Deblur report

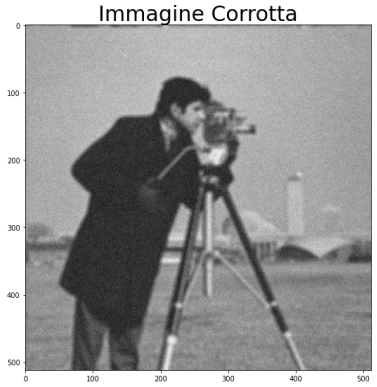
Giovanni Grotto, Carmine Venturiero, Francesca Chiriacò

January 2021

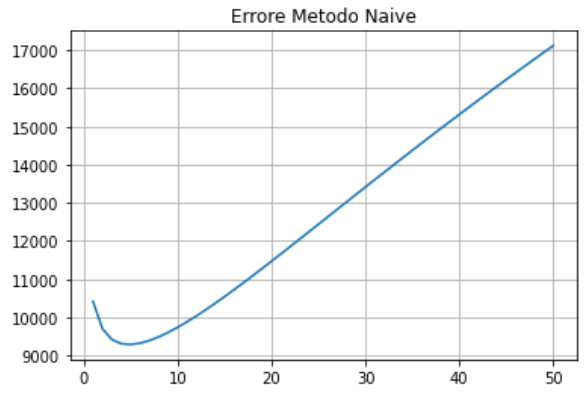
1) Introduction:

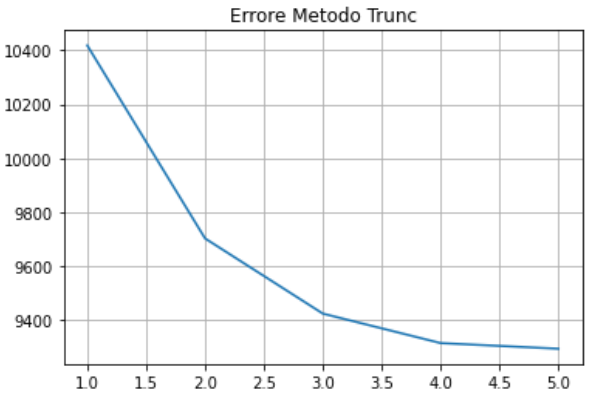
The project consists in reconstructing an image to which have been added Gaussian blur and noise.
The reconstruction takes place through the gradient descent method with step obtained by backtracking.
Various reconstructed images are calculated as the lambdas, the applied functions and the gradient changes.

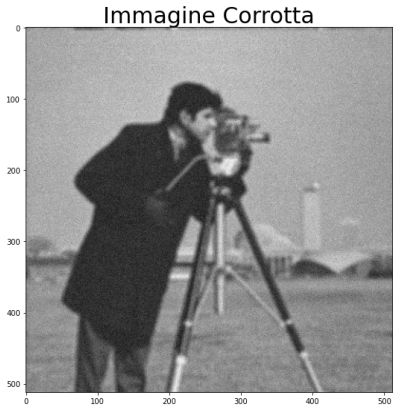
2) Results:



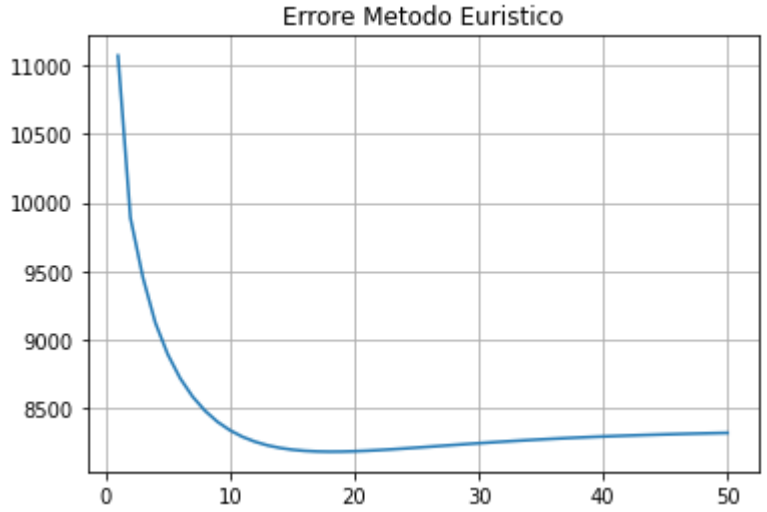
This is the sequence that leads to image corruption.



