Metodi del Calcolo Scientifico
Progetto 2

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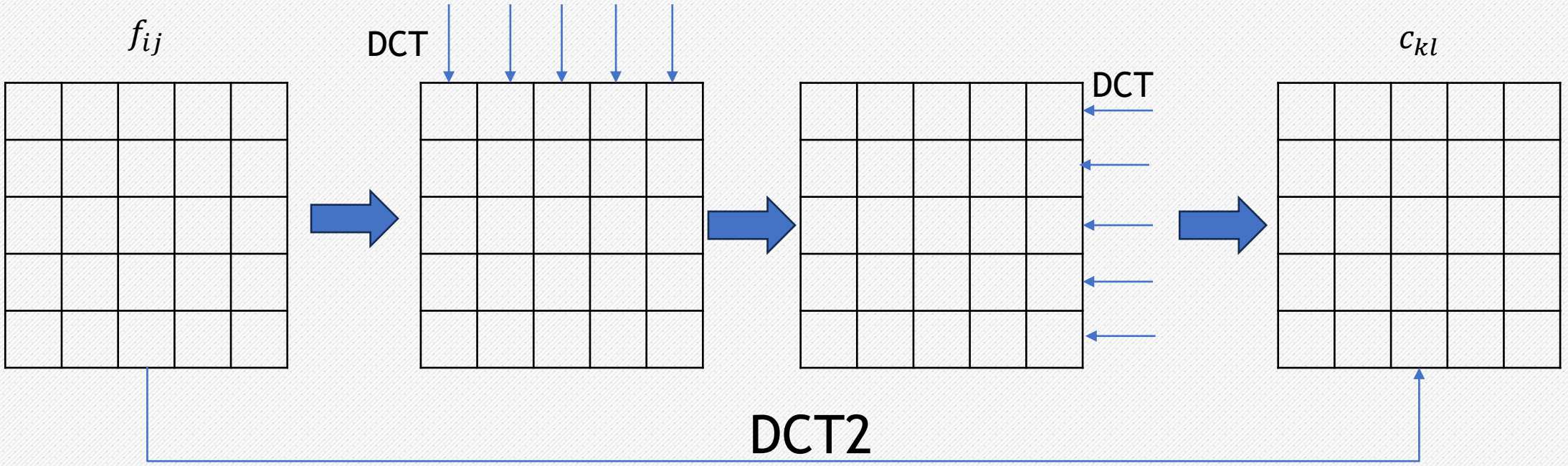

$$X_k = \sqrt{\frac{2}{N}} \cdot \sum_{n=0}^{N-1} x_n \cdot \cos\left(\frac{\pi}{N} \cdot n \cdot \left(n + \frac{1}{2}\right)\right)$$

DCT e DCT2

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Verifica correttezza DCT

$$\begin{bmatrix} 231 & 32 & 233 & 161 & 24 & 71 & 140 & 245 \end{bmatrix}$$

$$\begin{bmatrix} 4.01e+02 & 6.60e+00 & 1.09e+02 & -1.12e+02 & 6.54e+01 & 1.21e+02 & 1.16e+02 & 2.88e+01 \end{bmatrix}$$

```
[ 401.9902051    6.60001991  109.16736544 -112.78557857   65.40737726  121.83139804  116.65648855   28.80040722]
```

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Verifica correttezza DCT2

$$\begin{bmatrix} 231 & 32 & 233 & 161 & 24 & 71 & 140 & 245 \\ 247 & 40 & 248 & 245 & 124 & 204 & 36 & 107 \\ 234 & 202 & 245 & 167 & 9 & 217 & 239 & 173 \\ 193 & 190 & 100 & 167 & 43 & 180 & 8 & 70 \\ 11 & 24 & 210 & 177 & 81 & 243 & 8 & 112 \\ 97 & 195 & 203 & 47 & 125 & 114 & 165 & 181 \\ 193 & 70 & 174 & 167 & 41 & 30 & 127 & 245 \\ 87 & 149 & 57 & 192 & 65 & 129 & 178 & 228 \end{bmatrix}$$

