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# IPCV Assignment 7

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2) **Morphology**

→ Given :

- $A_B(f) = (f \oplus B) - f$
- $B_B(f) = f - (f \ominus B)$
- $C_B(f) = (f \oplus B) - (f \ominus B)$
- $D_B(f) = A_B(f) - B_B(f)$

(a) 1-D signal $f = (\ldots, 0, 0, 0, 0, 1, 1, 1, 1, \ldots)^T$
Also the structuring element is of size 3

i) $A_B(f) = (f \oplus B) - f$

→ $A_B(f) = (\ldots 0, 0, 0, 1, 1, 1, 1, 1, \ldots)^T - (\ldots, 0, 0, 0, 0, 1, 1, 1, 1, \ldots)^T$

$= (\ldots, 0, 0, 0, 1, 0, 0, 0, 0, \ldots)^T$ ✓

ii) $B_B(f) = f - (f \ominus B)$

→ substitute values of $f$ & $f \ominus B$

$B_B(f) = (\ldots, 0, 0, 0, 0, 1, 1, 1, 1, \ldots)^T - (\ldots, 0, 0, 0, 0, 0, 1, 1, 1, \ldots)^T$

$= (\ldots, 0, 0, 0, 0, 1, 0, 0, 0, \ldots)^T$ ✓

iii) $C_B(f) = (f \oplus B) - (f \ominus B)$

$C_B(f) = (\ldots 0, 0, 0, 1, 1, 1, 1, 1, \ldots)^T - (\ldots 0, 0, 0, 0, 0, 1, 1, 1, \ldots)^T$

$= (\ldots, 0, 0, 0, 1, 1, 0, 0, 0, \ldots)^T$ ✓

iv) $D_B(f) = A_B(f) - B_B(f)$

$\rightarrow D_B(f) = \big(\big((f \oplus B) - f\big) - \big(f - (f \ominus B)\big)\big)$

$= (f \oplus B) - 2f + (f \ominus B)$

$= (\ldots, 0, 0, 0, 1, 1, 1, 1, 1, 1, \ldots)^T - 2(\ldots, 0, 0, 0, 0, 1, 1, 1, 1, \ldots)^T + (\ldots, 0, 0, 0, 0, 0, 1, 1, 1, \ldots)^T$

$= (\ldots, 0, 0, 0, 1, -1, 0, 0, 0, \ldots)^T$ ✓

(b) Applying/state linear shift-invariant filter on $A_B, B_B, C_B, D_B$

→ • For $A_B$ we can apply 'schwarzer zylinderhut' which extracts small dark structures

i.e $f(\cdot B) - f$

f

• $B_B$: we can use 'white top hat' to extract small bright structures

$f - (f \circ B)$

f

• $C_B$: we can apply 'self dual Top hat'

i.e $(f \cdot B) - (f \circ B)$

[extract both bright & dark details]

• $D_B$: We would have to take difference both 'Black top & white top hat'

i.e $= \big((f \cdot B) - f\big) - \big(f - (f \ominus B)\big)$

$= (f \cdot B) - 2f + (f \ominus B)$

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1) Structure Tensor Analysis:

→ (b) Since the tensor/second moment matrix is derived from the gradient of a function, we can't detect corners when $P = 0$, since it invariantly means applying guassian smoothing over the tensor