

Local Normalization

※ Wang, W., Fredrik Bergholm, and B. Yang. "Froth delineation based on image classification." *Minerals Engineering* 16.11 (2003): 1183-1192.

ISL

안재원

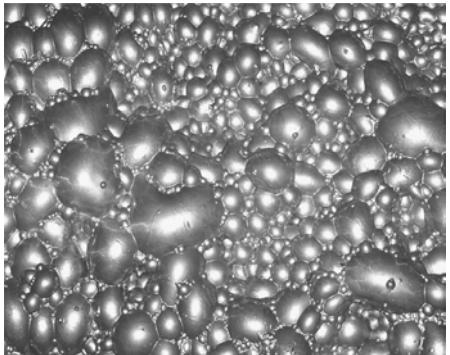
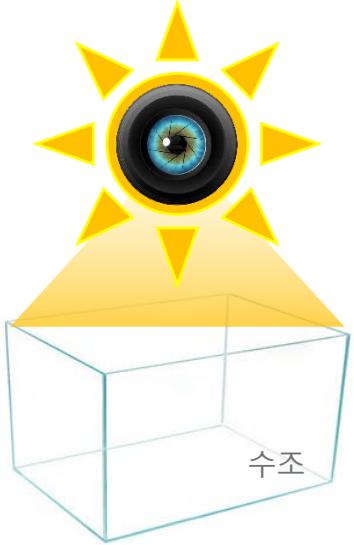
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Intro

Edge based bubble detection.

- 밝기 기반의 경계 검출



- 거품 영상과 Sobel operation 예시 영상.

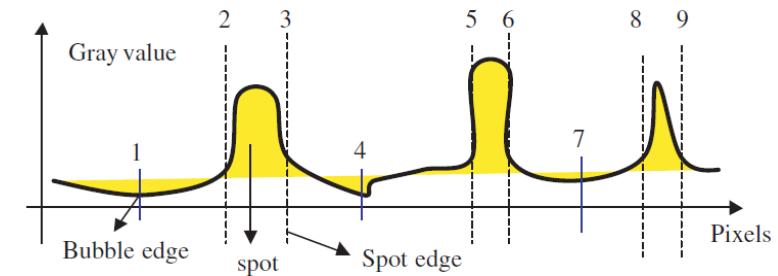
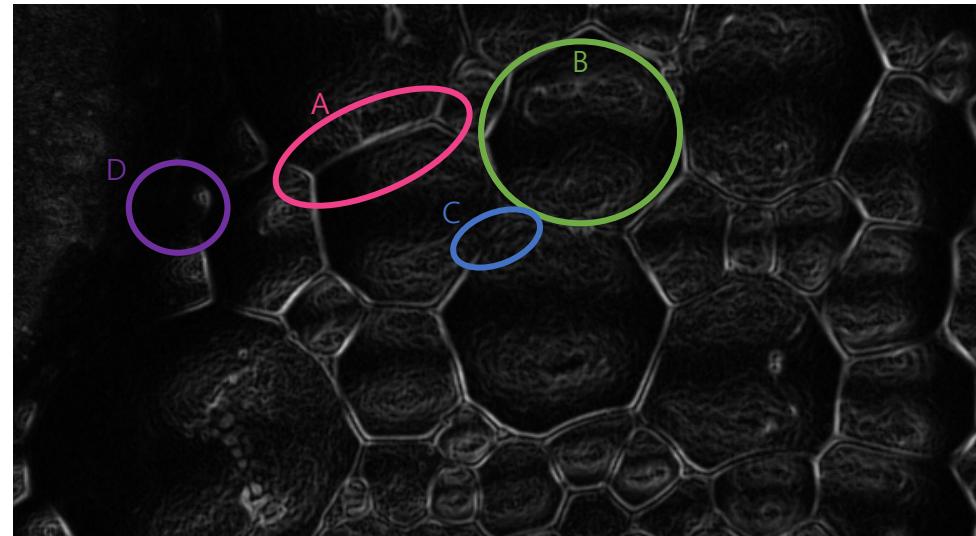
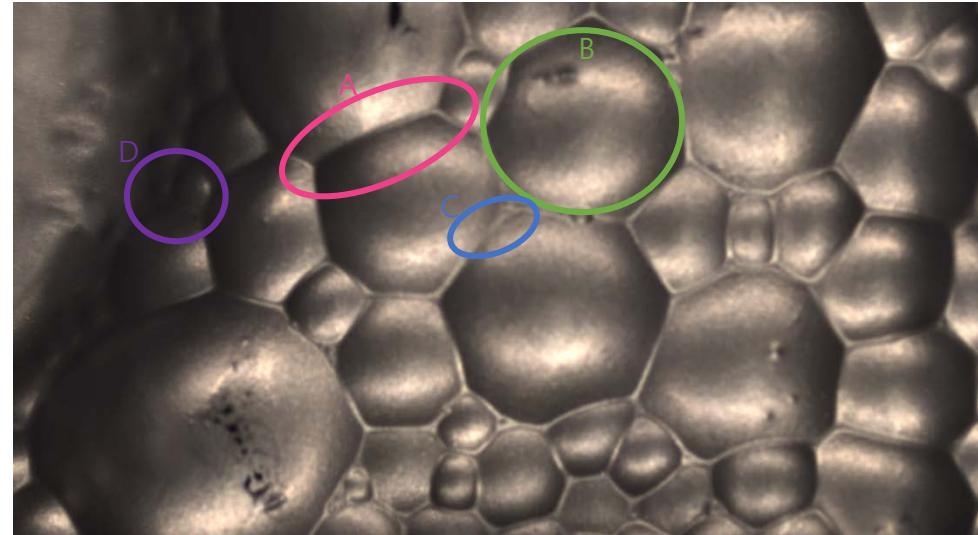


