ImplicitTerrain: a Continuous Surface Model for Terrain Data Analysis

Haoan Feng, Xin Xu, Leila De Floriani
University of Maryland, College Park

Project page

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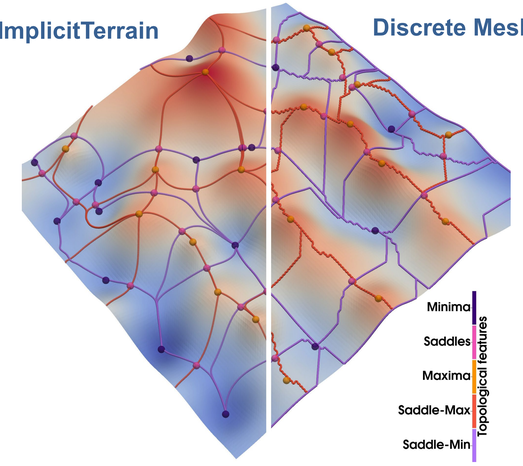
Introduction

A **smooth** terrain surface model via
Implicit Neural Representation (INR)



Surface model capacity depends on

- *# Network params*

Surface gradients

- *"Free lunch"*

Continuous surface model

- *C^n continuous*

Data analysis

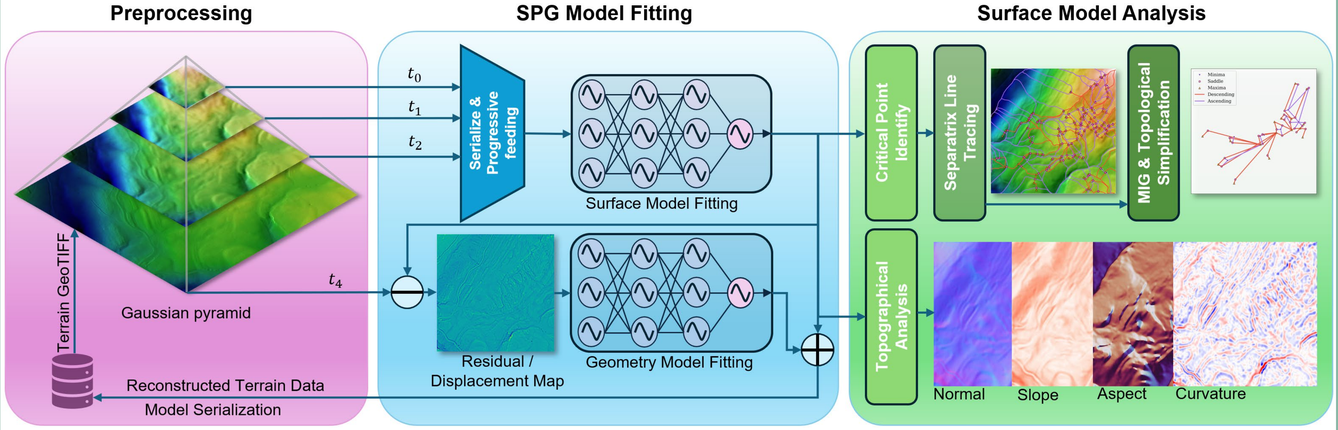
- *Simple & straightforward*

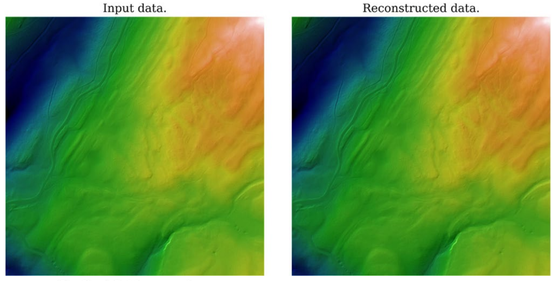
Parallel capability

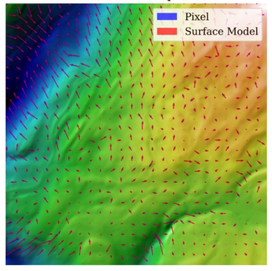
- *On Modern GPUs*

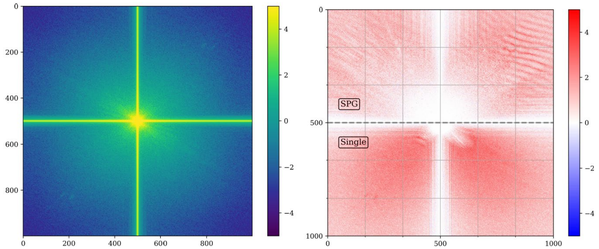
ImplicitTerrain

ImplicitTerrain, as a tool for understanding **terrain topological & topographical characteristics**, has three stages:









(a) Fourier transform of the Swiss$_1$. (b) Frequency domain loss.

Terrain datasets from **swissALTI3D [1]**

