Comparative Analysis of DEM Interpolation Techniques for Accurate Runoff Estimation in Different Slope Shapes

Presented By : C.R.Wagarachchi
Dept. of Surveying and Geodesy
Faculty of Geomatics, Sabaragamuwa University Of Sri Lanka

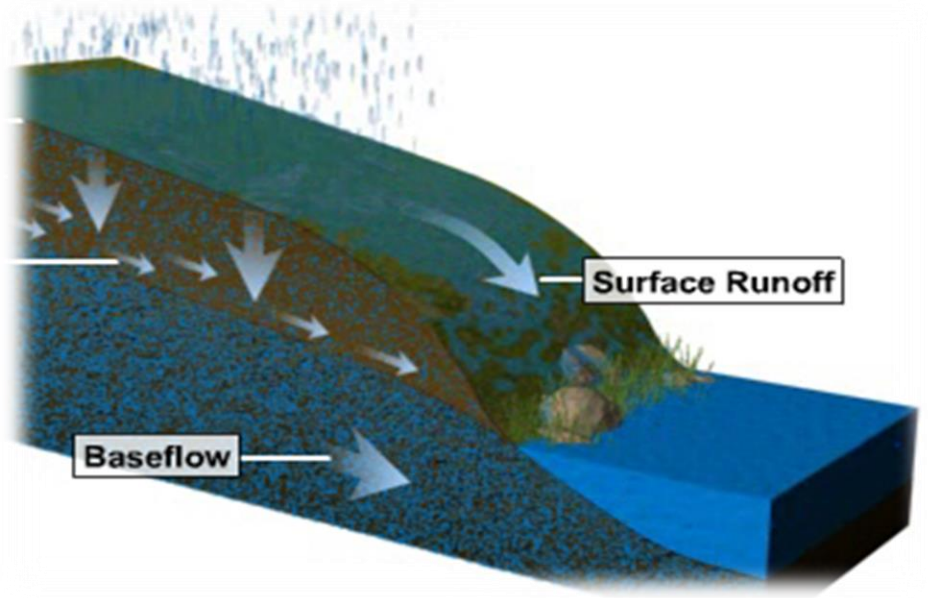
Supervised By : Mrs. D.S. Munasinghe
Dept. of Surveying and Geodesy
Faculty of Geomatics, Sabaragamuwa University Of Sri Lanka

Introduction

RUNOFF

- Water that flows over the land surface when that water cannot absorb into the ground.
- Depend on various factors.
- Varies with Slope shape.

  - Concave
  - Convex
  - Uniform

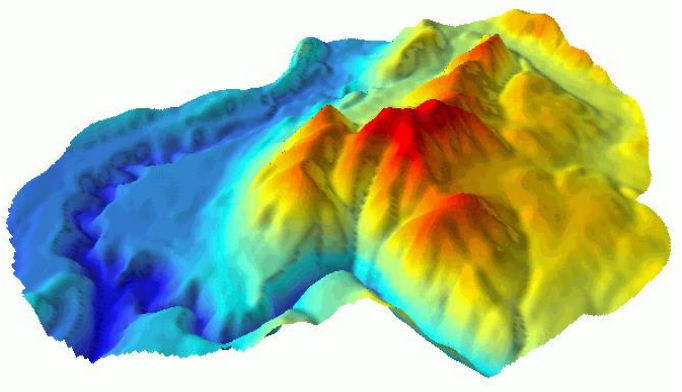


- Accurate representation of topographic features is needed for estimation.

Introduction CONT.

Digital Elevation Models (DEMs)

- ❑ representing shape of the terrain.
- ❑ Accuracy depends on the different factors.
- ❑ Interpolation techniques impact to the accuracy.
- ❑ Common interpolation techniques are,
  - Kriging
  - Inverse Distance Weighting (IDW)
  - Nearest Neighboure (NN)
  - Tringulated Irregular Network (TIN)



- ❑ Each Interpolation method uses different mathematical approaches to estimate elevation of the points.

Research Problem

- Accurate terrain representation in DEMs is crucial for runoff estimation.
- slope shape significantly affects runoff behavior.
- Various DEMs interpolation methods generate with different level of accuracy.
- Which interpolation method is the most suitable for each slope shape?

Objectives

Main Objective

• To evaluate the performance of interpolation methods in accurately representing topographic features, including concave, convex, and uniform slope shapes.