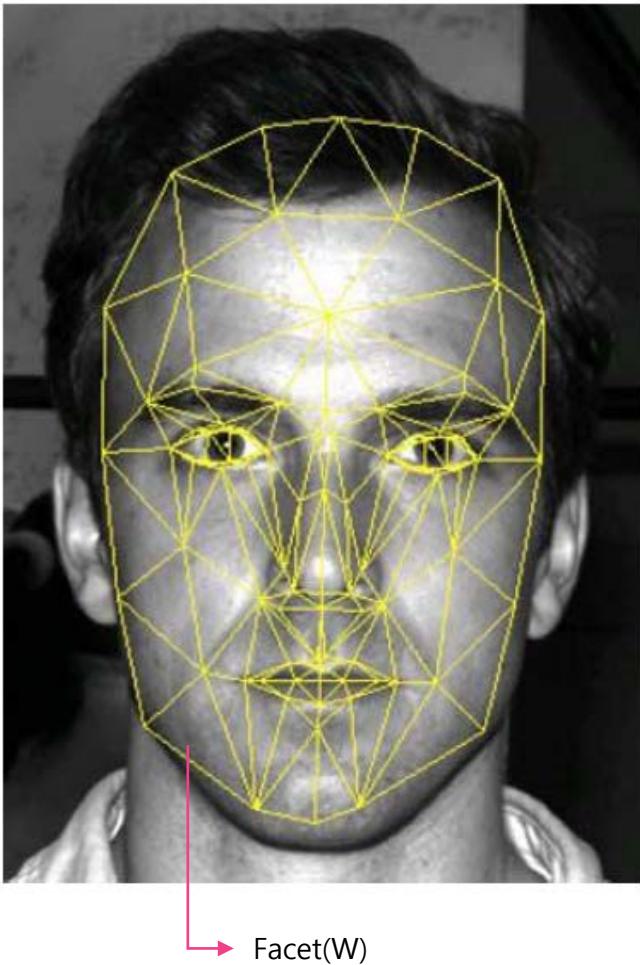
Fig. 6. Gray value versus pixels of a cross-section of a froth image.

- A : 거품의 경계가 검출된다.
- B : 조명 성분에 의한 노이즈를 확인 할 수 있다.
- C : 변화폭이 작아 경계가 명확하지 않다.
- D : 어두운 부분의 경계 검출은 힘들다.

Local normalization

Human face model and illumination model

- CANDIDE-3 model



획득 영상 $I(x, y) = p(x, y)n(x, y)s$

표면 방향(Surface normal direction) : 왼쪽 그림의 각 삼각형 모양의 평면의 노말 벡터
광원(Light source)
반사율

$I'(x, y) = A \cdot I(x, y)$ $A = \frac{n(x, y)s'}{n(x, y)s}$: illumination ratio

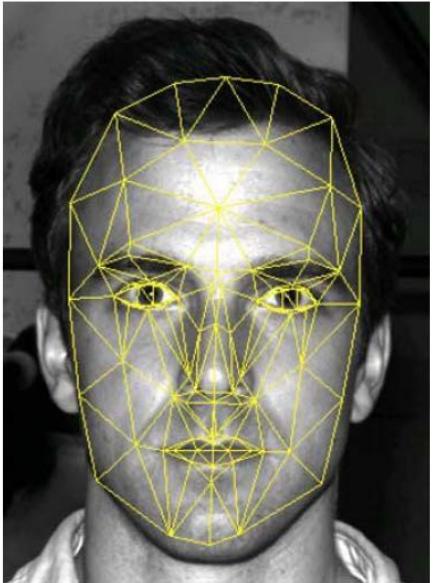
원하는 광원이 사용된 이미지 $I'(x, y) = p(x, y)n(x, y)s'$

원하는 광원

$I'(x, y) = A \cdot I(x, y) + B$: ill-posed problem.
노이즈 성분

Local normalization

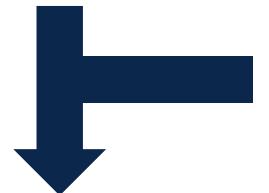
Local normalization



$$I'(x, y) = A \cdot I(x, y) + B$$

Intensity value : $I_p'(x, y) = \frac{I'(x, y) - E(I'(x, y))}{Var(I'(x, y))}$

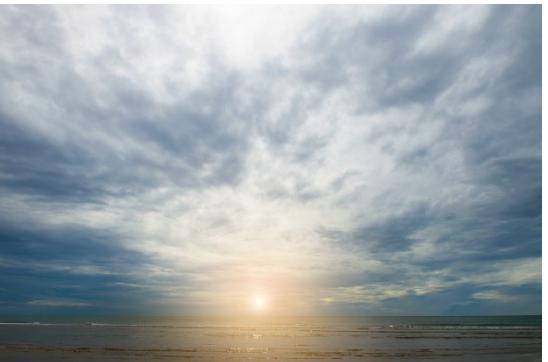
$$\begin{cases} E(I'(x, y)) = 0 \\ Var(I'(x, y)) = 1 \end{cases}$$



$$\begin{cases} E(A \cdot I(x, y) + B) = A \cdot E(I(x, y)) + B = 0 \\ Var(I'(x, y)) = \sqrt{\frac{\sum (I'(x, y) - E(I'(x, y))^2}{N}} = A \cdot \sqrt{\frac{\sum (I(x, y) - E(I(x, y))^2}{N}} = A \cdot Var(I(x, y)) = 1 \end{cases}$$

$$I_p'(x, y) = \frac{A \cdot I(x, y) + B - (A \cdot E(I(x, y)) + B)}{A \cdot Var(I(x, y))} = \frac{I(x, y) - E(I(x, y))}{Var(I(x, y))}$$

- Brightness vs Intensity



- Local normalization 결과



Local normalization

Depend on mask size.