Name	Sizes (MBs)	Size ratio	Ψ_s PSNR	Ψ_s SSIM	Freq diff $\times 10$	Grad norm diff $\times 10$	Grad direction diff (rad) $\times 10$	SPG PSNR	SPG SSIM
Swiss$_1$	1.51/7.6	0.20	64.85	0.9999	1.49±2.31	0.54±0.52	0.62±1.10	67.08	0.9999
Swiss$_2$	1.51/7.6	0.20	60.53	0.9998	0.95±2.08	0.77±1.00	0.61±0.77	52.34	0.9992
Swiss$_3$	1.51/7.6	0.20	59.75	0.9998	0.13±0.29	0.86±1.05	0.72±1.02	58.93	0.9997
Swiss$_3$	1.51/7.6	0.20	62.54	0.9999	0.17±0.32	0.56±0.61	0.46±0.57	66.59	0.9999

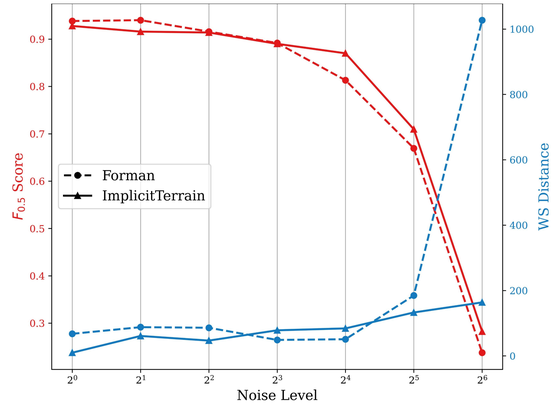
1. Swisstopo, *swissALTI3D datasets*, online accessible at: *https://www.swisstopo.admin.ch/en/height-model-swissalti3d*

Experiments

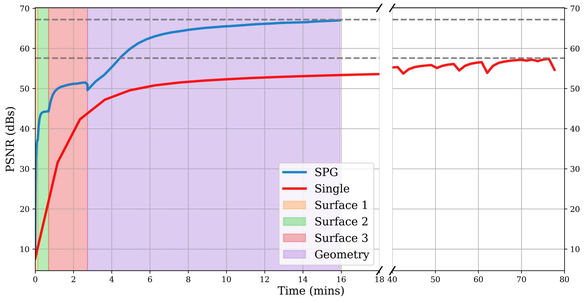
Topological analysis

Name	precision	recall	$F_{0.5}$ score	WS_{ratio}
Synth$_{ours}$	1.00	1.00	1.00	0.68
Swiss$_1$	0.90	0.96	0.91	0.17
Swiss$_2$	0.91	0.831	0.89	0.31
Swiss$_3$	0.89	0.78	0.87	0.69
Swiss$_4$	0.91	0.83	0.89	0.35

Noise robustness



Faster convergence and higher accuracy



Acknowledgment

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