Μη-γραμμικά συστήματα επεξεργασίας

Διάταξη τιμών
Μεσαία τιμή

Συνδυασμός γραμμικών / μη-γραμμικών

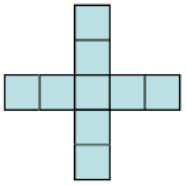
Τοπικά μεταβαλλόμενη επεξεργασία

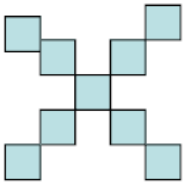
Μεσαία τιμή

Έκταση γειτονιάς
Συμμετρικά ως προς το σημείο αναφοράς
Συχνά τετραγωνική περιοχή *(2 K+1) x (2 K+1)*

1	1	1
2	2	2
2	2	2

1	1	1
1	2	2
1	2	2



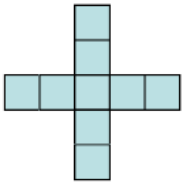


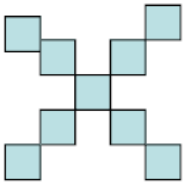
Μεσαία τιμή

Έκταση γειτονιάς
Συμμετρικά ως προς το σημείο αναφοράς
Συχνά τετραγωνική περιοχή *(2 K+1) x (2 K+1)*

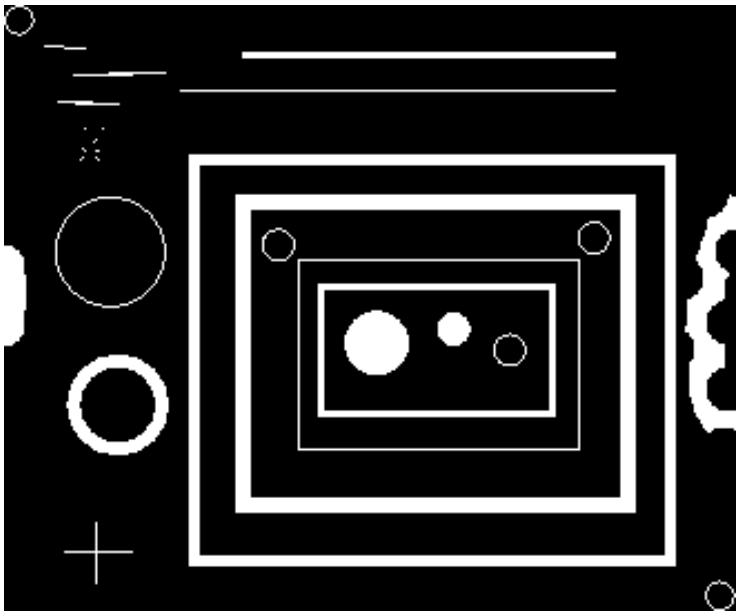
1	1	1
2	**2**	2
2	2	2

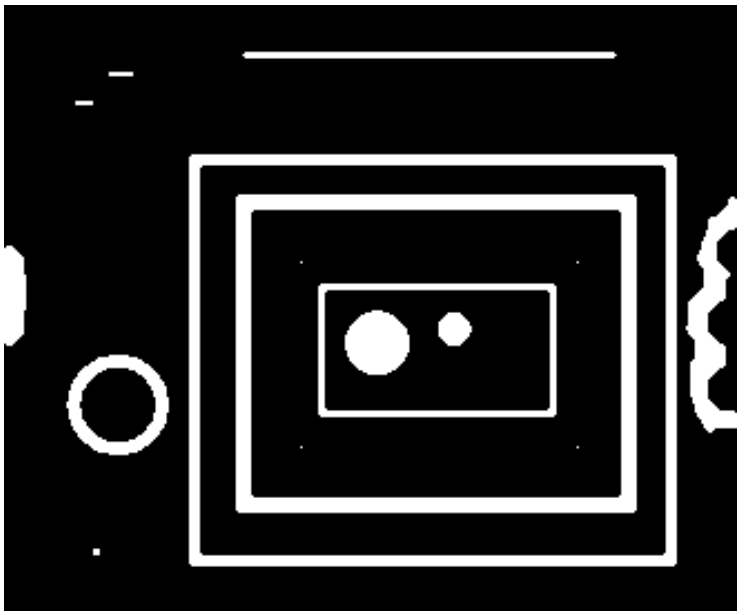
1	1	1
1	**1**	2
1	2	2





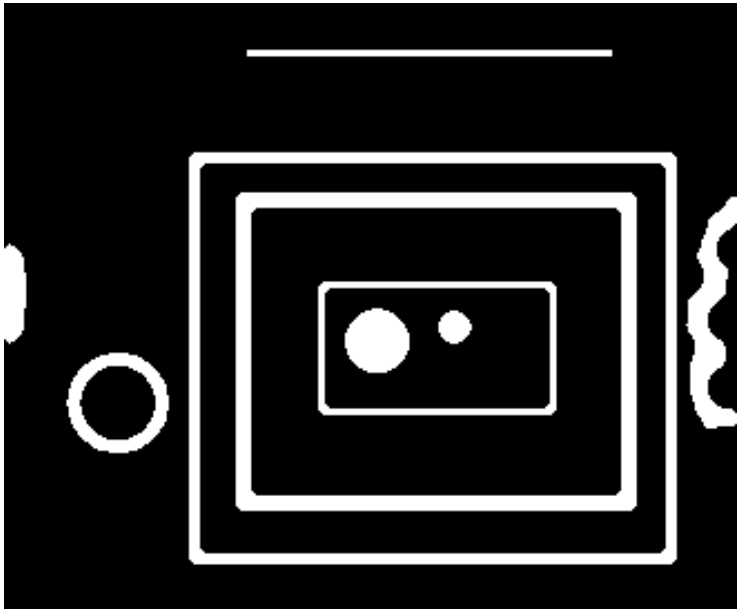
Μεσαία τιμή

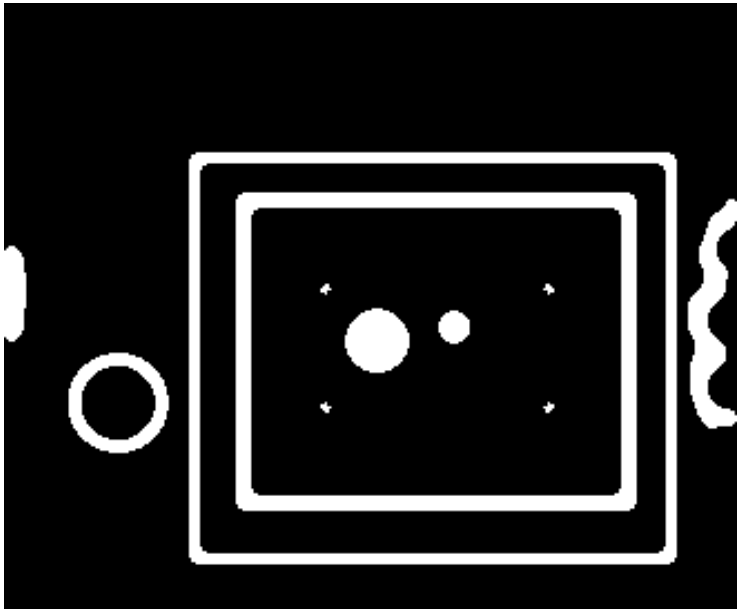




3x3

