Project Proposal

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Background and Existing Work:
A desert landscape is a terrain that is highly sensitive to time aeolian processes. Papers that try to model terrain changes due to wind are much fewer than the ones that model say hydraulic erosion. One such paper that does so is:

Desertscape Simulation

- Paper: (https://onlinelibrary.wiley.com/doi/epdf/10.1111/cgf.13815)
- Existing code: https://github.com/aparis69/Desertscapes-Simulation

The authors propose and implement a grid-based simulation that takes time-varying wind fields as input and generates the corresponding changes they lead to in the given desert terrain. These processes influenced by the wind are known as aeolian processes. They include bedrock abrasion, saltation, reptation and avalanching. These are treated as stochastic processes.

The resolution considered for the coarse simulation is 1-10m per grid cell. Fine-scale details such as ripples are added in a post-processing step.

Limitations
Due to the coarse resolution of the grid-based simulation (that allows it to be computationally feasible), sharp features such as dune edges are lost.

Proposal
We wish to implement a mechanism that helps generate these sharp features without increasing the overall resolution of the model by much.

1. One approach to be considered over the course of the project is to figure out and track surface grid cells and simulate over them (or their samples) in high resolution. At any instant, many grid cells will not be exposed to the outside and need not be simulated in high resolution.
2. Another approach could be to use amplification combined with procedural primitives similar to what is explained in Terrain Modelling from Feature Primitives (http://hpcg.purdue.edu/papers/Genevaux15CGF.pdf) to restore the sharpness of the terrain.
3. Finally, a data-centric approach may be deployed. The dataset for training may be few high-resolution models that help the network figure out what plausible sharp features

look like. These may later be augmented to coarse models simulated on the fly. (Since the time taken for the generation of this high-resolution dataset is expected to be quite high, we sincerely hope that we don’t need to resort to this approach!)