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Lecture-5

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Histogram equalisation is not ideally equalised uniformly but relatively better than original

$$s = (L-1)\sum_{0}^{r} p_r(r)$$

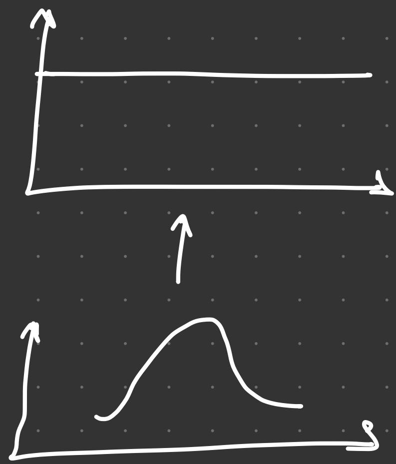
Derivation:

$$s = T(r)$$

$$p_s(s) = p_r(r)\frac{dr}{ds}$$

$$p_s(s)\,ds = p_r(r)\cdot dr$$

$$\frac{ds}{L-1} = p_r(r)\,dr$$



$$ds = (L-1)\,p_r(r)\,dr$$

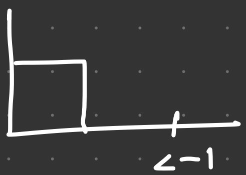
On integration,

$$s = (L-1)\int_{0}^{r} p_r(w)\,dw$$

Example:

Original:

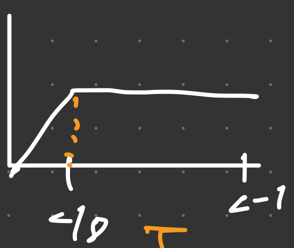
$r \rightarrow$



output

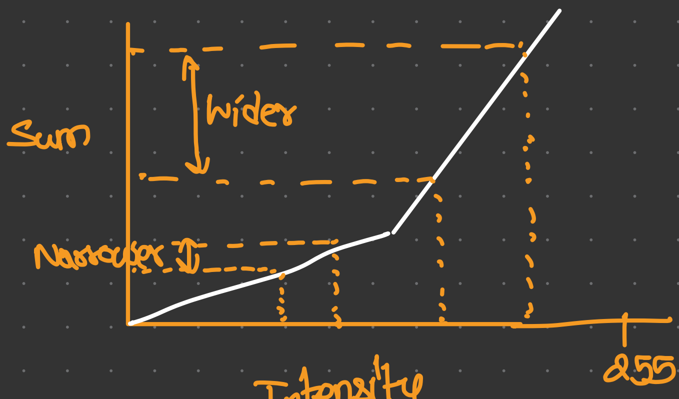
$\leftarrow s$

Transform



T

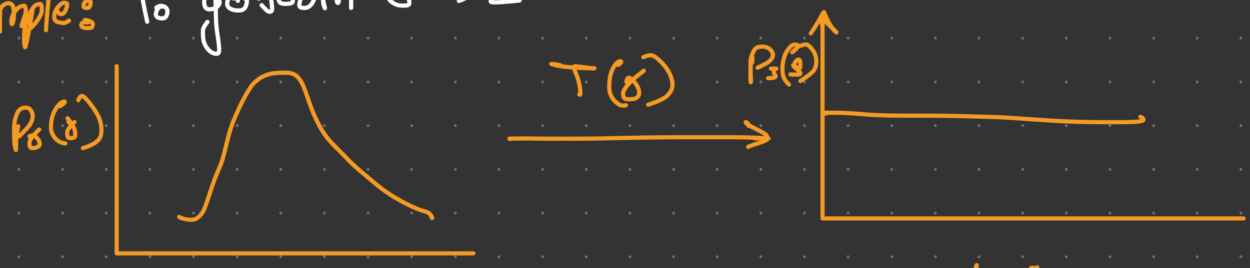
Multiple r can be mapped to single s.

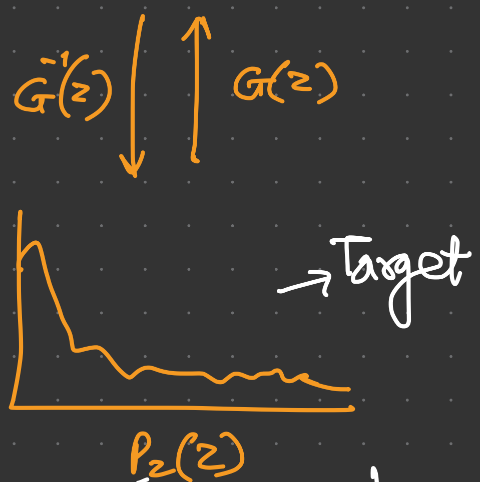


Cumulative Histogram

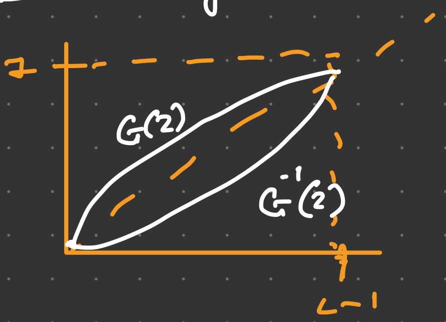
Histogram equalisation may not always work well for all images

Example: To go from $r \rightarrow z$





Inverse is taken by reflection about $y=x$ axis



If r maps to multiple s then inverse mapping can create an issue as we're not sure which r it should be mapped to?

Example
$$\left.\begin{aligned} s_5 &= 7 \\ s_6 &= 7 \\ s_7 &= 7 \end{aligned}\right\}$$
Not sure which value 7 will be mapped to

Solution possibilitys: → Map to smaller
→ Map to random
→ Average

Histogram specification (custom curve)

Tweak figure by changing control points

Histogram specification [Style Transfer]

Obtain curve from reference image and apply to original image

Histogram Processing [Global Attribute to point]

Histogram processing is also essentially point to point

1) Not dependent on image size (after normalisation)

2) Draw backs:
   - → No spatial info
   - → Intensity centric
   - → Raw (Unnormalised): Img.-size dependent

3) Equalisation:
   - → Normalisation approach
   - → Improves global contrast [could also increase noise]

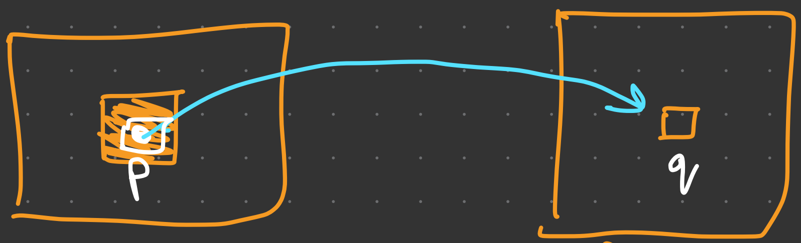
Pt → Pt → Intensity Transform

Global → Pt Histogram equalisation

Neighbourhood to point:

→ Value to value but transform functions takes neighbourhood too

→ Dependent on whole neighbourhood



$$q = T(\underbrace{N(p)}_{\text{Neighbourhood of } p})$$

Local Hist. Processing :

- → Map small regions and do histogram equalisation [can overlap too]
- → Window by window basis

Cond. Image Enhancement :

- → Enhance certain dark or light images by defining threshold and conditioned on statistics
- → Use some statistical parameters [local & global] like mean, threshold of dark & light

$$k_2 \sigma^2(r) < \sigma^2(S_{xy}) < k_1 \sigma^2(r)$$