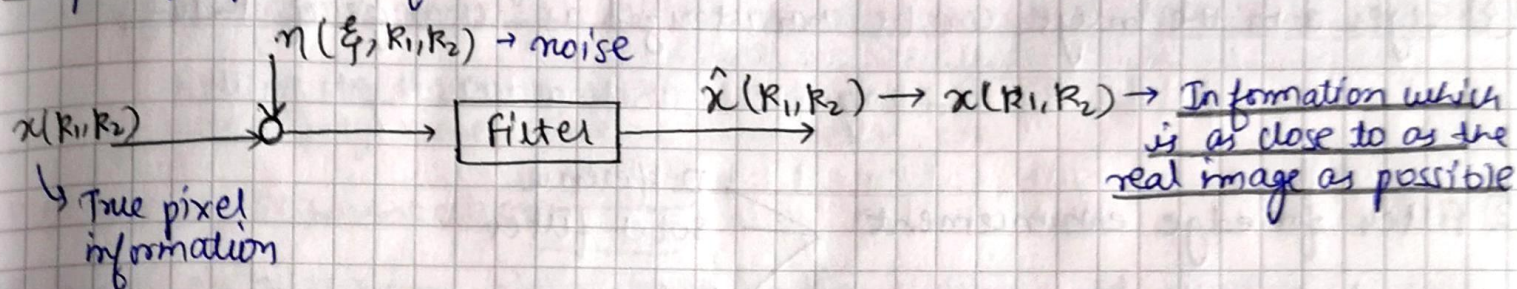
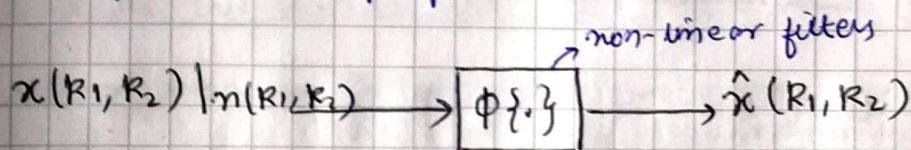


Noise suppression and edge enhancement

- ① When considering noise models, it is very important to know the image acquisition setup (i.e. how is our image being captured)
- ② Noise models can be distinguished by:
 - ① Kind of application of the noise
 - additive
 - multiplicative
 - replacing
 - ② Influence of noise in frequency domain
 - high frequent (scratches)
 - low frequent (shading)
 - broadband (broadband gaussian noise)
- ③ The additive noise model is used in linear signal processing and for the design of optimal filters.



- ④ For replacing noise, i.e. a noise which cannot be represented as additive or multiplicative superposition, there cannot be a optimal criterion.



- ⑤ Additive noise → We usually get a shaded image, meaning more illumination on 1 side and less illumination on other side.
→ modelled as grey slope.
- ⑥ multiplicative noise → The shading would remain the same independent from our image acquisition settings.
 - It's an external noise, additional information coming from outside to our image.
 - The modelling of multiplicative noise is inherent to the image acquisition process.
 - Eg. Vignetting effect: multiplicative because it is dampening the information at the corners (multiplication by 0. ...) at corners and maximum (1) at centre.

⑦ Removal of noise

- ✓ Additive noise → subtraction of noise model

$$\hat{x}(R_1, R_2) = x(R_1, R_2) - n(\xi, k_1, k_2)$$

- ✓ multiplicative noise → subtraction of logarithmic signals

$$\log(\hat{x}(R_1, R_2)) = \log(x(R_1, R_2)) - \log(n(\xi, k_1, k_2))$$

- ✓ Replacing noise → linear & non-linear filters
Eg. high pass, low pass, median.

⑧ Replacing noise → salt & pepper noise,

- ✓(1) It is generated by pixel errors, sensor noise, scratches or dust on the objective.
- ✓(2) It is irregularly distributed in size and shape as well as in spatial position.
- ✓(3) To remove this kind of noise, low pass filters or non-linear rank order operators (median filter) are used.

Edge enhancement

- ① Before segmentation, we want to detect the edges of objects in the image.
- ② Edges in the image can be characterized as "change of texture".

③ Filter for edge enhancement

└─ Difference
└─ Sobel filter
└─ LoG

④ Canny edge detector → It is an operation.