$$\begin{bmatrix} 1.11e+03 & 4.40e+01 & 7.59e+01 & 1.38e+02 & -3.50e+00 & 1.22e+02 & 1.95e+02 & -1.01e+02 \\ 7.71e+01 & 1.14e+02 & -2.18e+01 & 4.13e+01 & 8.77e+00 & 9.90e+01 & 1.38e+02 & 1.09e+01 \\ 4.48e+01 & -6.27e+01 & 1.11e+02 & -7.63e+01 & 1.24e+02 & 9.55e+01 & -3.98e+01 & 5.85e+01 \\ -6.99e+01 & -4.02e+01 & -2.34e+01 & -7.67e+01 & 2.66e+01 & -3.68e+01 & 6.61e+01 & 1.25e+02 \\ -1.09e+02 & -4.33e+01 & -5.55e+01 & 8.17e+00 & 3.02e+01 & -2.86e+01 & 2.44e+00 & -9.41e+01 \\ -5.38e+00 & 5.66e+01 & 1.73e+02 & -3.54e+01 & 3.23e+01 & 3.34e+01 & -5.81e+01 & 1.90e+01 \\ 7.88e+01 & -6.45e+01 & 1.18e+02 & -1.50e+01 & -1.37e+02 & -3.06e+01 & -1.05e+02 & 3.98e+01 \\ 1.97e+01 & -7.81e+01 & 9.72e-01 & -7.23e+01 & -2.15e+01 & 8.13e+01 & 6.37e+01 & 5.90e+00 \end{bmatrix}$$

```
[[ 1.11875000e+03  4.40221926e+01  7.59190503e+01 -1.38572411e+02   3.50000000e+00  1.22078055e+02  1.95043868e+02 -1.01604906e+02]
 [ 7.71900790e+01  1.14868206e+02 -2.18014421e+01  4.13641351e+01   8.77720598e+00  9.90829620e+01  1.38171516e+02  1.09092795e+01]
 [ 4.48351537e+01 -6.27524464e+01  1.11614114e+02 -7.63789658e+01   1.24422160e+02  9.55984194e+01 -3.98287969e+01  5.85237670e+01]
 [-6.99836647e+01 -4.02408945e+01 -2.34970508e+01 -7.67320594e+01   2.66457750e+01 -3.68328290e+01  6.61891485e+01  1.25429731e+02]
 [-1.09000000e+02 -4.33430857e+01 -5.55436908e+01  8.17347083e+00   3.02500000e+01 -2.86602437e+01  2.44149822e+00 -9.41437025e+01]
 [-5.38783591e+00  5.66345009e+01  1.73021519e+02 -3.54234494e+01   3.23878249e+01  3.34576728e+01 -5.81167864e+01  1.90225615e+01]
 [ 7.88439693e+01 -6.45924096e+01  1.18671203e+02 -1.50904840e+01  -1.37316928e+02 -3.06196663e+01 -1.05114114e+02  3.98130497e+01]
 [ 1.97882438e+01 -7.81813409e+01  9.72311860e-01 -7.23464180e+01  -2.15781633e+01  8.12999035e+01  6.37103782e+01  5.90618071e+00]]
```