Sub Objectives

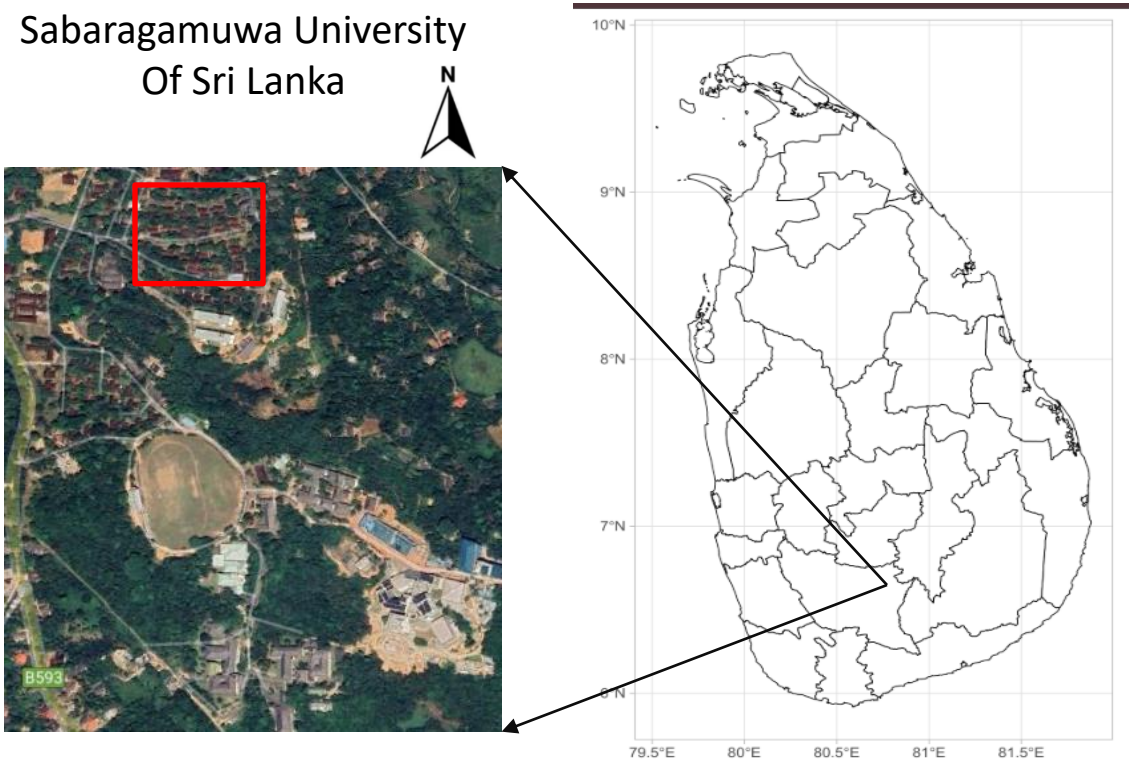
• To identify the most suitable interpolation method for creating DEMs best suited for runoff estimation in varied topographies.

• To identify the impact of grid-based sampling method and random sampling data collecting method on different DEM interpolation techniques.

Study Area

The study area is Sabaragamuwa University premises which is located on Sabaragamuwa province, Sri Lanka. About 160 Km south east from Colombo, the Capital of Sri Lanka.

- Province- Sabaragamuwa
- District - Rathnapura
- GN division – Kinchigune
- Village – Muttettuwegama
- Latitude - $6^0\ 42'\ 39''$
- Longitude - $80^0\ 47'\ 27''$



Literature Review

Title of the research	Objectives	Method used	Findings
No – 01 (Şensoy and Kara, 2014).			
Slope Shape Effect on Runoff and Soil Erosion Under Natural Rainfall Conditions	To investigate how different slope shapes (uniform,concave, convex) affect runoff and soil erosion.	uniform, concave, convex. under natural rainfall conditions. Runoff and soil loss were measured	Uniform slopes experienced the highest runoff and soil loss. concave and convex slopes showed reduced erosion.
NO – 02 (Arun, 2013)			
A Comparative Analysis of Different DEM Interpolation Methods	To analyze and compare the effectiveness of common DEM interpolation methods.	IDW, Kriging, ANUDEM, NN, and Spline interpolation methods. field survey data collected via DGPS.	Kriging performed accurately in average cases. Kriging and IDW have been found to adjust themselves to the terrain variation.

Literature Review CONT.

No – 03 (Chang Ao et al., 2021)			
The effects of slope shape and polyacrylamide application on runoff, erosion and nutrient loss from hillslopes under simulated rainfall .	To examine runoff, erosion, and nutrient loss on different slopes. To investigate the effects of slope shape and polyacrylamide (PAM) application	uniform, concave, convex. Artificial rainfall. The polyacrylamide used. Analyzed PAM's impact.	Runoff amount for concave and convex slopes was greater than that for uniform slopes. convex slopes had the largest soil and nutrient loss. The application of PAM effectively reduced soil erosion and nutrient loss.