- 마스크 사이즈를 3에서 13까지 변화 시켰을 때 결과 영상 비교.

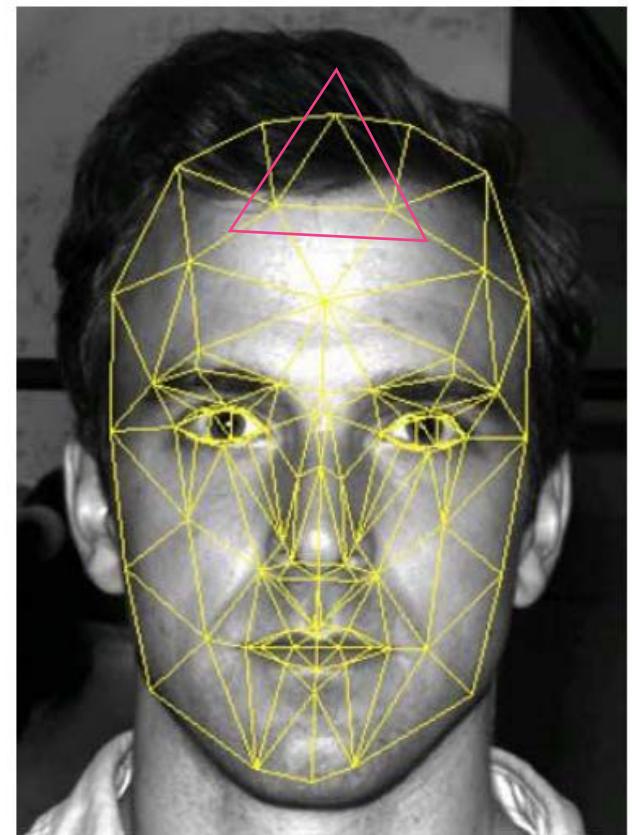


(a)



(b)

- 마스크 크기가 너무 작으면 $E(I(x,y))$ 와 $\text{Var}(I(x,y))$ 의 신뢰도가 낮기 때문에 노이즈가 많은 결과가 얻어진다.
- 마스크 크기가 너무 커도 $E(I(x,y))$ 와 $\text{Var}(I(x,y))$ 의 신뢰도가 낮아져 인식에 적합하지 않은 결과가 얻어진다.



$$I(x, y) = p(x, y)n(x, y)s$$

Result

Result

- 각 test set 이미지와 recognition 기법에 따른 결과 비교

Table 2

Face recognition results based on different databases using PCA

(%)	Yale	AR	YaleB	PIE	Combined
None	43.3	78.0	60.3	88.6	60.8
HE	50.0	81.0	63.3	96.8	68.4
LN	93.3	86.0	99.5	100.0	96.4
HE + LN	93.3	86.2	99.7	100.0	96.5

Table 3

Face recognition results based on different databases using ICA

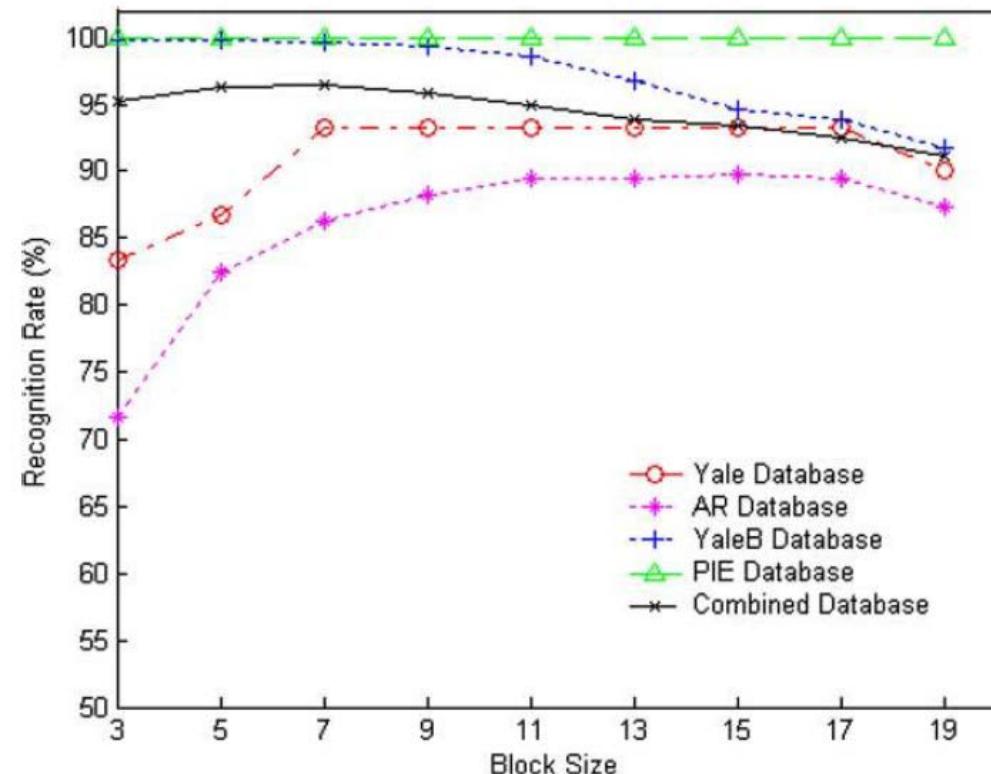
(%)	Yale	AR	YaleB	PIE	Combined
None	40.0	77.4	65.6	95.1	64.8
HE	53.3	78.5	72.0	97.5	75.4
LN	83.3	82.4	98.1	100.0	90.6
HE + LN	86.7	82.6	99.8	100.0	94.5

