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по направлению 01.03.04 « »

Студент _____ . .

Руководитель,

, ..-.. _____ . .

– 2018

Оглавление

Введение

2017 [mobileUsers]. , , . - - , , . . -, .
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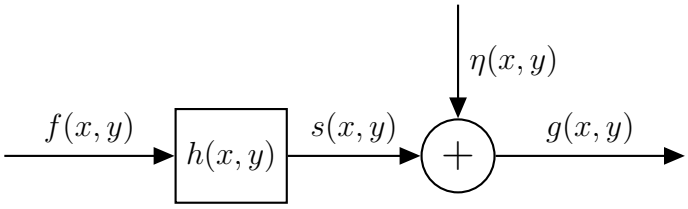
1.1.

— . () — . $f(x,y)$, $0 \leqslant x \leqslant M$, $0 \leqslant y \leqslant N$ (M, N —). $0 \leqslant f(x,y) \leqslant 1$.



. 1.1.

$f(x,y)$ — ; $g(x,y)$ — ; $h(x,y)$ — () ; $\hat{f}(x,y)$ — $f(x,y)$; $\eta(x,y)$ — . $F(u,v)$, $G(u,v)$, $H(u,v)$, $N(u,v)$ - $f(x,y)$, $g(x,y)$, $h(x,y)$ $\eta(x,y)$, [gonsalesDigital2012]. , $g(x,y)$ [gonsalesDigital2012]

$$g(x,y) = h(x,y) **f(x,y) + \eta(x,y), \tag{1.1}$$

$< ** >$ — $f(x,y)$ $M \times N$ $h(x,y)$ $m \times n$, [gonsalesDigital2012]:

$$h(x,y) **f(x,y) = \sum_{s=-a}^{a} \sum_{t=-b}^{b} h(s,t) f(x-s, y-t), \tag{1.2}$$

$a = (m-1)/2$ $b = (n-1)/2$.

1. (- ,) .

$$\delta(n,m) = \begin{cases} 1, n = m = 0 \\ 0, n \neq 0, m \neq 0 \end{cases}$$

.

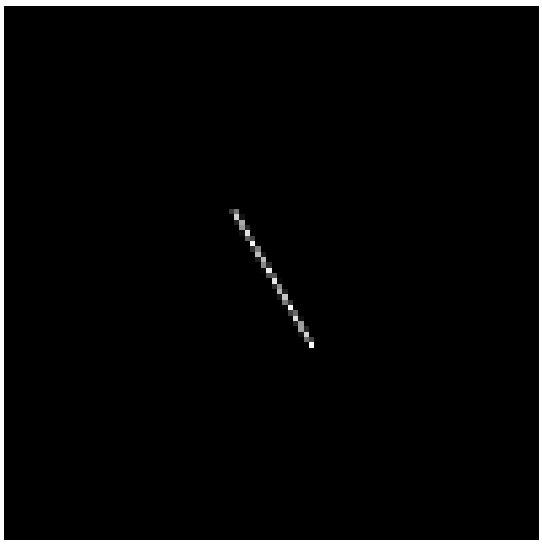
, $f(x,y)$ - , 1.1. $f(x,y)$ $h(x,y)$, . - , , . (1.1) :

$$G(u,v) = H(u,v) \cdot F(u,v) + N(u,v), \tag{1.3}$$

[basicsOfDigitalDataProcessing2016Umnyashkin]

. , , . [iterableImageRestorationBiemonLangdeik]:

$$h(x,y) = \begin{cases} \frac{1}{L+1}, & 0 \leqslant y \leqslant L, x = 0 \\ 0 \end{cases}, \tag{1.4}$$



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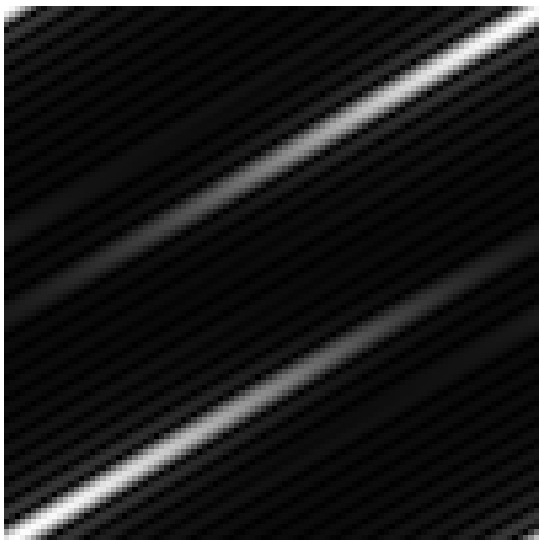

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. 1.2. 30 240°

L — , (), , . (1.4) — .
[iterableImageRestorationBiemonLangdeik]:

$$H(u,v) = \frac{1}{L+1} e^{-i\frac{L\pi}{N}m} \frac{\sin\frac{\pi(L+1)u}{N}}{\sin\frac{\pi u}{N}} \tag{1.5}$$

(1.2) 30 240°. 30°. - (1.5) $\frac{N}{L+1}k, v,\ k = \pm1, \pm2, ...$, 1.2, 1/40. 1.2, [iterableImageRestorationBiemonLangdeik].