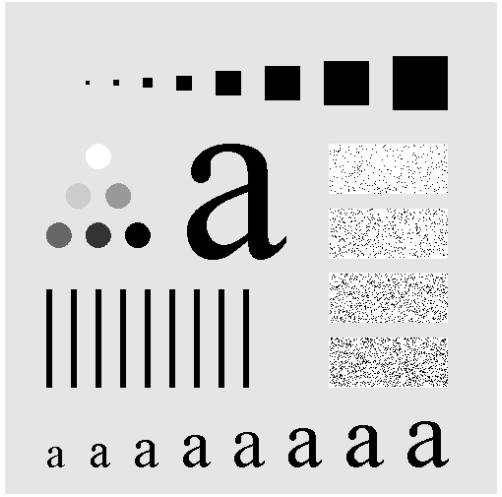
5x5

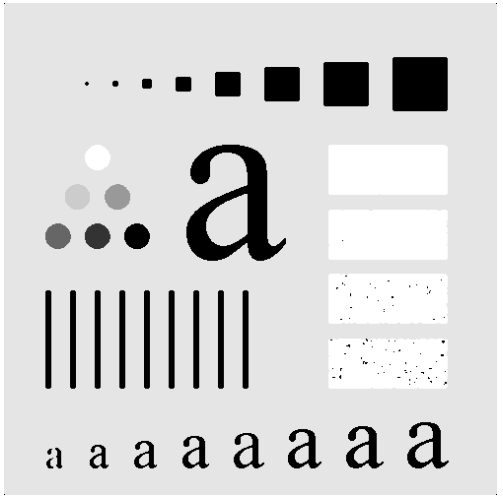




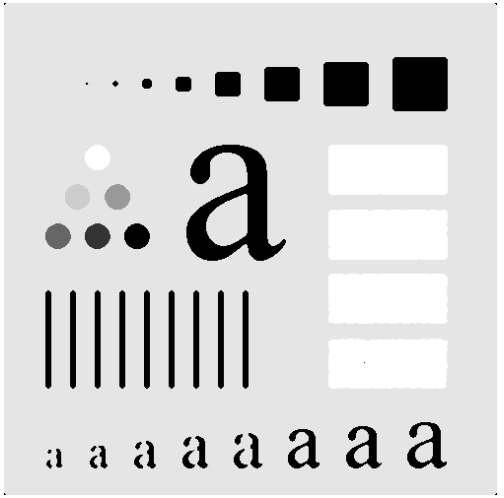
7x7

Μεσαία τιμή

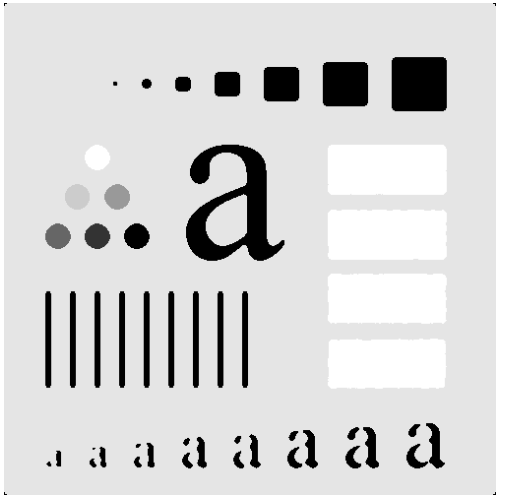




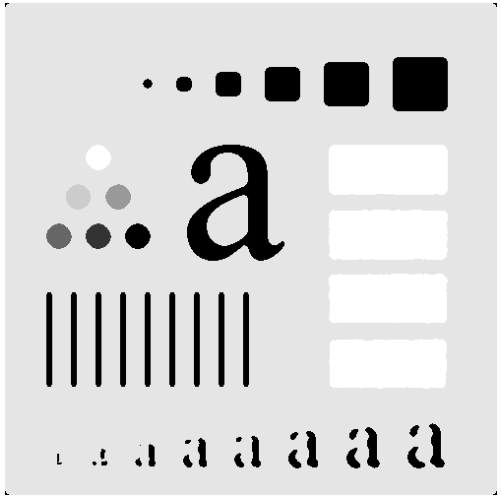
3x3



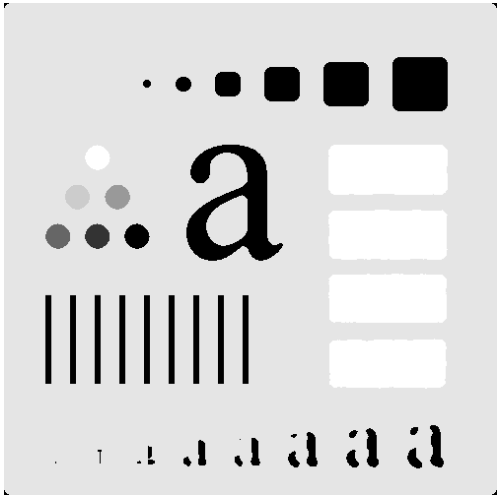
5x5



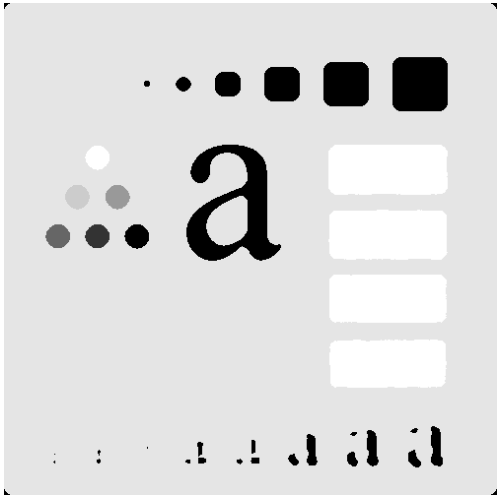
7x7



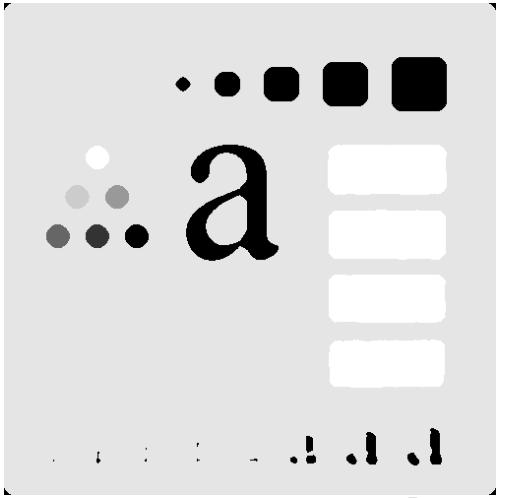
9x9



11x11

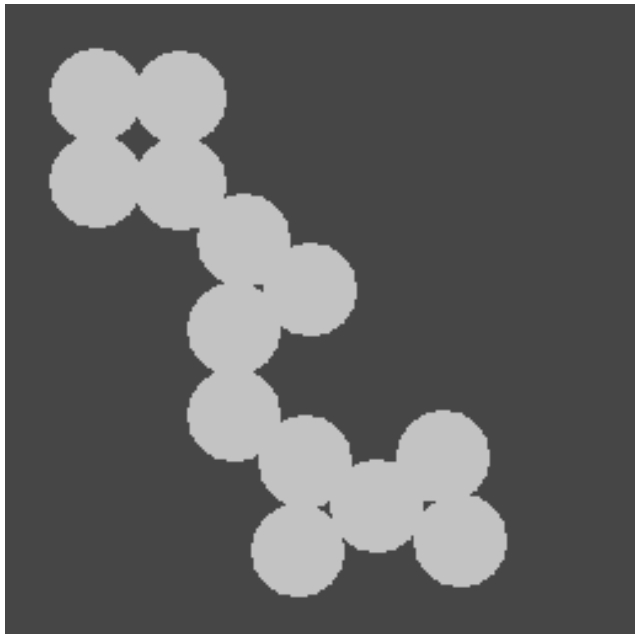