Table 4

Face recognition results based on different databases using Gabor wavelets

(%)	Yale	AR	YaleB	PIE	Combined
None	63.3	90.9	86.7	99.9	86.1
HE	73.3	94.5	98.4	100.0	90.8
LN	100.0	98.3	99.4	100.0	98.4
HE + LN	100.0	98.6	99.5	100.0	98.7

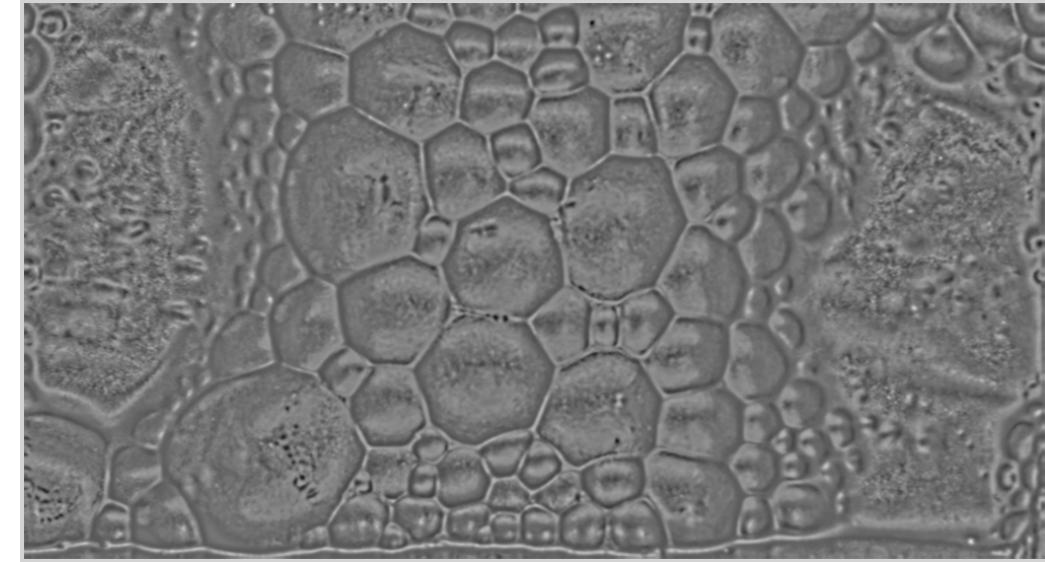
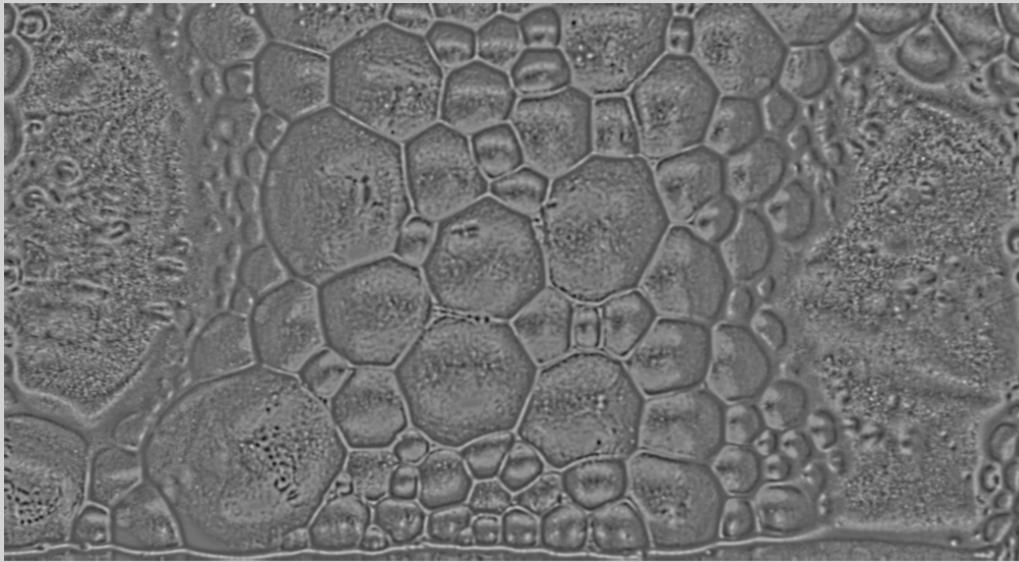
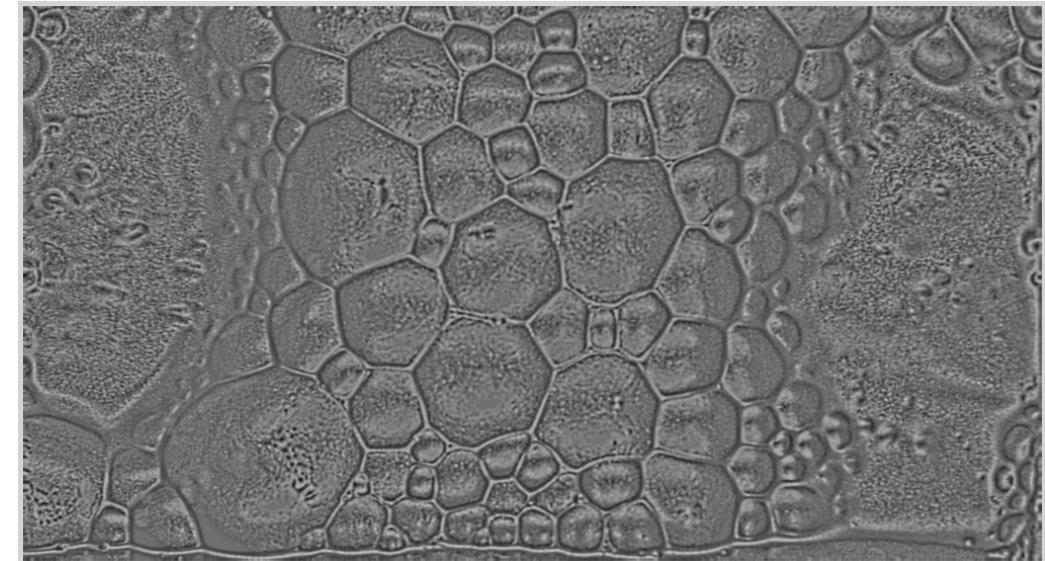
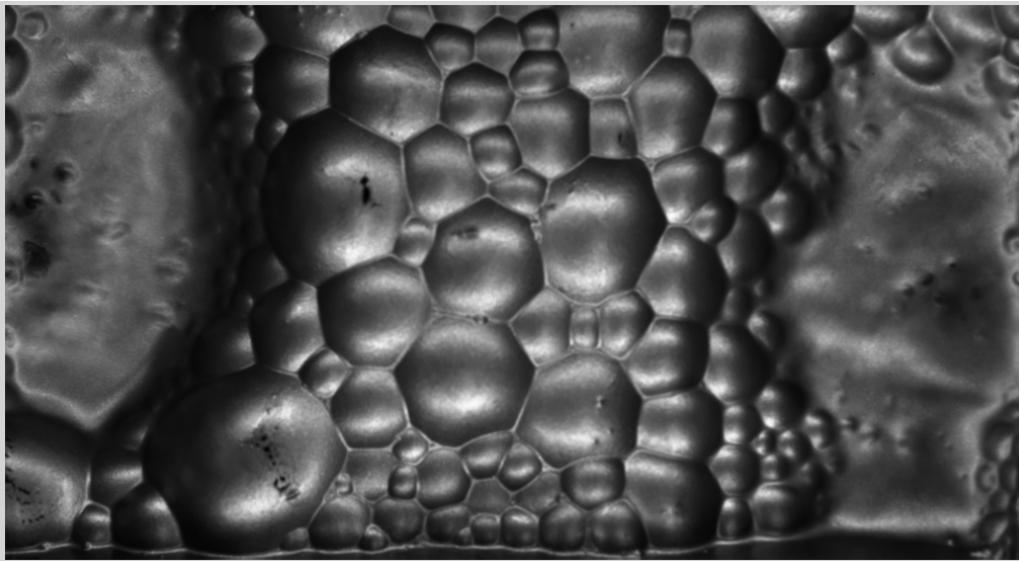
- Mask 크기에 따른 recognition rate.