1.2.

— , . : .
I_1, I_2 , () MSE(mean square error)

$$MSE = \frac{1}{MN} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} |I_1(i,j) - I_2(i,j)|^2 \tag{1.6}$$

PSNR(peak signal to noise ratio) , MSE:

$$PSNR = 20 \log_{10} \left(\frac{MAX_I}{\sqrt{MSE}} \right), \tag{1.7}$$

MAX_I — .

() — 10 () PSNR=19.21

. 1.3. 512×512 c . : — 10 , 240°, — $\sigma_\eta = 10^{-3}$

1.2.1.

, (1.3) $\hat{F}(u,v)$ [gonsalesDigital2012]:

$$\hat{F}(u,v) = \frac{G(u,v)}{H(u,v)}. \tag{1.8}$$

(1.3) (1.8) ,

$$\hat{F}(u,v) = F(u,v) + \frac{N(u,v)}{H(u,v)} \tag{1.9}$$

: , (1.9) . , , .

1.2.2.

— . , , , . : . : $\hat{f}$ f, e .

:

$$\hat{F}(u,v) = \left(\frac{1}{H(u,v)} \frac{|H(u,v)|^2}{|H(u,v)|^2 + K} \right) G(u,v), \tag{1.10}$$

K — , , .

(1.10), , K , .

() — () 15 PSNR=16.51

. 1.4. 512×512 c . : — 15 , 240°, — $\sigma_\eta = 10^{-3}$

1.2.3.

, . — . [gonsalesDigital2012]:

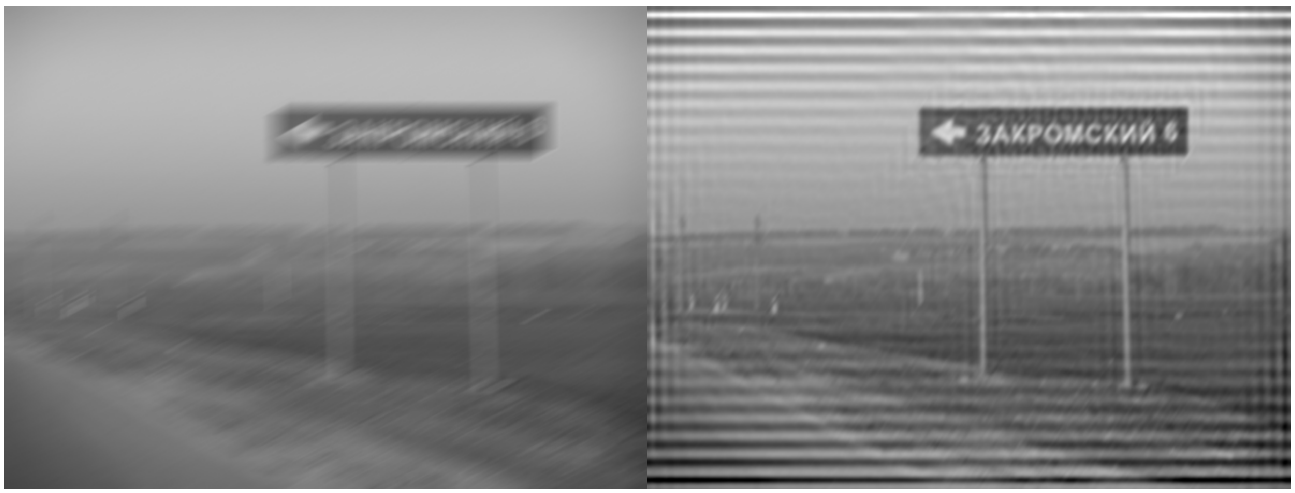
$$\hat{F}(u,v) = \left(\frac{H^*(u,v)}{|H(u,v)|^2 + \gamma |P(u,v)^2} \right) G(u,v) \tag{1.11}$$

γ ( ) . $P(u,v)$ — $\nabla^2 = \left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)$:

$$p(x,y) = \begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix} \tag{1.12}$$

$\gamma = 0$. 1.5 . , $h(x,y)$. , , . . . (1974)[lucy] . . (1972)[richardson]. , . $\hat{f}_{k+1}(x,y)$ $(k+1)$- - :

$$\hat{f}_{k+1}(x,y) = \hat{f}_k(x,y) \left(h(-x,-y) ** \frac{g(x,y)}{h(x,y) ** \hat{f}_k(x,y)} \right) \tag{1.13}$$



() — () 20 PSNR=45

. 1.5. 450×600 c . : — 20 , 56°, — $\sigma_\eta = 0.003$

1.2.4. -

1.2.5.

1.3.

2

2.1.

2.1.1.

2.1.2.

2.2.

2.2.1.

2.2.2.

2.2.3.

2.2.4.

2.3.

3

3.1.

3.2.

3.2.1.

3.2.2. « »

3.3.

Заключение

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