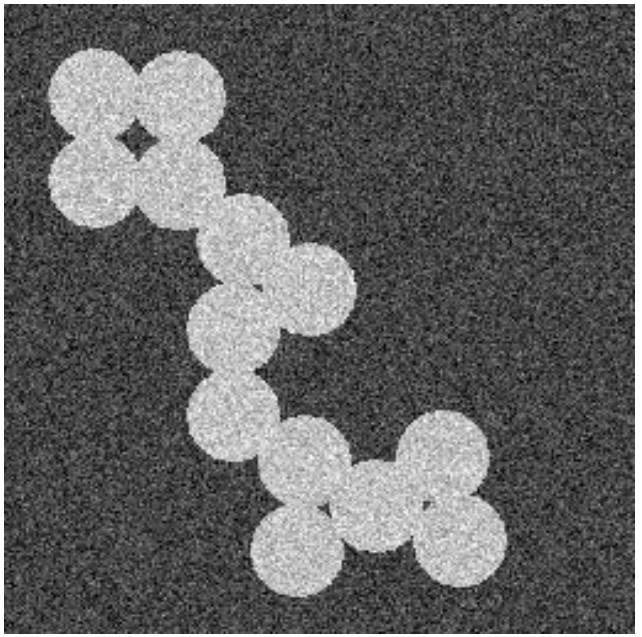
13x13

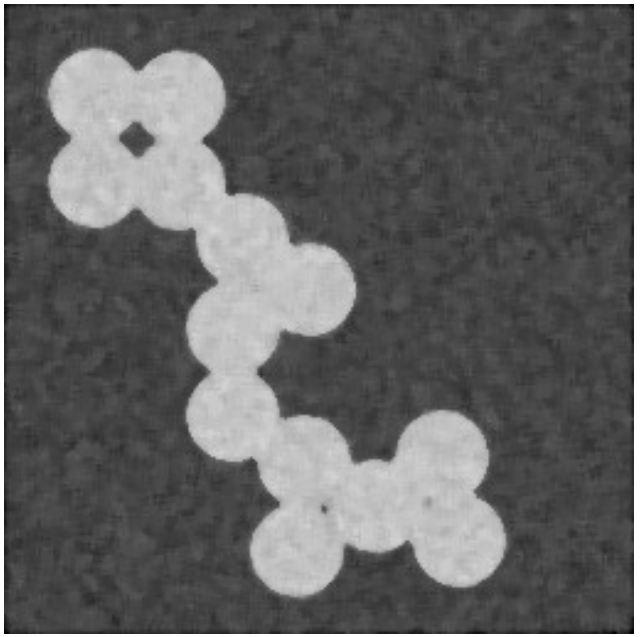


15x15

Μεσαία τιμή



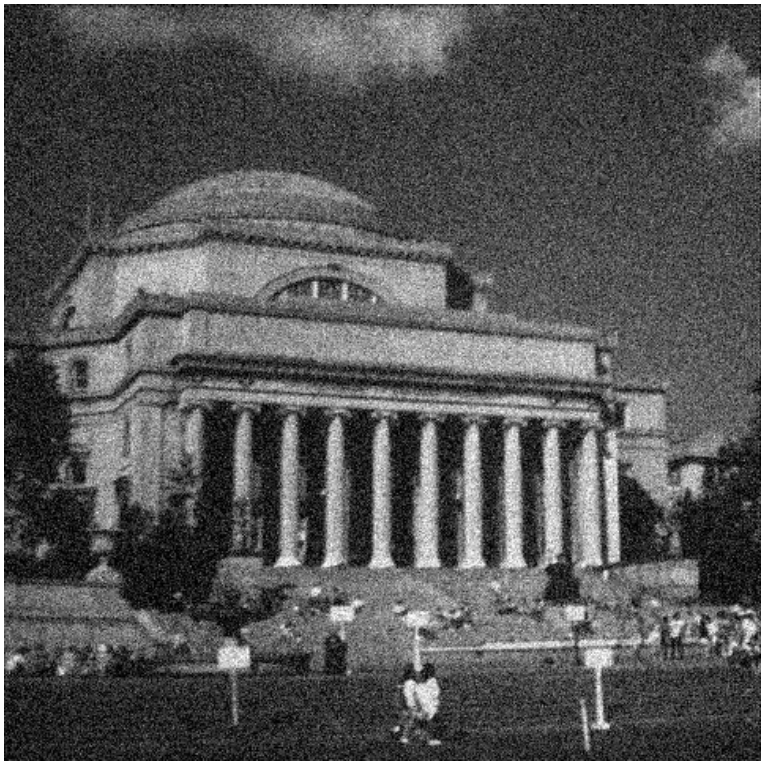




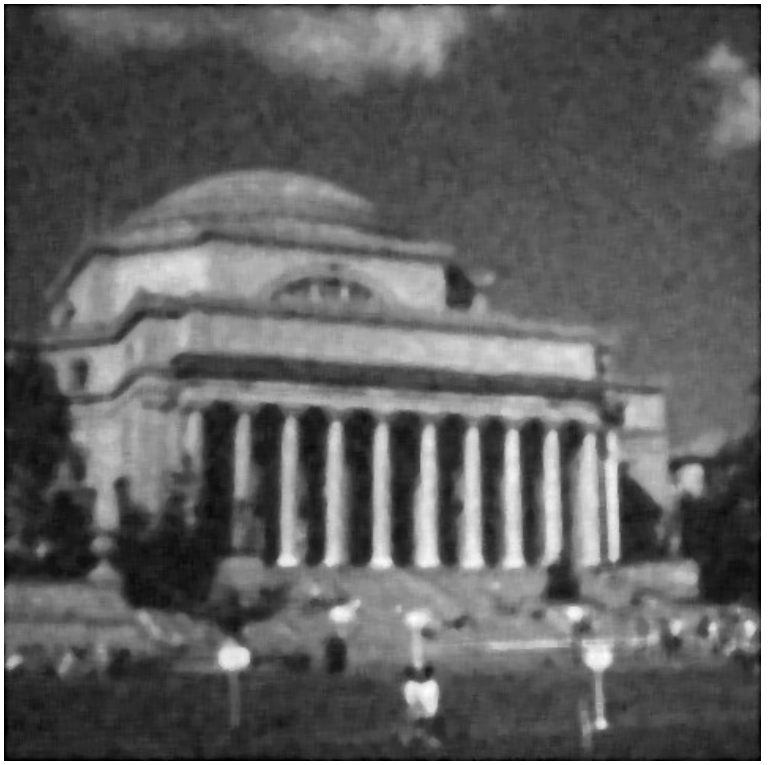
5 x 5

Βελτίωση : 7,0

Μεσαία τιμή

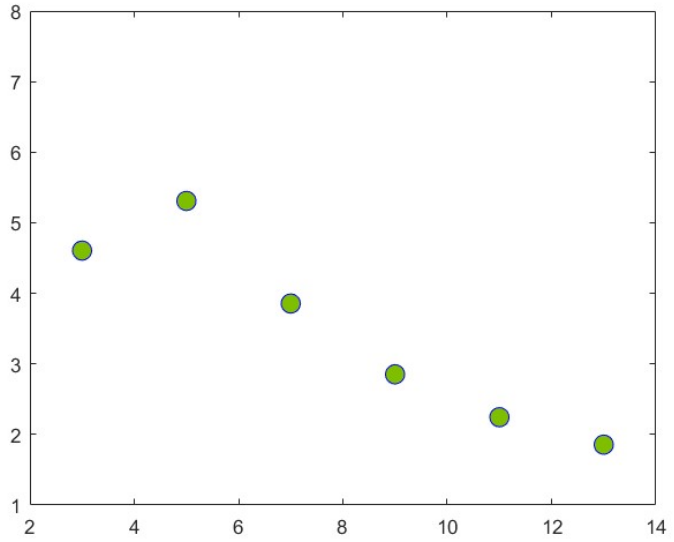


σ = 0.1

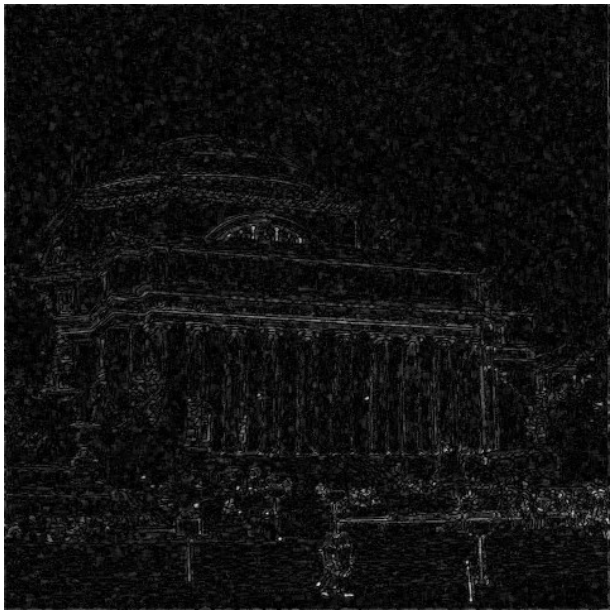


7 x 7
Βελτίωση : 3.9

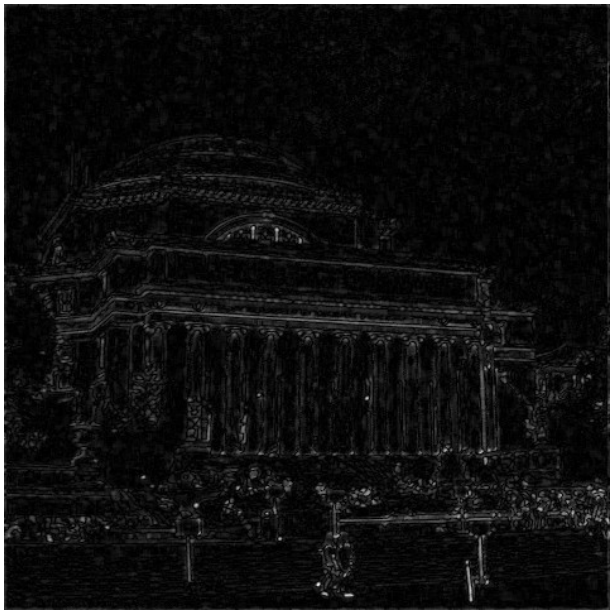