Result

2019-04-09

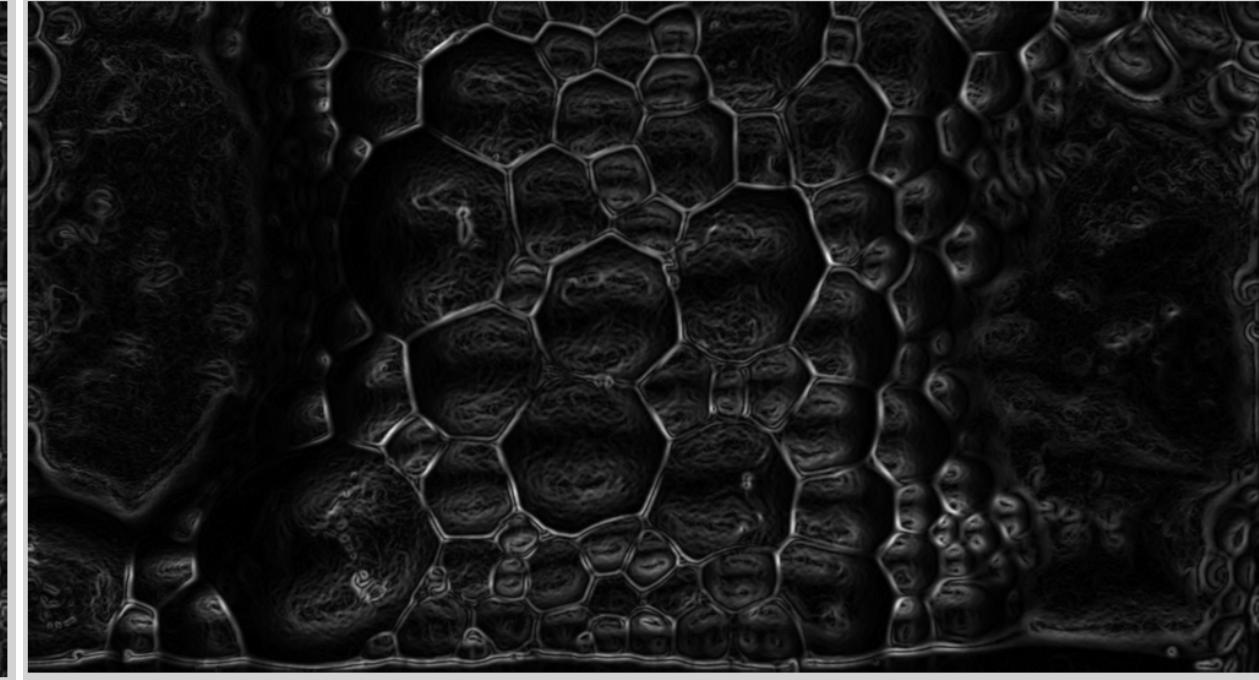
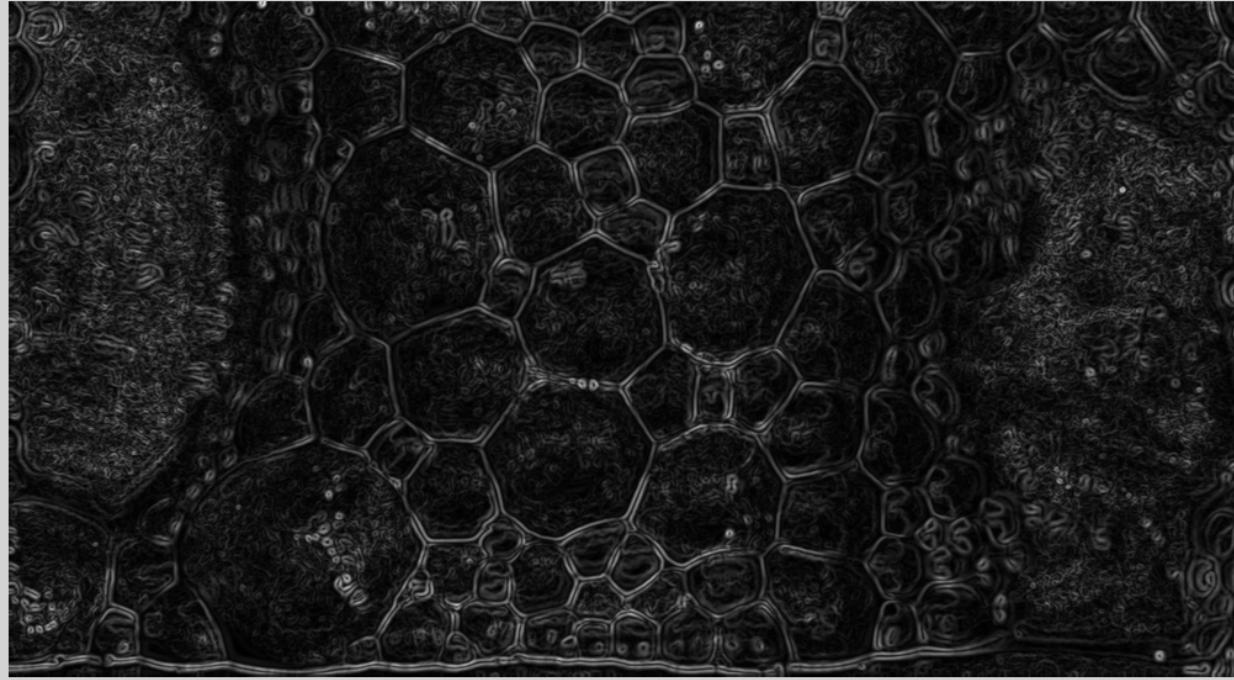
Result(마스크 사이즈 별 비교)