Required resources

Equipment

- Total station with related equipment

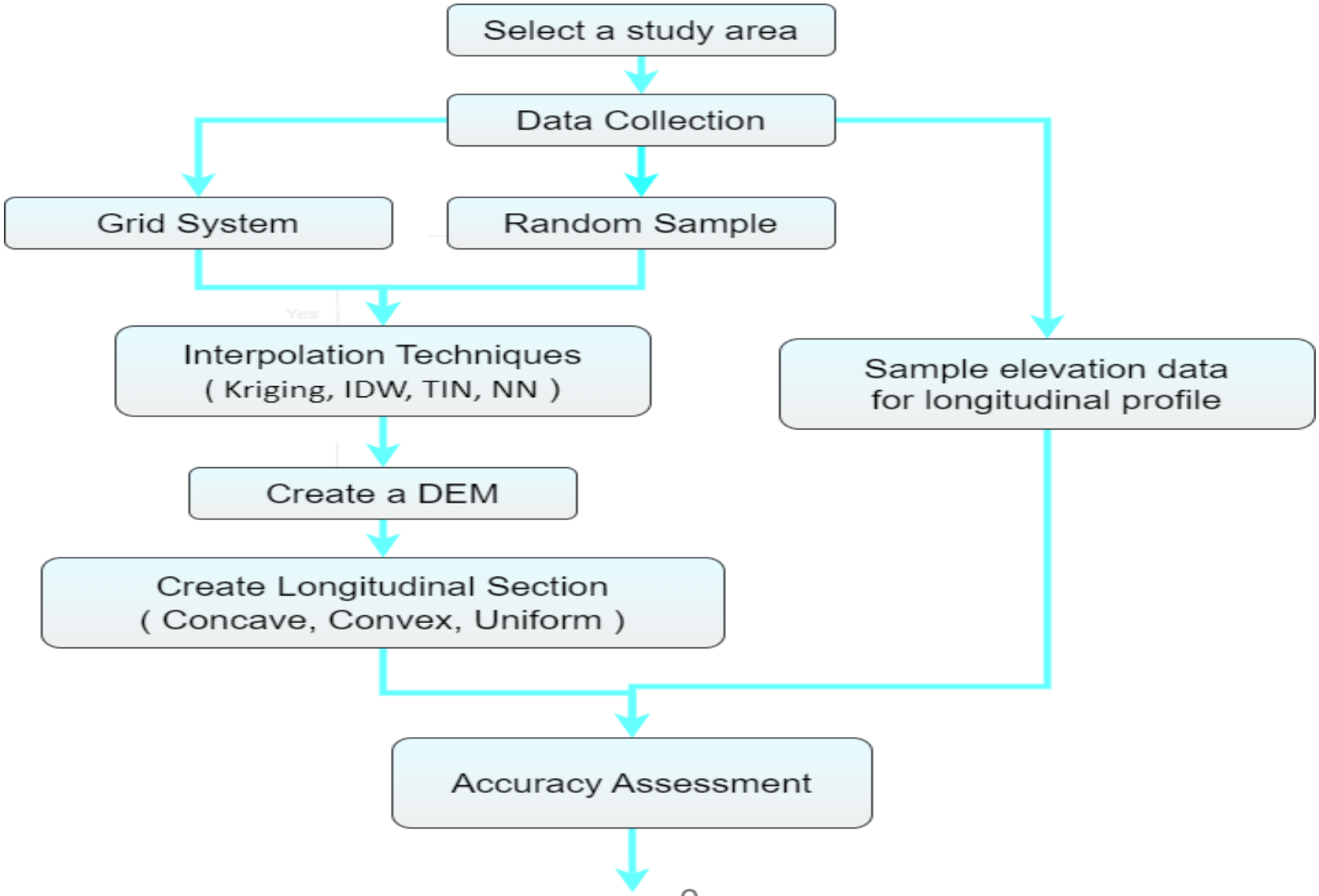
Software

- ArcGIS
- MATLAB

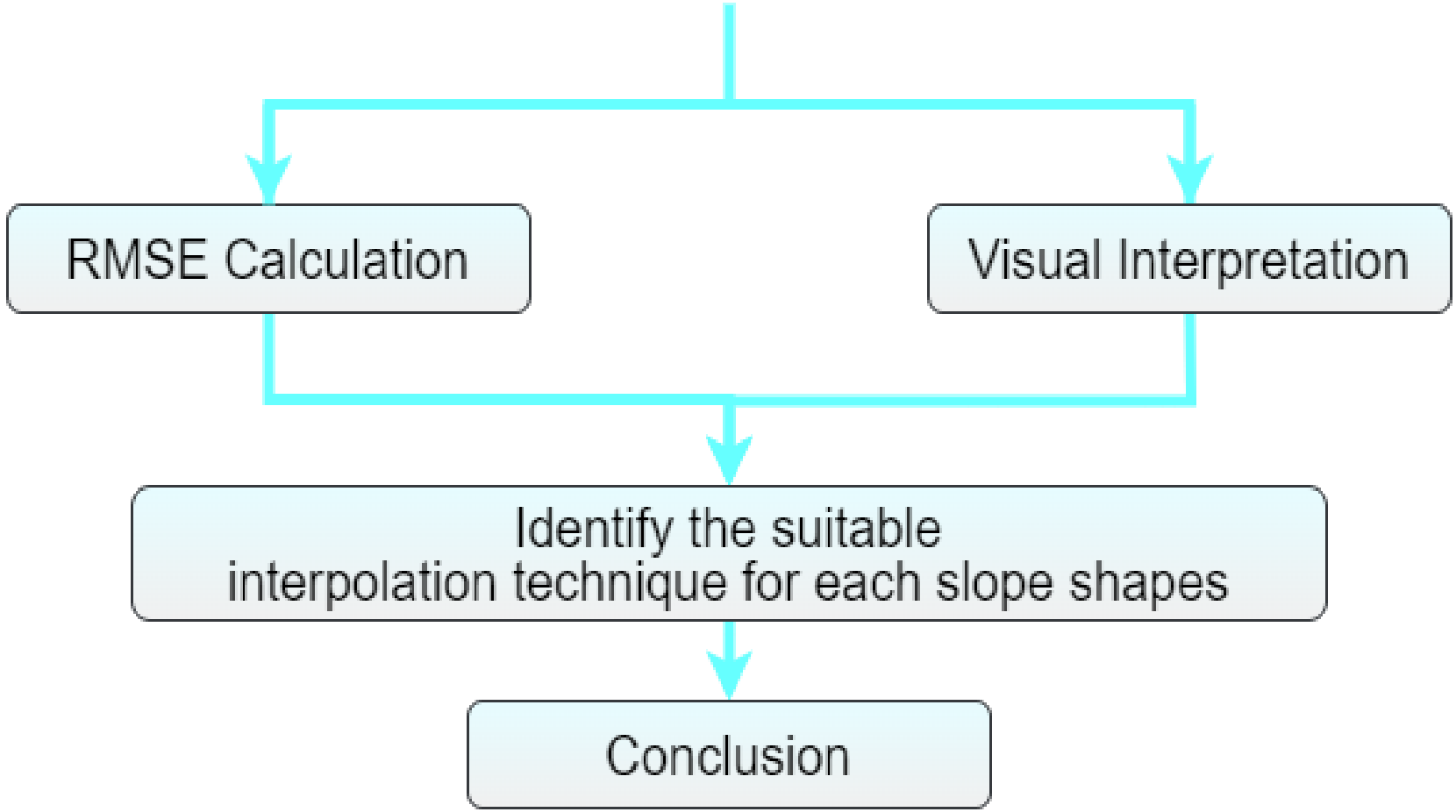
ArcGIS

MATLAB

Methodology



Methodology CONT.



References

- Arun, P. V., 2013. A comparative analysis of different DEM interpolation methods. Egyptian Journal of Remote Sensing and Space Science. https://doi.org/10.1016/j.ejrs.2013.09.001
- Şensoy, H., Kara, Ö., 2014. Slope shape effect on runoff and soil erosion under natural rainfall conditions. IForest 7, 110–114. https://doi.org/10.3832/ifor0845-007
- Ao, C., Zeng, W., Yang, P., Xing, W., Lei, G., Wu, J., Huang, J., 2021. The effects of slope shape and polyacrylamide application on runoff, erosion and nutrient loss from hillslopes under simulated rainfall. Hydrol Process 35. https://doi.org/10.1002/hyp.14130
- Šiljeg, A., Lozić, S., Radoš, D., 2015. The effect of interpolation methods on the quality of a digital terrain model for geomorphometric analyses. Tehnicki Vjesnik 22, 1149–1156. https://doi.org/10.17559/TV-20131010223216
- Huang, X., Qiu, L., 2024. Impacts of Climate Change and Land Use/Cover Change on Runoff in the Huangfuchuan River Basin. Land (Basel) 13, 2048. https://doi.org/10.3390/land13122048


Thank you!