input:

• I: (M, N)

• p: (M, N)

• size = 2 * r + 1

output:

• q: (M, N)

$$ar{I}(i,j) = E[I](i,j) = rac{\sum \limits_{\Delta x = -r o r} I(i+\Delta x,j+\Delta y)}{[2r+1]^2} \ ar{p}(i,j) = E[p](i,j) = rac{\sum \limits_{\Delta x = -r o r} p(i+\Delta x,j+\Delta y)}{[2r+1]^2}$$

and

$$E[I^2](i,j) = rac{\sum \limits_{\Delta x = -r o r} I^2(i+\Delta x,j+\Delta y)}{\sum \limits_{\Delta y = -r o r} I \cdot p(i+\Delta x,j+\Delta y)} \ E[I \cdot p](i,j) = rac{\sum \limits_{\Delta x = -r o r} I \cdot p(i+\Delta x,j+\Delta y)}{[2r+1]^2}$$

then **goal 1**:

$$\sigma^2[I](i,j) = E[I^2](i,j) - E^2[I](i,j) \ \cos[Ip](i,j) = E[Ip](i,j) - E[I](i,j)E[p](i,j)$$

Define

$$egin{aligned} a(i,j) &\equiv rac{ ext{cov}[Ip](i,j)}{\sigma^2[I](i,j) + \epsilon} \ b(i,j) &\equiv E[p](i,j) - rac{ ext{cov}[Ip](i,j)}{\sigma^2[I](i,j) + \epsilon} E[I](i,j) \end{aligned}$$

calc

$$egin{aligned} ar{a}(i,j) &= E[a](i,j) = rac{\sum \limits_{\Delta x = -r
ightarrow r} a(i+\Delta x,j+\Delta y)}{\Delta y = -r
ightarrow r} \ ar{b}(i,j) &= E[b](i,j) = rac{\sum \limits_{\Delta x = -r
ightarrow r} b(i+\Delta x,j+\Delta y)}{\Delta y = -r
ightarrow r} \ ar{b}(i,j) &= E[b](i,j) = rac{\Delta x = -r
ightarrow r}{\Delta y = -r
ightarrow r} \end{aligned}$$

In the end **goal 2**:

$$q(i,j) = E[a](i,j) imes I(i,j) + E[b](i,j)$$