Result

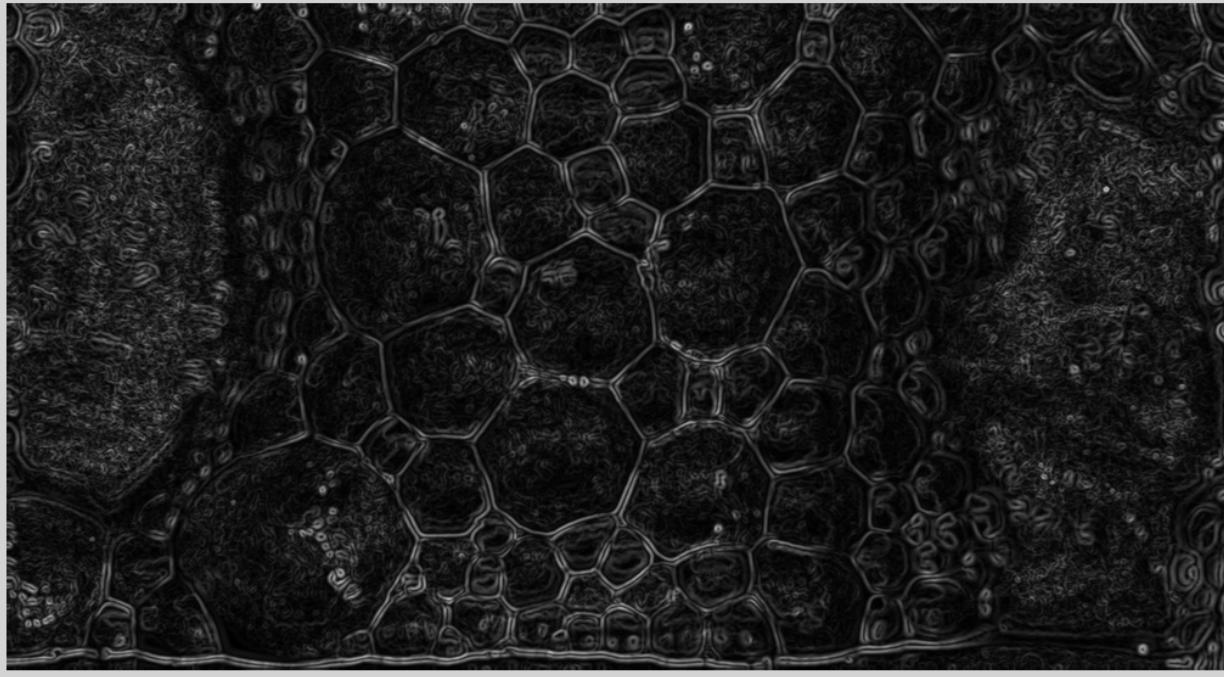
2019-04-09

Result(Sobel Operation 결과)

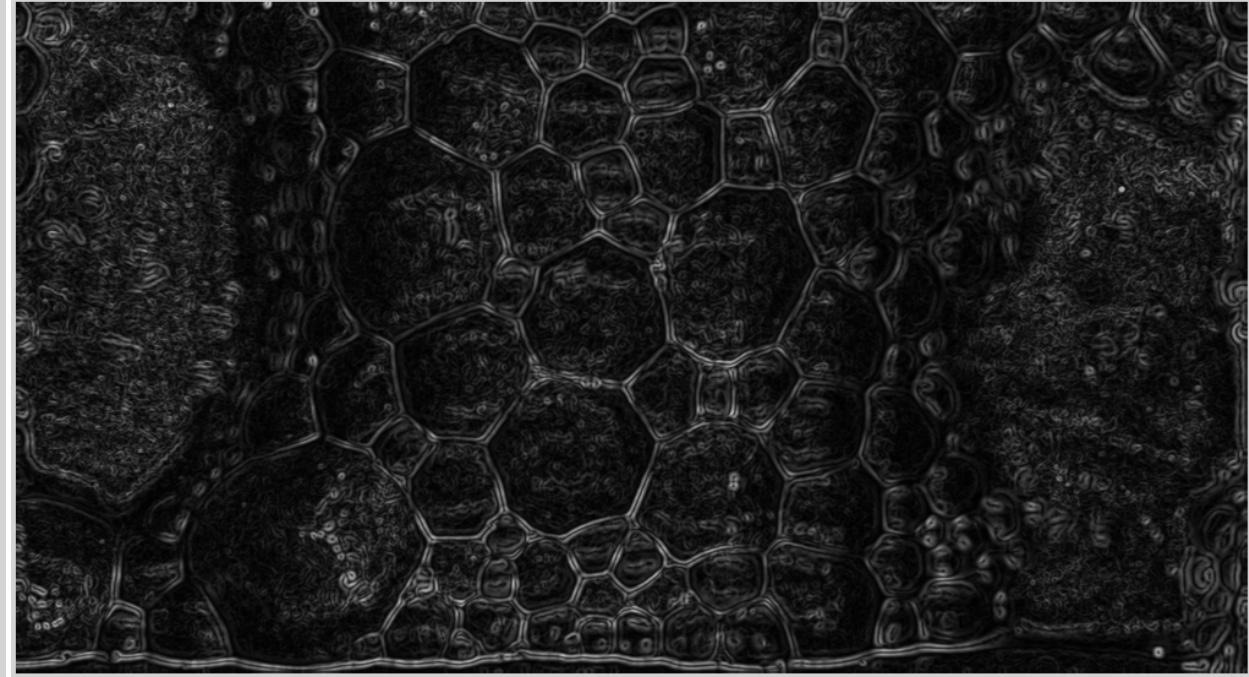


Result

Result(Histogram equalization 유무 비교)