Μεσαία τιμή



Βελτίωση
σ = 0.1

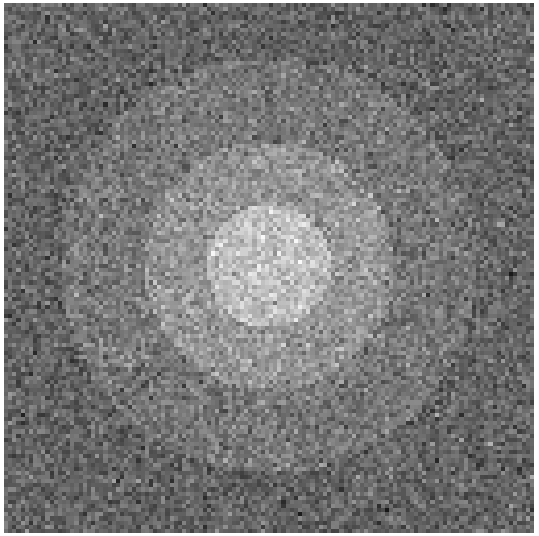


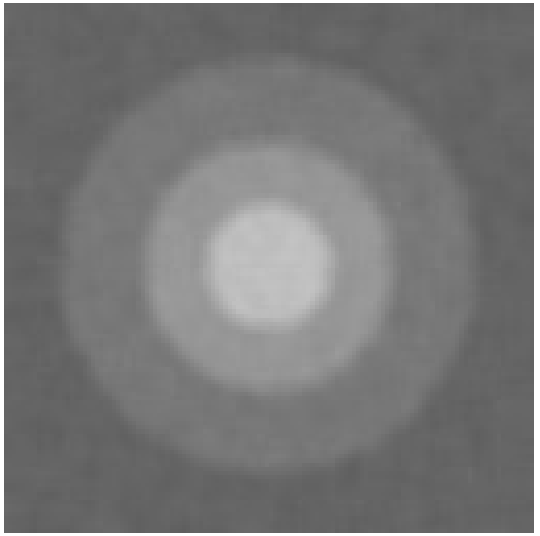
5 x 5



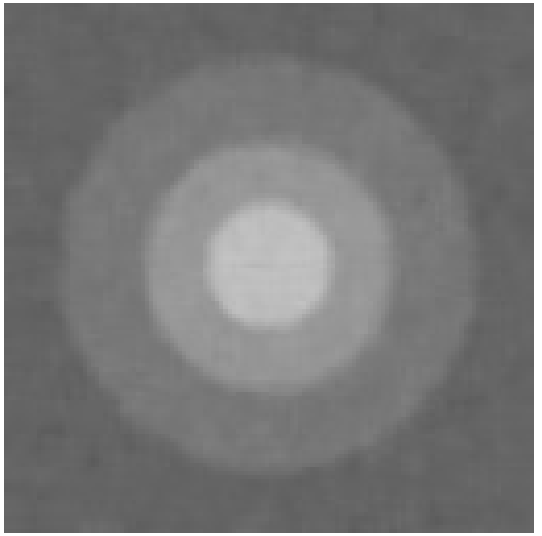
7 x 7

Σύγκριση μέσης / μεσαίας τιμής





11 x 11



11 x 11

Θόρυβος “αλατοπίπερο”

Ποσοστό : 0.05

3 x 3

Σταθμισμένη μέση τιμή με απόρριψη

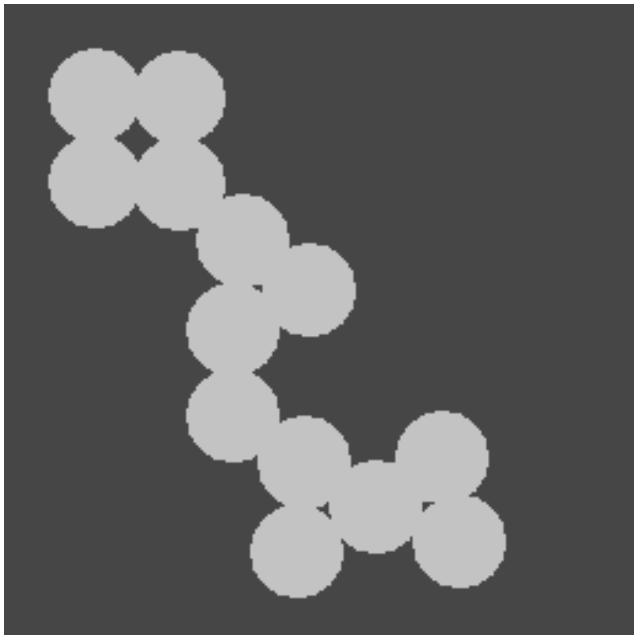
Συνδυασμός σταθμισμένης μέσης τιμής με μεσαία τιμή

