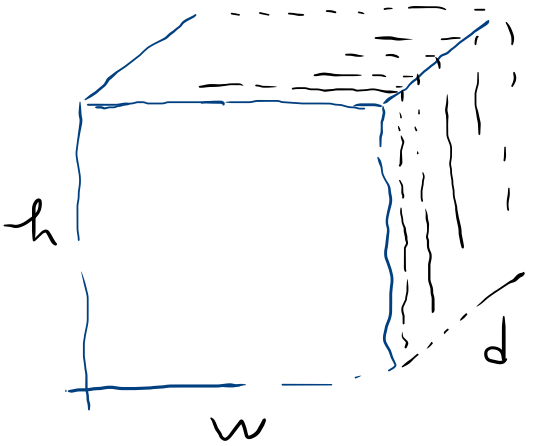
3D Images

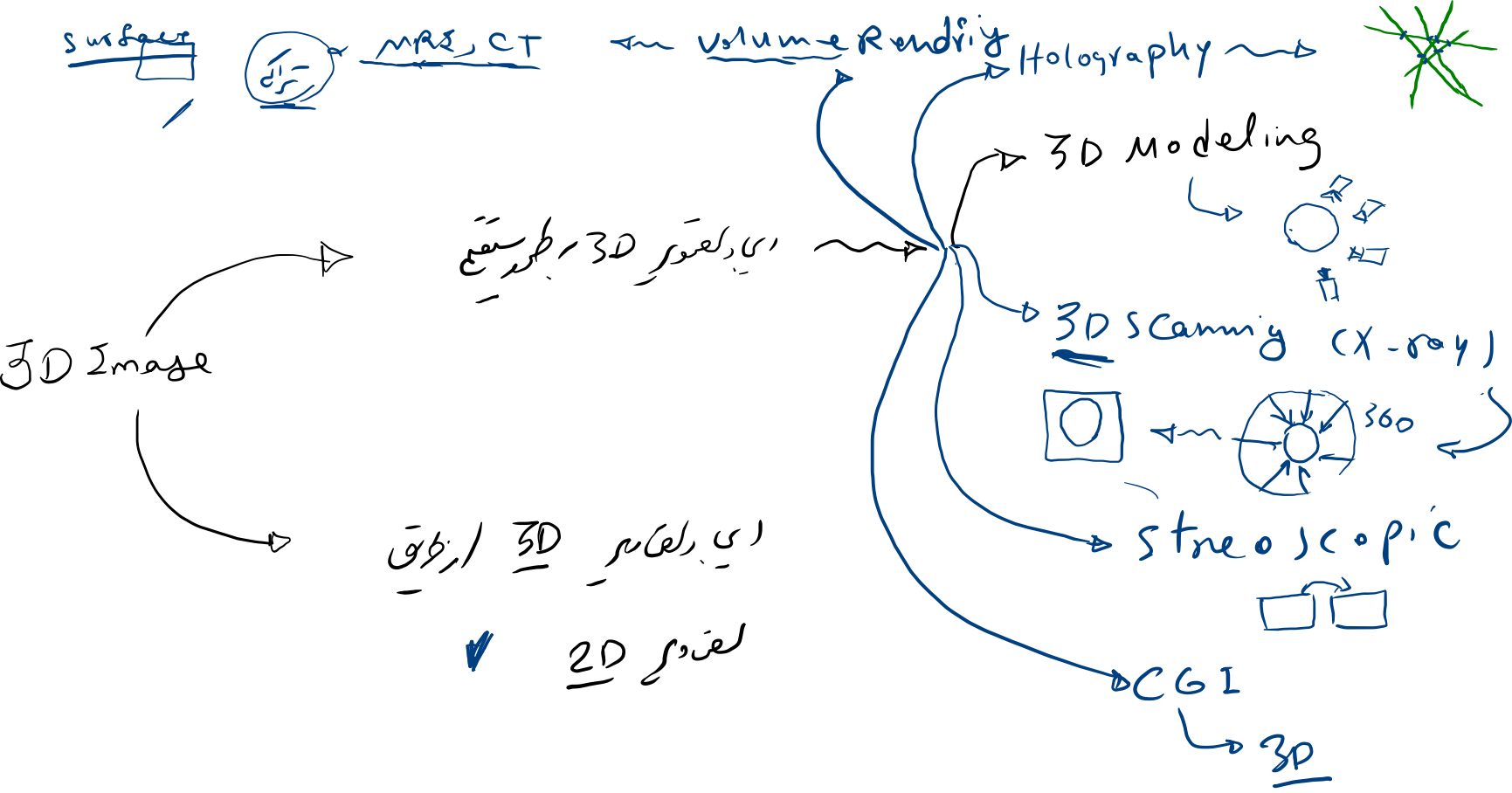
ref.

