Project 1: Image reconstruction using GMRFs

Group 15: Ivan Flensburg, Mats Richardsson

April 2022

1 Variograms

Estimating covariates with least squares, binning the residuals of our observed pixels, doing weighted least squares covariance estimation to get parameters and then fitting a matern variogram resulted in figure 1

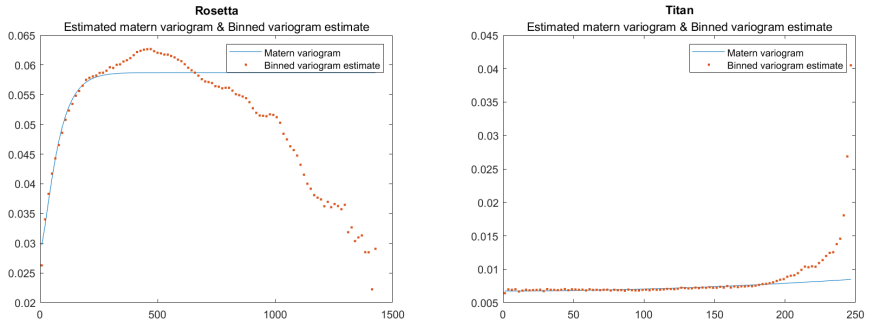

Figure 1: Variogram for both images.

2 Reconstructions

The LSE-estimate of κ was optimal for the Titan image, and very close to optimal for the Rosetta image. In the latter, approximately 0.03% lower error rating (sum of absolute difference in pixel values vs real image) was achieved by increasing the size of κ to 0.244 as shown in figure 2

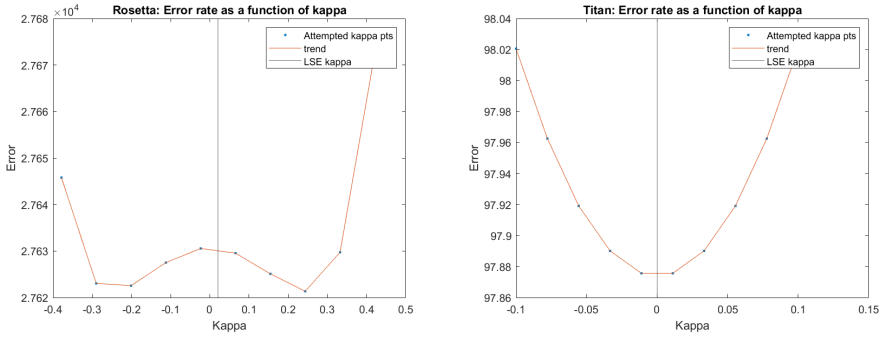

Figure 2: Error rate vs. kappa for both images.

Down below follows result of our reconstructed image for the κ estimated through least squares shown next to the original image and also differences in pixel values.

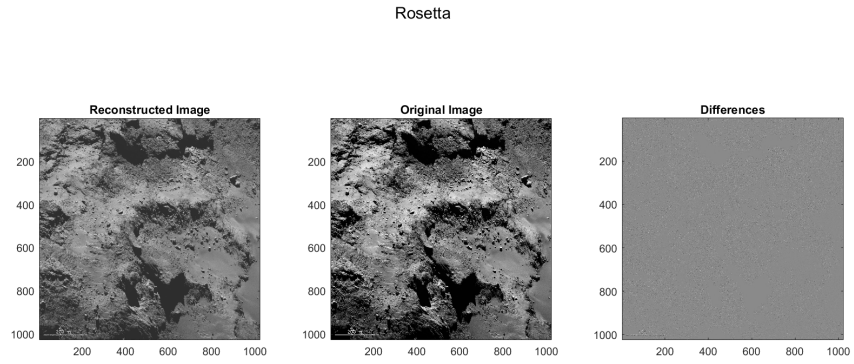

Figure 3: Reconstructed Rosetta image and differences for approximately 50% observed pixels, and subset size 10000 pixels.