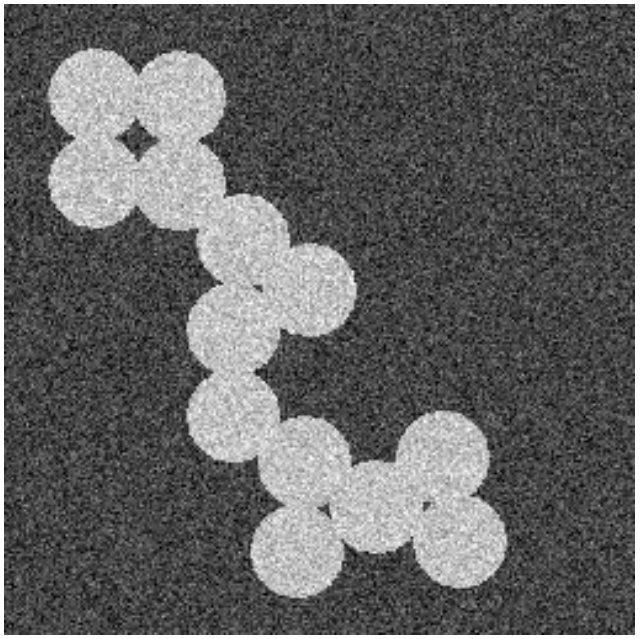
$$y(m,n) = \frac{\sum_{k=-M}^{M}\sum_{l=-N}^{N} h(k,l)\phi(x(m-k,n-l) - \text{Μεσαία}[x(m,n)])x(m-k,n-l)}{\sum_{k=-M}^{M}\sum_{l=-N}^{N} h(k,l)\phi(x(m-k,n-l) - \text{Μεσαία}[x(m,n)])}$$

Απόρριψη

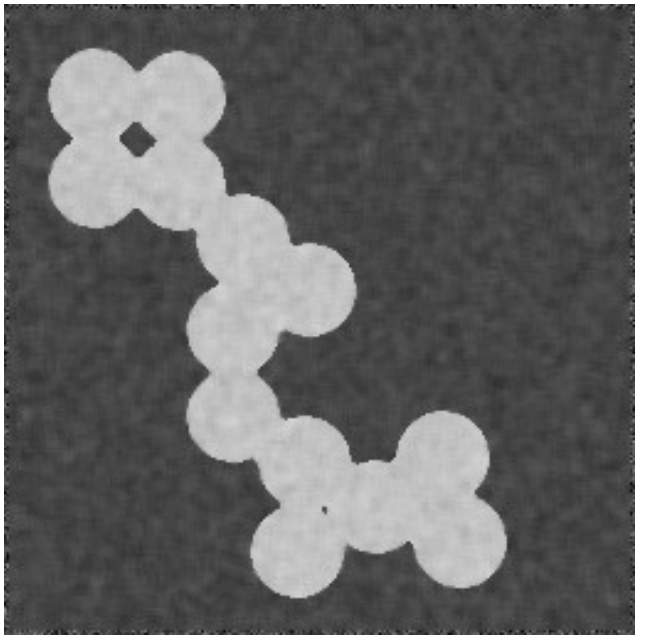
$$\phi(x) = \begin{cases} 1 & |x| \le \delta \\ 0 & |x| > \delta \end{cases}$$