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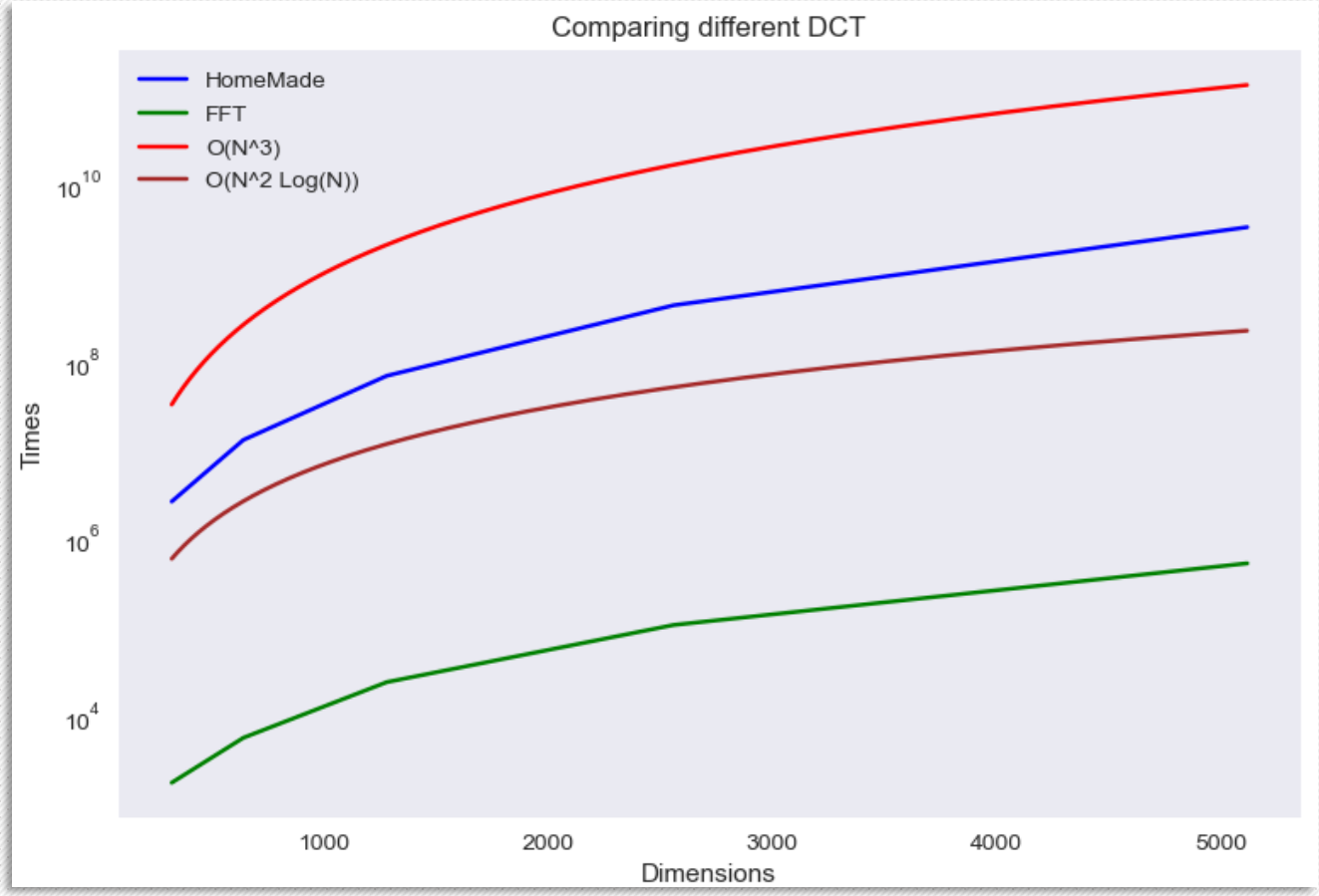
Confronto tempistiche con FFT

$$\begin{bmatrix} 320 \times 320 \\ 640 \times 640 \\ 1280 \times 1280 \\ 2560 \times 2560 \\ 5120 \times 5120 \end{bmatrix}$$



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Compressione delle immagini tramite DCT

