an optimization process towards better design points, as demonstrated by the function predictions shown in Table 1. The Prediction-based exploration method selects the design point with the minimum value of the predicted surrogate function. This strategy aims to identify regions of the design space that are likely to have low values of the true function.

In contrast, the Error-based exploration method focuses on increasing confidence in the true function by sampling at a point where the standard deviation between the true function and the predicted function is maximized. By targeting areas with high uncertainty, this strategy aims to gain more information about the true behavior of the function.

The Lower Confidence Bound (LCB) based exploration method selects a design point that minimizes the Lower Confidence Bound of the objective function. This strategy strikes a balance between exploration and exploitation by seeking regions with both low predicted values and high uncertainty.

By employing these different exploration strategies, optimization algorithms can effectively navigate the design space and discover better solutions.

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Figure : Updated Gaussian Plot from Prediction Based Exploration

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Figure : Updated Gaussian Plot from Error Based Exploration

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Figure : Updated Gaussian Plot from LCB Based Exploration

**Code:**

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**A screen shot of a computer program

Description automatically generated with low confidence**

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