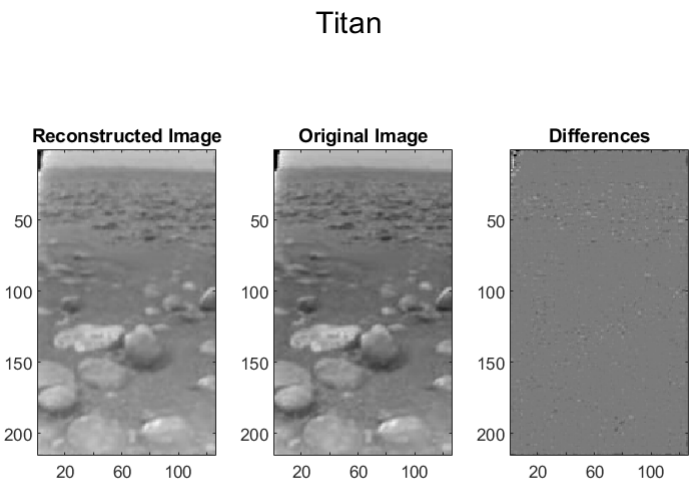

Figure 4: Reconstructed Titan image and differences for approximately 50% observed pixels, and subset size 10000 pixels.

3 Missing pixels

Below follows a series of reconstructions for different percentages of missing pixels for Rosetta and titan respectively. Figure 5 shows that for around 98% missing pixels the picture the reconstructed image becomes very bad. For 95% missing pixels there is some noise as well, but you can still determine the most important image features. Figure 6 shows that for around 90% missing pixels and higher, the image is too blurry.

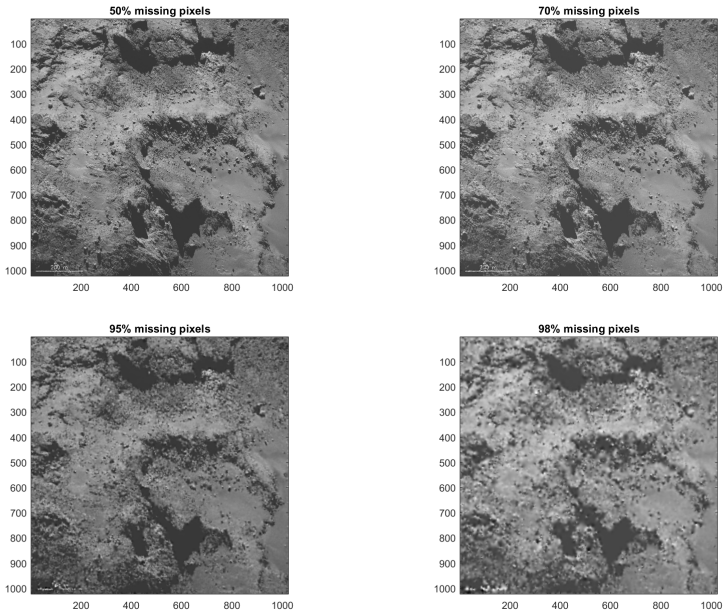

Figure 5: Image reconstruction of Rosetta image for different share of missing pixels.

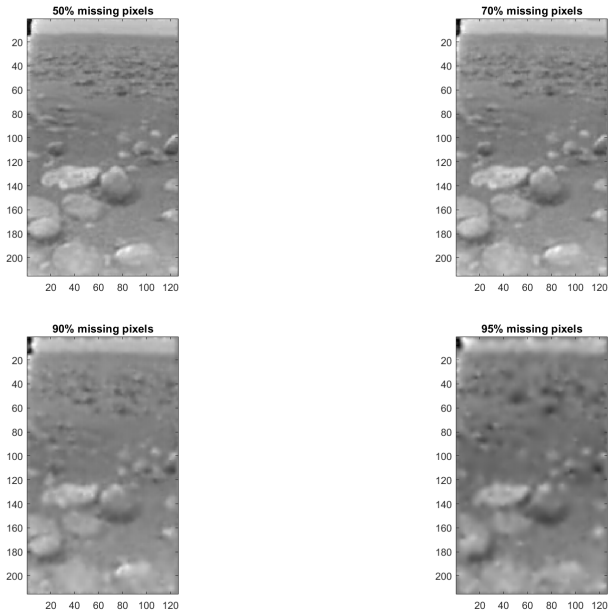

Figure 6: Image reconstruction of Titan image for different share of missing pixels.