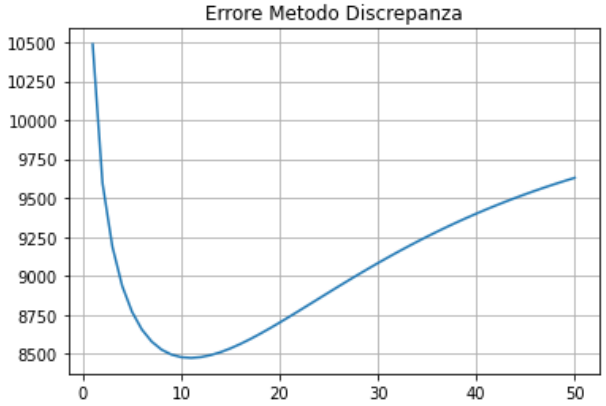


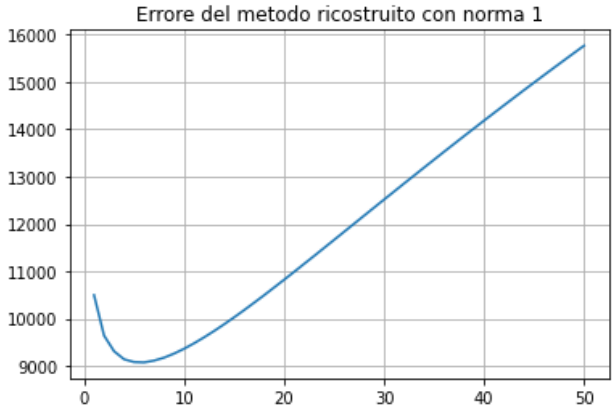


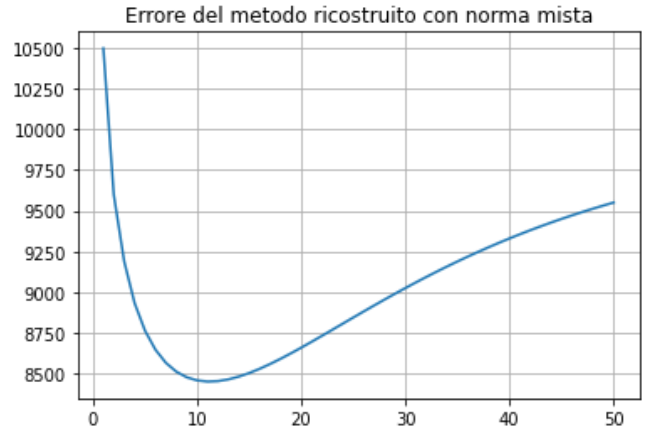
Here are represented graphs, and reconstructed images corresponding to the error calculated through the step with the backtracking algorithm, and stopping the calculation iterations of the matrix at k which corresponds to the minimum error in the graph.



Here we have the error and the image reconstructed using a lambda calculated in a heuristic way, we generated 10 lambdas starting from random lambda0 and increasing it, we then used the one that generates the minor error.