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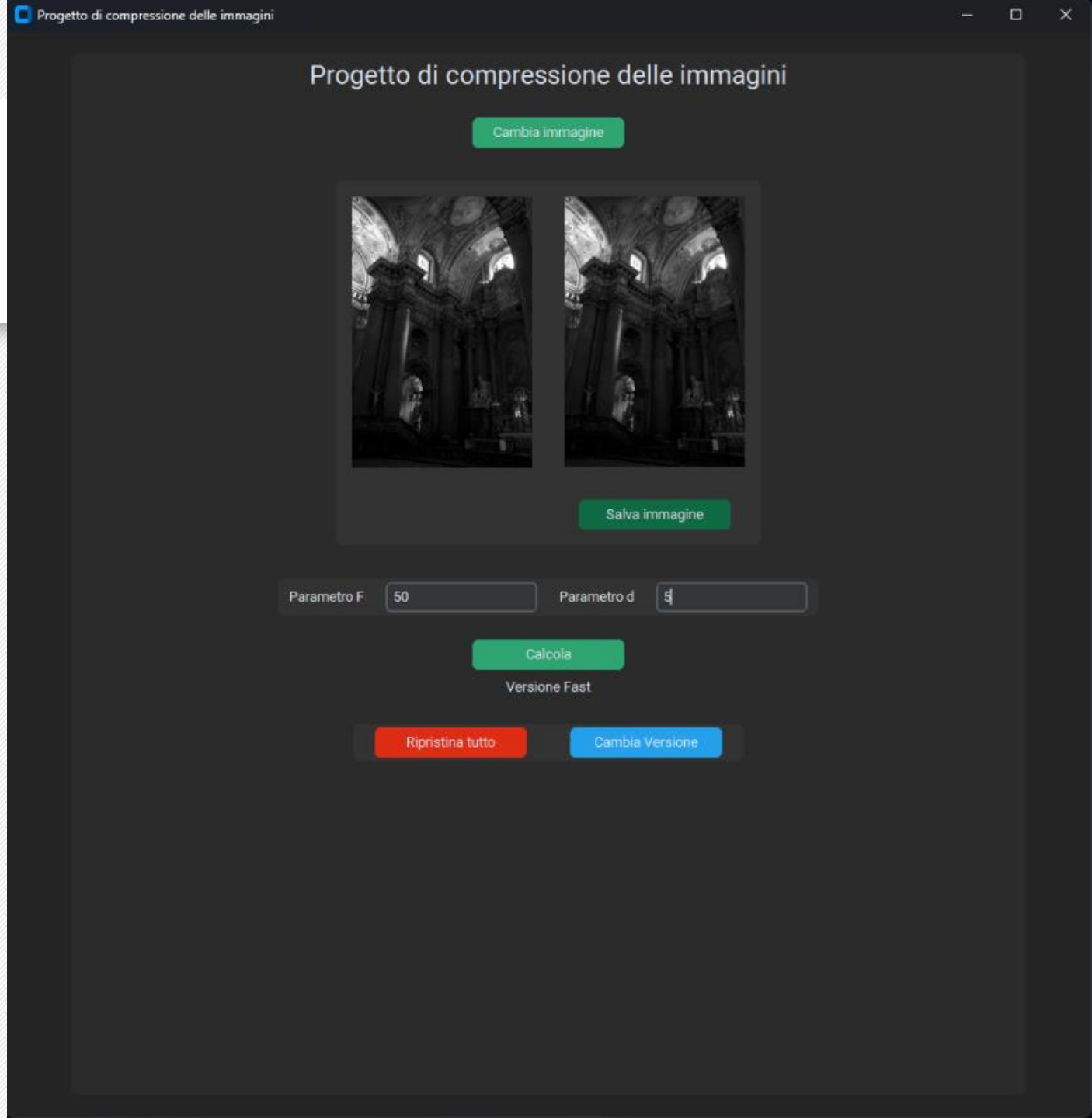
Interfaccia

- **F** → Ampiezza Macroblocchi
  - Compreso tra 1 e min(width, heigth)
- **d** → soglia di taglio delle frequenze
  - Compreso tra 0 e (2F-2)

- Versioni disponibili:
  - cv2 (FFT)
  - Custom



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Processamento

Suddivisione immagini in blocchi FxF

Processamento per ogni blocchi

Ricostruzione immagine

Applicare DCT2

Taglio delle frequenze sotto a d

Applicare IDCT2

Riportare i valore nel range [0;255]

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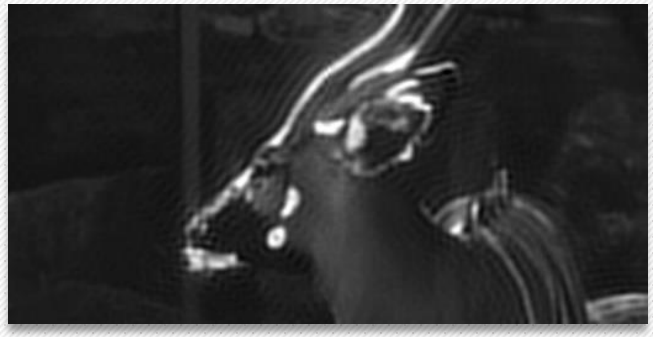
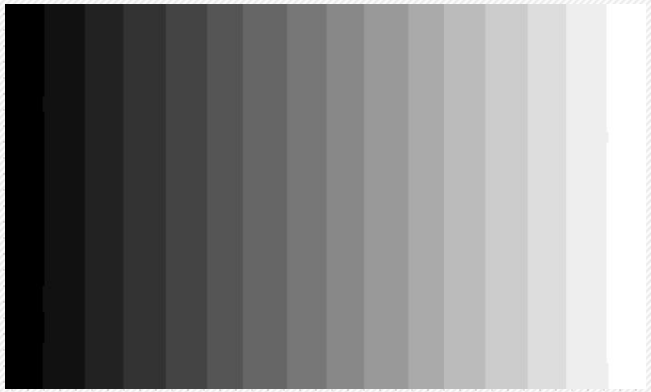
Parametri F e d



F = 500 d = 80

F = 500 d =230



F = 500
d = 80

Grazie per l'attenzione

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