CIVE 650 - Spatiotemporal Data Analysis (2025 Fall)

Assignment 3
Estimate spatial process with Gaussian process

Date assigned: Oct 21, 2025
Date due: Nov 4, 2025

The `spatial_data.mat` file has two 100×100 matrices `z` and `train_z`, as shown in Fig. 1. Assume the ground truth value `z` of the spatial process is unknown, and we need to use Gaussian process (GP) on the train data `train_z` to interpolate the spatial process.

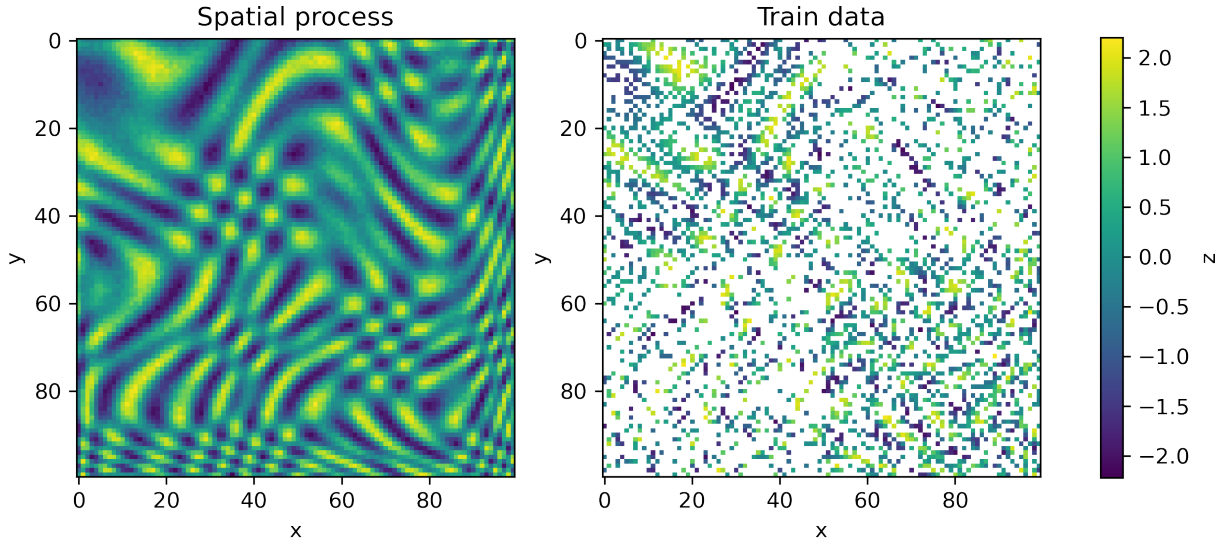

Figure 1: Left: the ground truth spatial process `z`. Right: the training dataset `train_z`.

1. Train a GP with a squared exponential kernel and a white noise kernel. Report the best length scale, kernel variance, and noise variance you find. Note that if you use the code from `GP_demon.ipynb`, you will need to wait around 10 minutes for the optimizer to find the solution. Try to use a reasonable initial value (based on your understanding of the physical meaning of hyper-parameters) to avoid local optimal.

2. Use your trained GP to estimate the spatial process on the 100×100 grid. Plot maps (like Fig. 1) of the ground truth value, the GP estimation, the error, and the standard deviation of your GP estimation.

3. Describe how good is the GP estimation. Discuss whether there is any problem in the current GP model and what potential solutions are.

You can use the `GP_demon.ipynb` or MATLAB or any GP packages.