1. IMGN1
   1. *roipoly*

Circle

Description automatically generated



Icon

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* 1. minimal CNR

From the CNR calculated, we can confidently distinguish *all* structures by eye starting ***CNR >= 10.9***.

Circle

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With smaller size tissues, we need higher CNR.

MTF is the Fourier transform of the PSF. For small spatial changes 🡪 need higher resolution/contrast, or a higher one-value-concentrated PSF (like a Dirac delta) 🡪 need more data further out in frequency space 🡪 Larger MTF

A transfer function that rolls off to **lower values** at **higher spatial frequencies**

* **Small structures** need to be identified at **higher spatial frequencies**.
* worth noting that beyond a certain point **(CNR ~ 20),** our eyes don't seem much improvement 🡪 but if analyzed these images numerically, the statistically ability to distinguish different tissues improves AS CNR increases.

1. IMG2
   1. Convolution & magnitude Fourier spectrum

|  |  |  |  |
| --- | --- | --- | --- |
| Filter/PSF | Effect | Result | Magnitude Fourier spectrum |
| h1 | blurred |  |  |
| h2 | More blurred |  |  |
| h3 | Less bright/contrast |  |  |

* 1. Spectrum explain

We see h1 & h2 have a shape resembling a Gaussian filter, which suppress high & bump low frequencies, thus blur the image when perform convolution. The opposite is seen in the h3 PSF, where high frequencies are encouraged when apply convolution.

c. 2D delta would acts as the ‘identity’ PSF

This can be understood easily from point of view of a 1-D dirac delta, where a 1D convolved signal with the delta function stays unchanged.

Chart, histogram

Description automatically generated

|  |  |
| --- | --- |
|  |  |

* 1. Since the “identity” point spread function is a 2D delta function, its 2D Fourier transform takes most/as much frequencies in the frequencies domain to construct the image, so we see the sum of frequencies displayed on the magnitude spectrum, at the color close to value 0.

Chart, histogram

Description automatically generated

3. Create PSF that:

a. Perform 3x3 integral of an area

b. Perform first derivative in x-direction