Preparing Gaussian Stochastic Processes for Coupling Landslide Hazards

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Introduction

Landslides are a devastating natural disaster.

We hope to:

- Pinpoint the effects of landslide hazards in susceptible regions
- Forecast landslide hazards more efficiently for civil protection
    - Who and when to evacuate

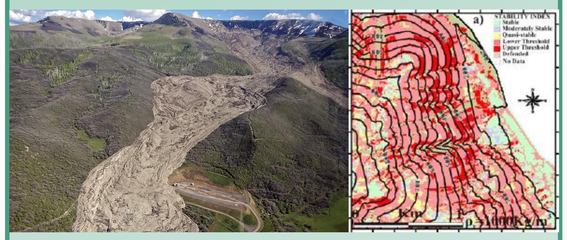
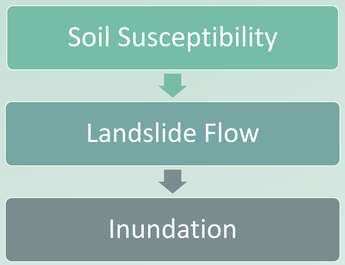


Figure 1 (left): Landslide Image [1]
Figure 2 (right): Susceptibility Map [2]



Our goal is to create a proficient strategy to predict landslides. The approach:

- Couple flow and susceptibility
- Utilize Gaussian Stochastic Processes (GaSP) and Logistic Regression

Objectives

- Use GaSP on coupled landslide flow
    - Implement a model in Python (open-source)

Accomplishments

1. A basic GaSP was modeled, using external Python packages.

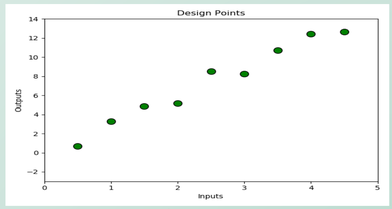


Figure 2: The Design Points

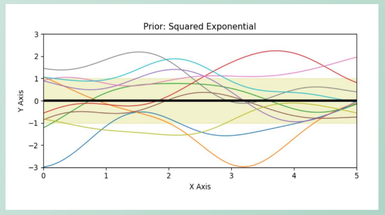


Figure 3: Random Functions

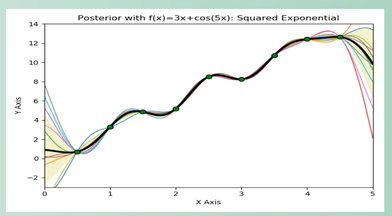
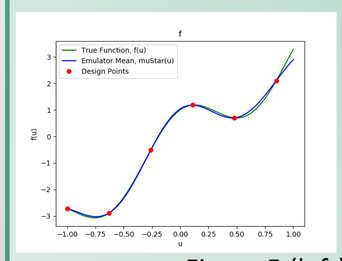


Figure 4: GaSP – Random Functions Fit to Data

2. Developed code for composite computational models using trivial functions.



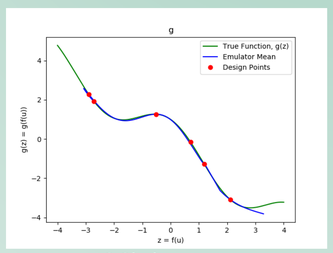


Figure 5 (left): GaSP of f(u)
Figure 6 (right): GaSP of g(z)

Functions f(u) and g(z) are linked together to create a GaSP of the composite function.

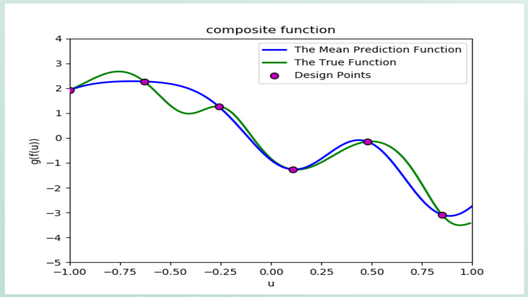


Figure 5: The Inbuilt Gaussian Process on Composite Data

Clearly, inbuilt Gaussian packages are not quite ready to handle linked functions.

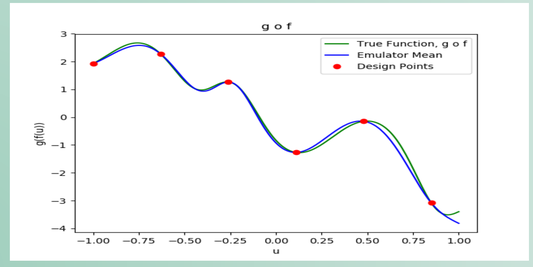


Figure 6: Linked Gaussian Process

Implemented linked GaSP theory in Python accurately created a linked Gaussian process.

3. The inbuilt GaSP packages were modified to accept 2D arrays and create 2D gaussians. The code is easily adjustable for other degrees of input arrays.

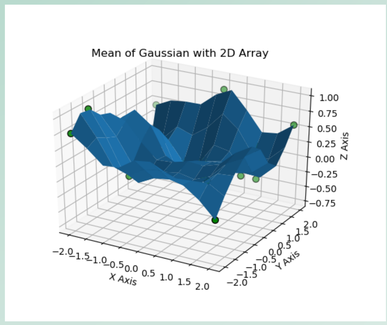


Figure 8: 2 Dimensional GaSP

Future Steps

- Try to utilize the inbuilt Gaussian Process functions for the current linked GaSP code
- Combine the 2D array GaSP with the composite GaSP
- Apply that to landslide flow
- Couple the landslide flow model with landslide susceptibility models

Resources

[1] – Jon White, Colorado Geological Survey.
[2] Gabriel Legorreta Paulin. *Assessment of Landslides Susceptibility.* Department of Geology, SUNY at Buffalo, 2007.
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[7] Jan Hendrik Metzen. Illustration of prior and posterior gaussian process for different kernels.

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