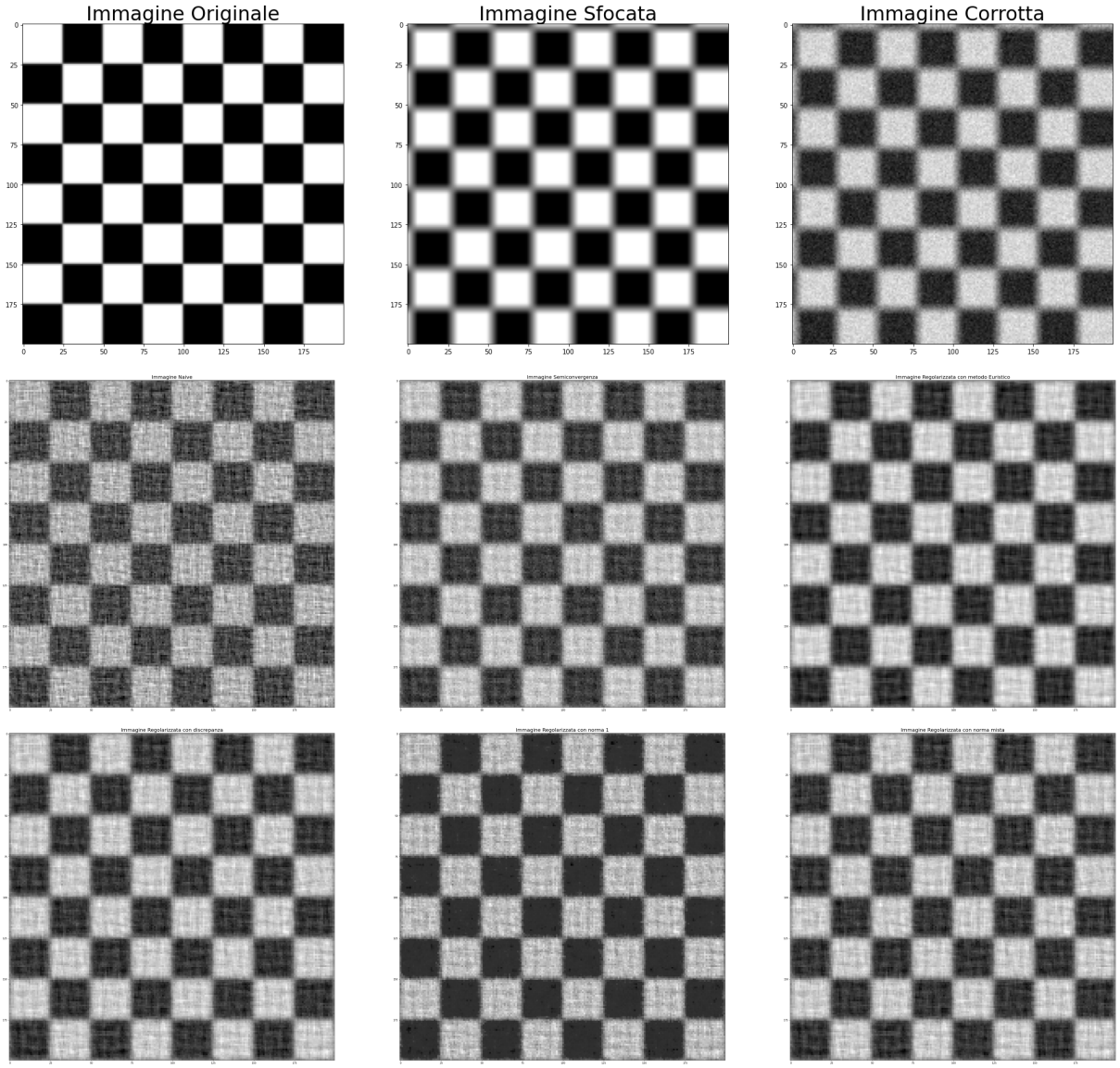


Here we have used lambdas calculated through the discrepancy principle, i.e. increasing the lambda until it meets a given condition.

Values of various errors:
Corrotta= 0.20845426105524795
Backtracking= 0.2502394308408125
BactrackingMinore= 0.13588039721270082
Euristico= 0.11963065183271966
MetodoDiscrepanza= 0.12392284269712348
Norma1= 0.13273412949575822
NormaMista= 0.12358706793859858

We note that with this image,the method that give the closer image to the original is obtained with Heuristic method.