Σταθμισμένη μέση τιμή με απόρριψη



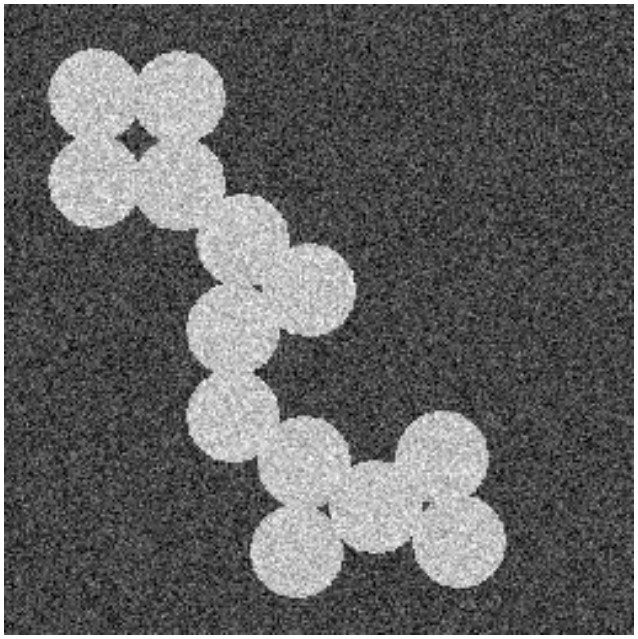


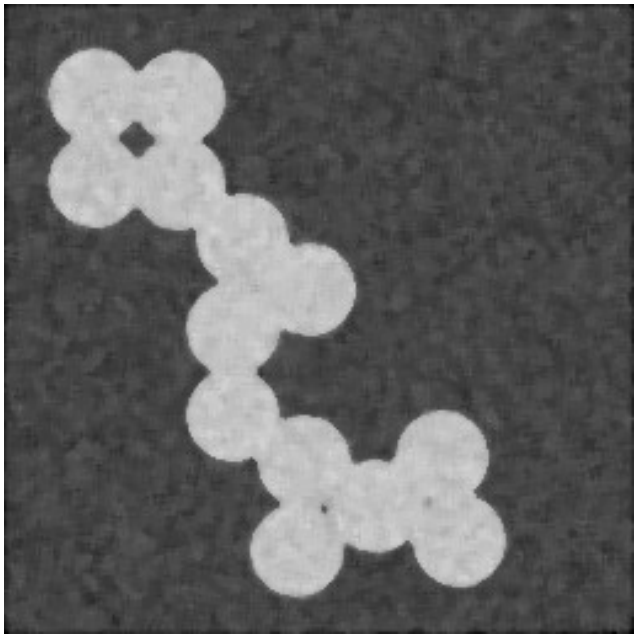
σ = 0.1



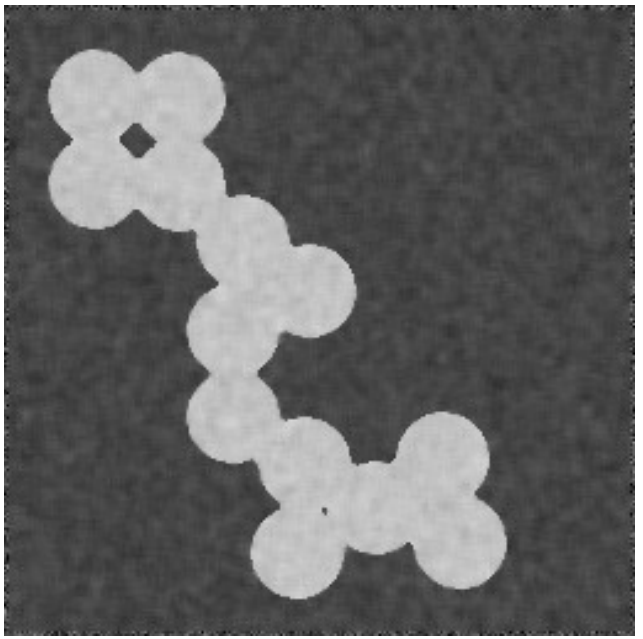
5 x 5
Βελτίωση : 7.5

Σταθμισμένη μέση τιμή με απόρριψη





Μεσαία τιμή
5 x 5
Βελτίωση : 7.0

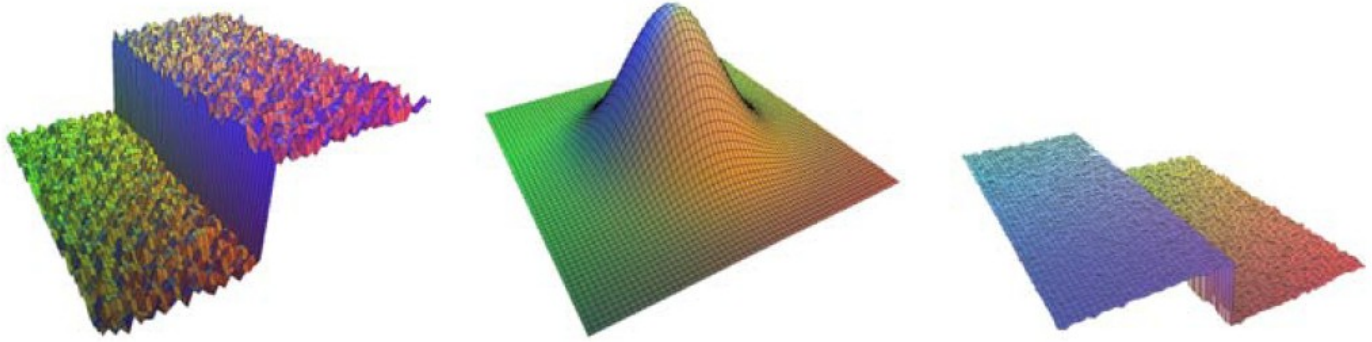


Φίλτρο με απόρριψη
5 x 5
Βελτίωση : 7.5

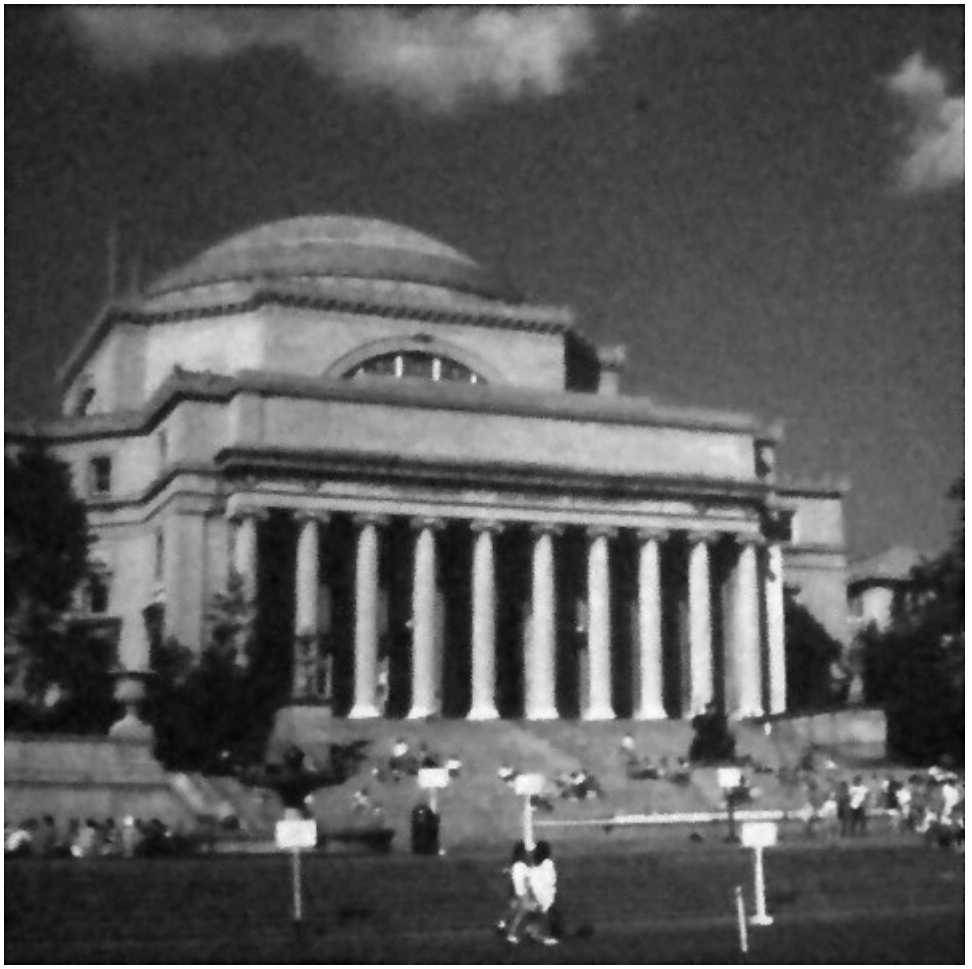
Φίλτρο διπλής στάθμισης

$$g(i,j) = \frac{\sum_{k,l} f(k,l) w(i,j,k,l)}{\sum_{k,l} w(i,j,k,l)}$$

$$w(i,j,k,l) = \exp\left(-\frac{(i-k)^2 + (j-l)^2}{2\sigma_d^2} - \frac{\|f(i,j) - f(k,l)\|^2}{2\sigma_r^2}\right)$$

