PPE Kriging	Fall Semester 2020	Subject NR. 103-0787-00 L

HOMEWORK 3: KRIGING FOR DEM INTERPOLATION

1 Contents and Aim of Homework

- **Write a Matlab function (including documentation) that is able to perform Kriging and apply it for the Interpolation of a DEM with coverage holes**
- **Be able to explain the Kriging procedure, its theoretical properties and practical limitations**
- **See the practical relevance of geostatistical methods and potential applications within the tasks awaiting you in your profession**

Note: This homework is to be handed in on **2nd** of December. During the session on the 27th of November help for this programming project will be available via zoom. E-mail: jemil.butt@geod.baug.ethz.ch

2 Tasks

2.1 Preliminary Information

The Function "kriging_ppe.m" should have the following properties:

i)   It takes as Input 1 a (3,n_data) Matrix "Data". This matrix contains in the first two rows the coordinates of the data points and in the third row it contains their elevation values. n_data is the number of data points

ii)   It takes as Input 2 a (n,m) Matrix "Field_values_init". This Matrix contains nothing interesting in the beginning and then will later be filled with the interpolated values. It is only of use to define the dimension of the output.

iii)   The output 1 and 2 of the function "kriging_ppe.m" should be two (n,m) Matrices:
"Field_values"   (Each entry is a BLUP or a data value)
"Field_variances" (Each entry is the estimated error variance)

iv)   The output 3 should be a pair of values (DX,DY) giving the appropriate conversion factors between Pixel/Matrix entries and real world length scales.

2.2 Prestructuring your Code

a) Write down in form of a small diagram, flow chart or other sort of scheme, how you plan to assemble all the parts you need for the program.

b) For the parts / buildings blocks that you have mentioned in a) please write down in a tabular fashion, what each one of them takes as Input and how it generates its -output.

2.3 Writing and applying the code

a) Write the Function kriging_ppe.m

b) Please include some comments into your code for improved readability

c) Use your code to estimate the values of the DEM at the position of the NaN's

dtm_basedata_coarse ← ? → dtm_basedata_coarse_lossy
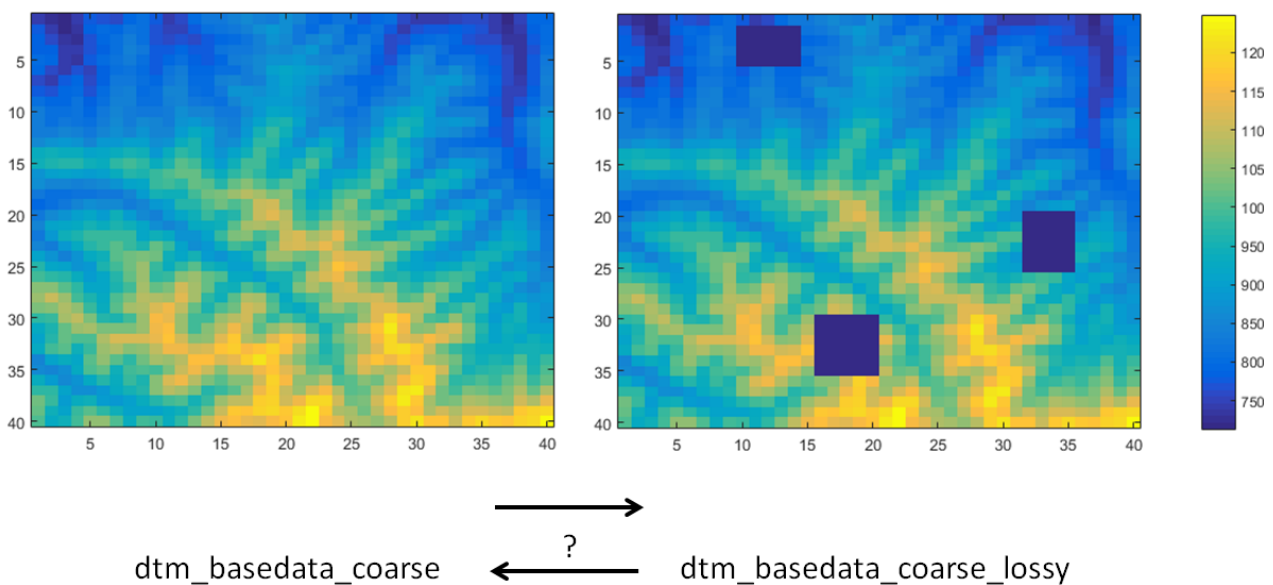
Both datasets and additional Files that I provide to help you (Variogramfitting) have been sent to you already; additional explanations can be given during the next class. In case of Questions, discuss with your colleagues or feel free to ask me directly.

2.4 Explain

a) Please explain why your results look like they do. Are you satisfied? How could you improve your algorithm to account better for the structure of the data?

b) Since the amount of missing data in the above example is rather small, please test out your function on the two datasets "Data_dense_HW3.mat" and "Data_sparse_HW3.mat". Accompanying these two datasets is the original image "Original_image.mat" and the second input to your Kriging_PPE function in the form of a matrix "Field_values_init.mat". Furthermore, there exists a supporting function of the name "Make_comparative_interpolation.m" that allows you to interpolate the data in some standard ways (Nearest Neighbor, Cubic spline, ...).

How does your Kriging approach work for this data? Try out the spherical, exponential and squared exponential covariance models. Which one works best, which fails, and why?

c) There exist different forms of Kriging briefly described on slides 13-24. For each type of Kriging, think of an application example from your profession and explain it briefly.

d) Please give a short outline of what you have learnt in this part of the course "Project Parameter Estimation" and depict a scenario, in which this knowledge might be helpful.

2.5 Present

a) Please prepare a short Powerpoint presentation filling approximately 10 minutes. In this you should cover, what you think is important to know regarding Kriging. Try to give it a personal touch! If there are still open questions, state them in your presentation and we will discuss them in class afterwards.

Presentations will be held on the **4th** of December by each group.

Good Luck!