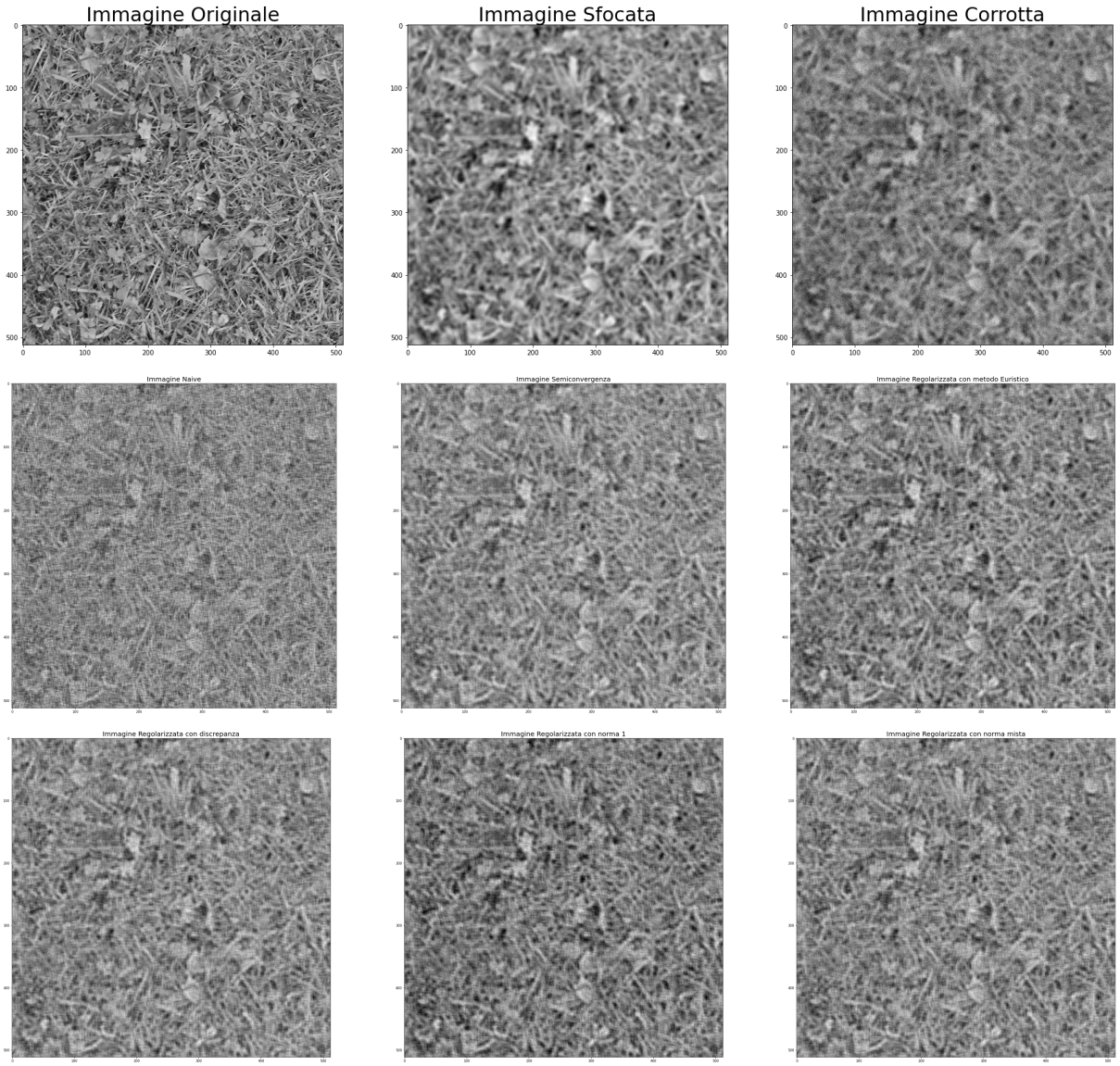
Analysis Image with Texture:



