

# SPATIAL-DOMAIN TEXTURAL FEATURES

## Co-occurrence Matrix Approaches

### A. Spatial Gray Level Dependence Matrix(SGLDM)

- Construct the co-occurrence matrix  
 $P(i, j | d, \theta) = \text{probability of going from gray level } i \text{ to gray level } j, \text{ given the intersample space } d \text{ and direction } \theta$

Gray level i \ Gray level j	0	1	2	...	255
0					
1					
2					
⋮					
255					



# Spatial Gray Level Dependence Matrix(SGLDM)

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➤ Design the measures

1. Energy: a measure of homogeneity

$$M_E = \sum \sum [P(i, j | d, \theta)]^2$$

*Uniform surface:  $P(i, j | d, \theta) = 1$  for some  $(i, j)$*

*and then  $M_E = 0$*

*Complicated surface:  $P(i, j | d, \theta)$  are small and*

*then  $M_E$  is large*

2. Inertia: a measure of the amount of local variations

$$M_I = \sum_i \sum_j [(i - j)^2 \cdot P(i, j | d, \theta)]$$

*A Large amount of local variation gives a large  $M_I$*



# Co-occurrence Matrix Approaches

## B. Gray Level Run Length Matrices(GLRLM)

- Construct the co-occurrence matrix

$P(i, r | \theta)$ : probability of runs of length  $r$ ,  
in some direction  $\theta$ , of gray level  $i$

Run length r \ Gray level i	0	1	2	...	W
0					
1					
2					
⋮					
255					



# Gray Level Run Length Matrices(GLRLM)

➤ Design the measures

1. Long run emphasis

$$M_L = \sum_i \sum_r r^2 \cdot P(i, r | \theta)$$

2. Short run emphasis

$$M_S = \sum_i \sum_r \left[ \frac{1}{r^2} \cdot P(i, r | \theta) \right]$$

3. Run length nonuniformity

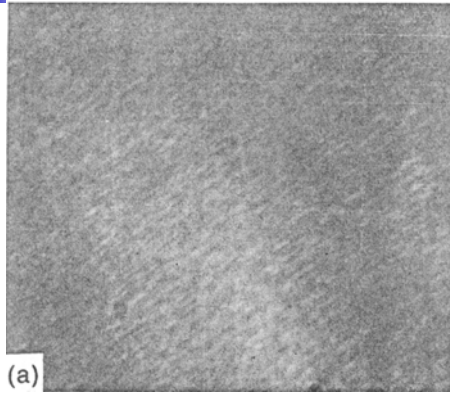
$$M_R = \sum_r \left[ \sum_i P(i, r | \theta) \right]^2$$

*M<sub>R</sub> is small when run lengths are evenly distributed.*

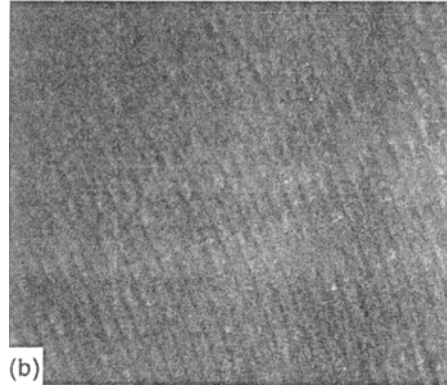
4. Gray level nonuniformity

$$M_G = \sum_i \left[ \sum_r P(i, r | \theta) \right]^2$$

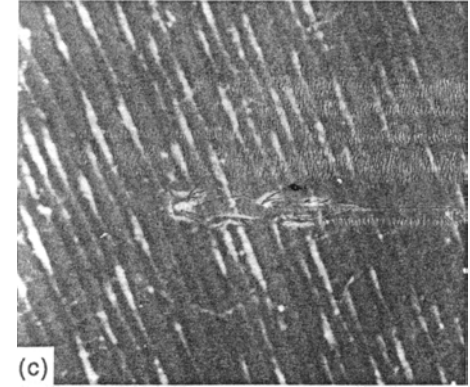
# Roughness of Machined Surfaces



Grinding



Milling



Shaping

