LoadAnalysis Class Documentation

Description

The `LoadAnalysis` class is designed to perform load analysis on a structure given various input parameters. The analysis includes the generation of master forces, calculation of strains, validation, thermal effects, and noise studies.

Class Initialization

```
LoadAnalysis(E, y_loc_master, I_master, F_l_1, F_l_2, F_l_3, F_l_4, max_training_load, m
 min_testing_load, increment_testing, noise_level, BL, sen_locs, alpha,
 max_training_temp, min_training_temp, max_testing_temp, min_testing_temp)
```

Parameters:

- `E`: Young's modulus of the material.
- `y_loc_master`: List or array containing the y-locations of sensors.
- I_master: List or array containing the moments of inertia at corresponding sensor locations.
- `F_l_1`, `F_l_2`, `F_l_3`, `F_l_4`: Applied loads on the structure.
- `max_training_load`, `min_training_load`, `increment_training`: Parameters for generating master forces for training.
- `max_testing_load`, `min_testing_load`, `increment_testing`: Parameters for generating master forces for testing.
- `noise_level`: Standard deviation of noise in the system.
- `BL`: Boundary condition's location of the structure.
- `sen_locs`: Sensor locations on the structure.
- `alpha`: Coefficient of thermal expansion.
- `max_training_tem`, $min_t raining_t emp$, `max_testing_temp`, `min_testing_temp`: Parameters for temperature variation during training and testing.

Methods

1. `generate_master_force(min_training_load, max_training_load, increment_training)`

Generates a master force matrix for training based on specified parameters.

2. `calculate_strain(master_force)`

Calculates the strains in the structure based on the master force matrix.

3. `generate_C(master_training_strain, master_force)`

Generates the C matrix for the training dataset and visualizes it using a heatmap.

4. `Validation(master_force, master_training_strain, C)`

Performs validation on the training dataset and visualizes the results.

5. `generate_master_force_test(min_testing_load, max_testing_load, increment_testing)`

Generates a master force matrix for testing based on specified parameters.

6. `calculate_strain_test(master_force_test)`

Calculates the strains in the structure for testing.

7. `Validation_test(master_force_test, master_testing_strain, C)`

Performs validation on the testing dataset and visualizes the results.

8. `Validation_test_noise(noise, master_force_test, master_testing_strain, C)`

Performs validation on the testing dataset with added noise and visualizes the results.

9. `Thermal_C(calculate_strain, master_force,alpha,max_training_temp,min_training_temp)`

Calculates the C matrix considering thermal effects during training.

10. `Thermal_test(C_thermal, master_force_test, calculate_strain_test, alpha, max_testing_temp, min_testing_temp)`

Simulates thermal effects during testing and predicts thermal loads.

11. `noise_study(C)`

Studies the effect of noise on the system by plotting the variance of loads against different noise levels.