With Histogram equalization

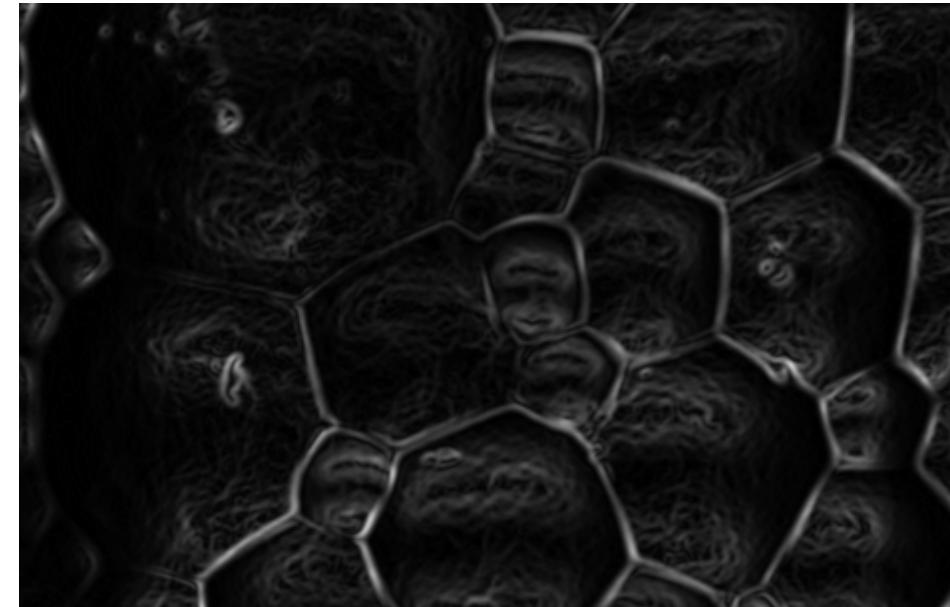
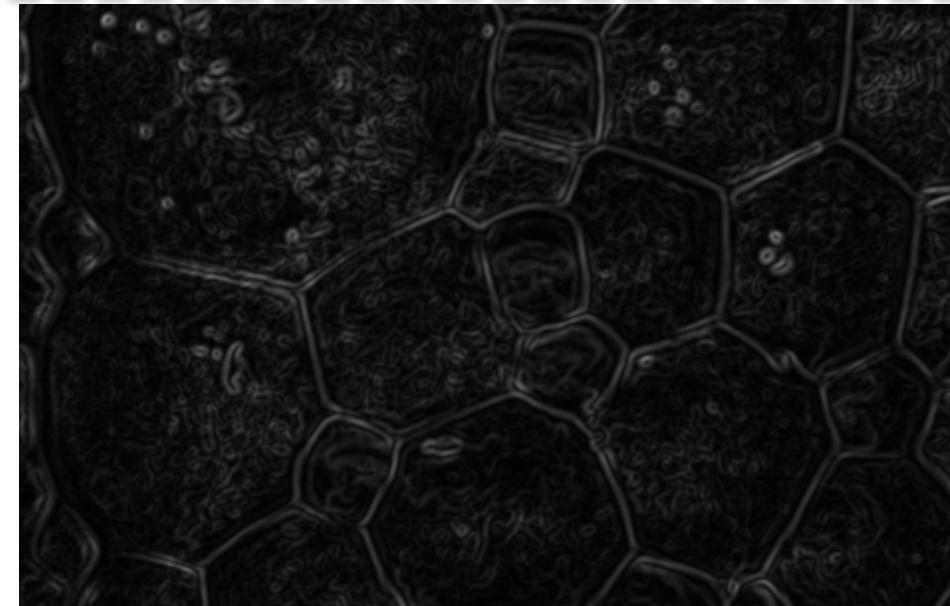
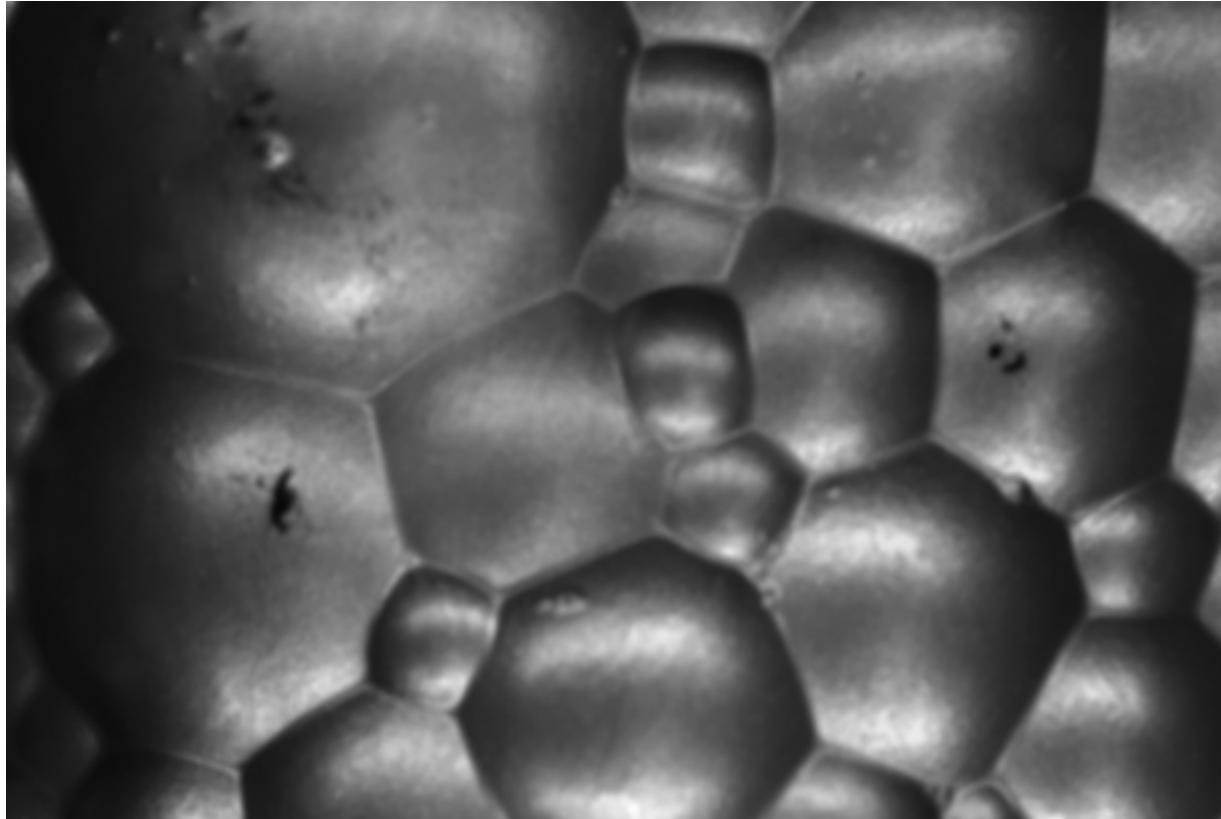


Without Histogram equalization

Result

2019-04-09

Result(다른 거품 영상)



Q & A