ErroreCorrotta = 0.48818045557478706
Errorex_naive = 0.2627983139962143
Errorex_trunc = 0.19893433910343833
Errorex_E = 0.19194616183287203
Errorex_Dis = 0.18739626219063854
ErroreX1 = 0.16680079806039008
Errorex_mista = 0.18554431103732288

With this geometric image close method is calculated using Norma1

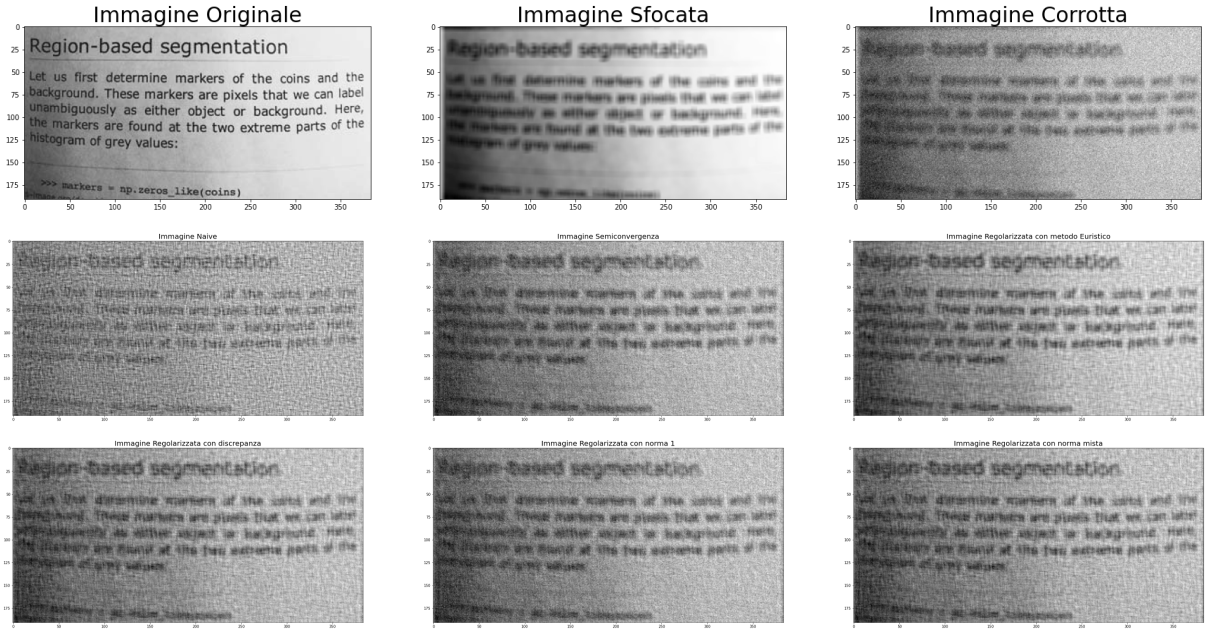
detailed image analysis:



ErroreCorrotta = 0.3038574426363241
Errorex_naive = 0.2904095898524023
Errorex_trunc = 0.22915838562518553
Errorx_E = 0.21687767968045268
Errorx_Dis = 0.21698908767723543
ErrorX1 = 0.23087119484392163
Errorx_mista = 0.21709234635937147

With this more detailed image than the previous one, it has heuristic and discrepancy methods as best.

Image analysis with text:



ErrorCorrotta = 0.2212625566000552
Errorx_naive = 0.2696221219471694
Errorx_trunc = 0.18603565389462484
Errorx_E = 0.17323232728502136
Errorx_Dis = 0.17558207875451887
ErrorX1 = 0.1870772322249438280

As the previous method, euristic and discrepancy method are the best.

3) From the results we can see that in most cases the image obtained through the heuristic method is the one closest to the original with the exception of the image with texture which is more precise if calculated with Norma1.