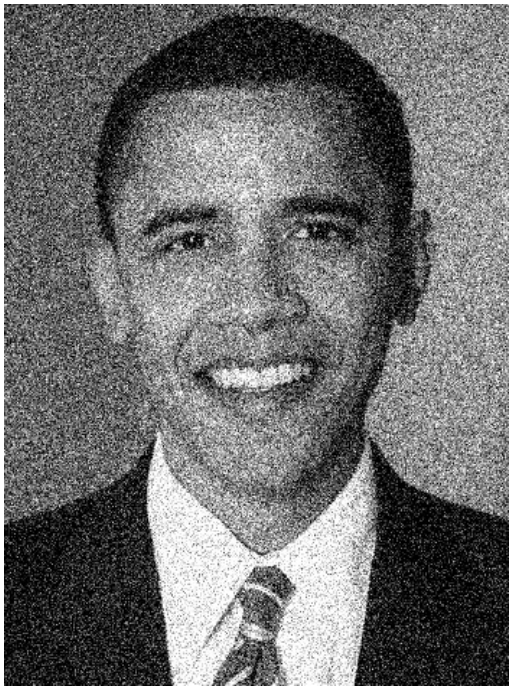


Φίλτρο διπλής στάθμισης



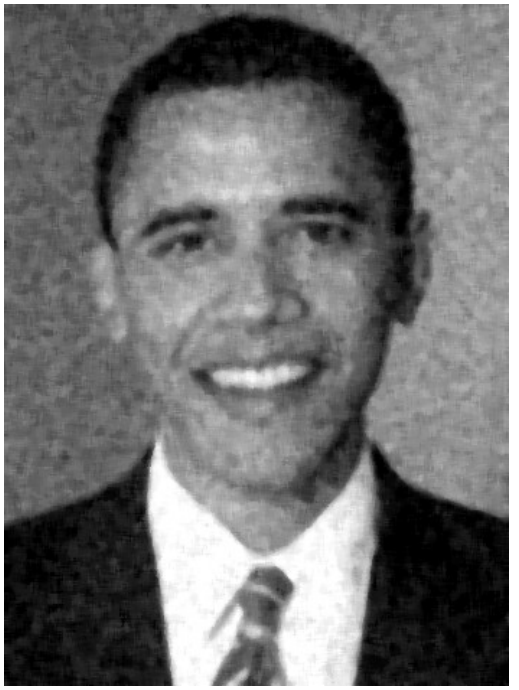
σ = 0.05

Μέση τιμή από όμοια μπλοκ



X, σ = 0.2

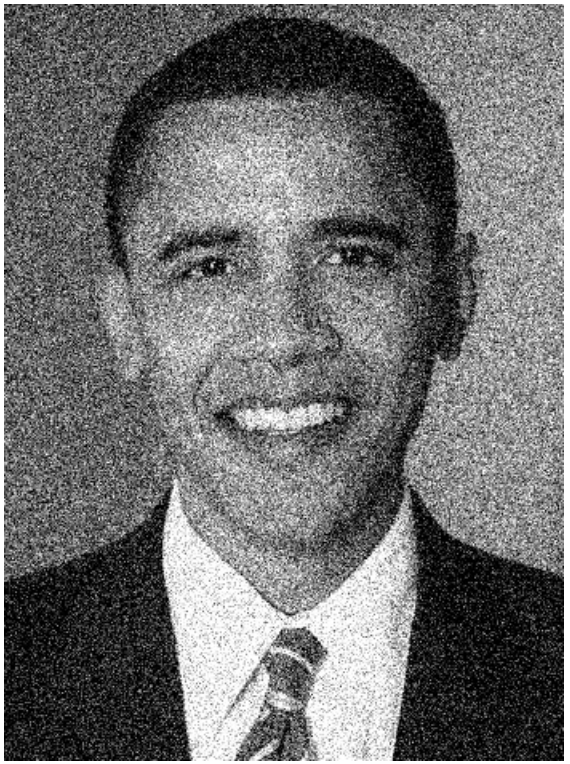
Y

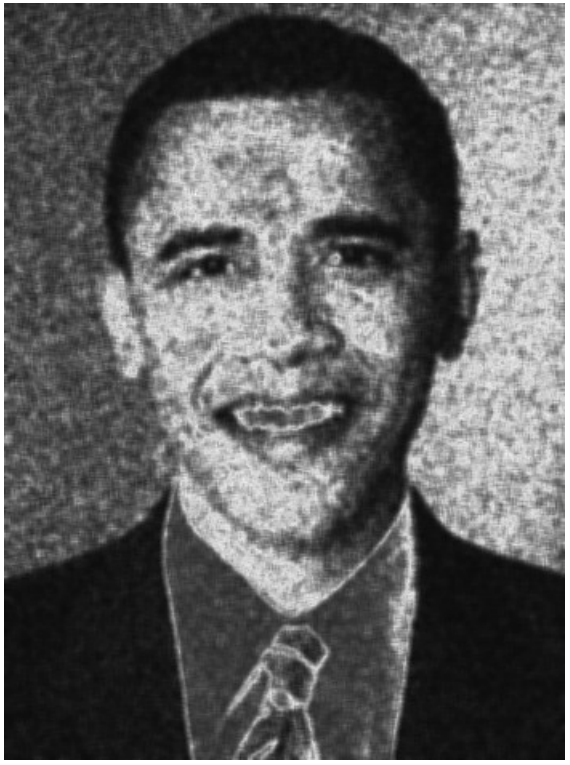


med(X)
7x7

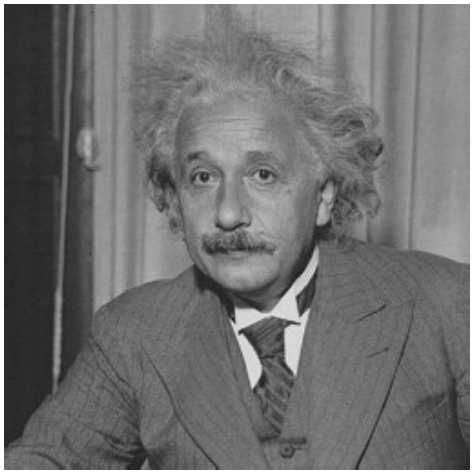
$$y(m,n) = \frac{\sum_{k=-N}^{N}\sum_{l=-N}^{N}\phi(x(m-k,n-l),x(m,n))x(m-k,n-l)}{\sum_{k=-N}^{N}\sum_{l=-N}^{N}\phi(x(m-k,n-l),x(m,n))}$$

Ομοιότητες





Σύγκριση



'gaussian'

'median'

'non-local'