ch 13. Computer vision Szeliski

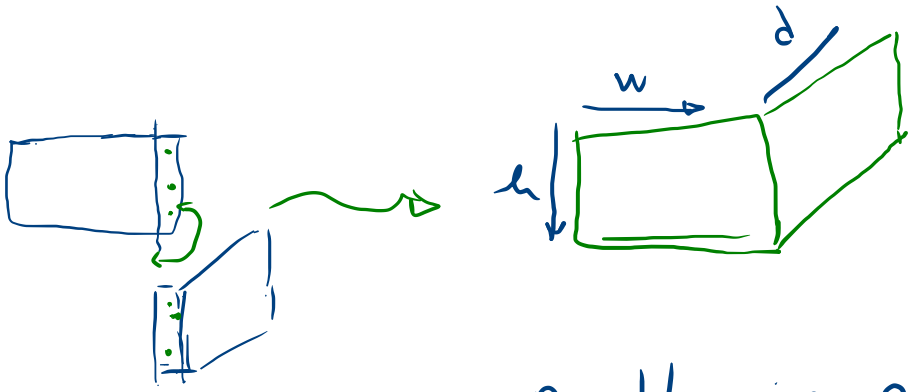
First principle of computer Vision

↳ three layer


h
w
d

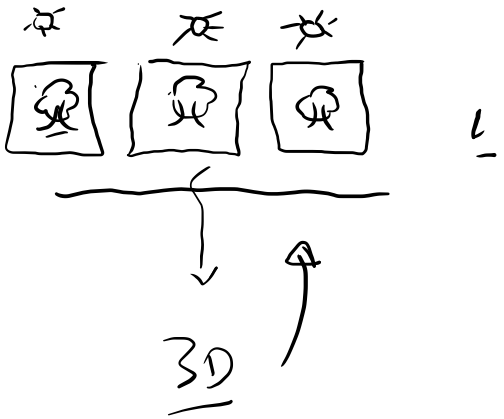

surface
MRI, CT
Volume Rendring
Holography
3D Modeling
3D Scanning (X-ray)
360
stereoscopic
CGI
3D
3D Image

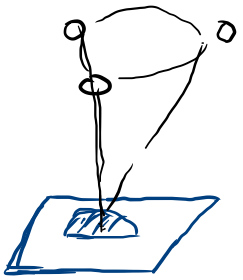
ایجاد تصویر 3D توسط تصویر 2D

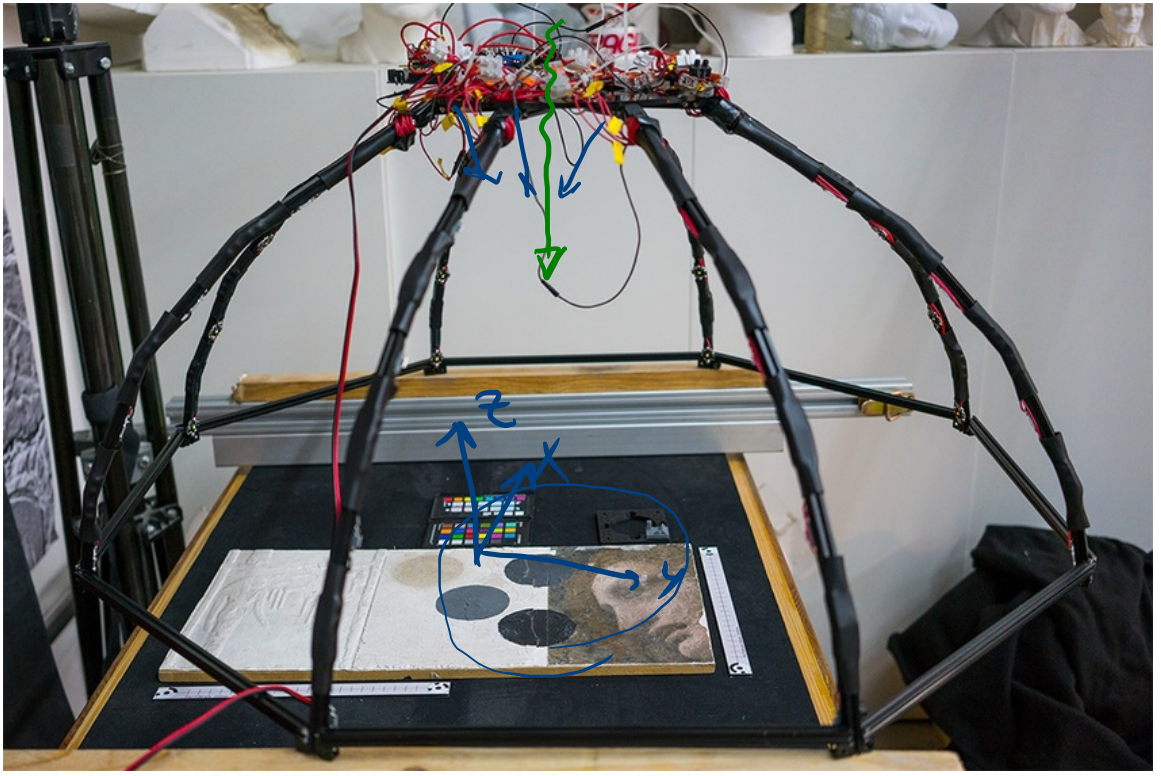


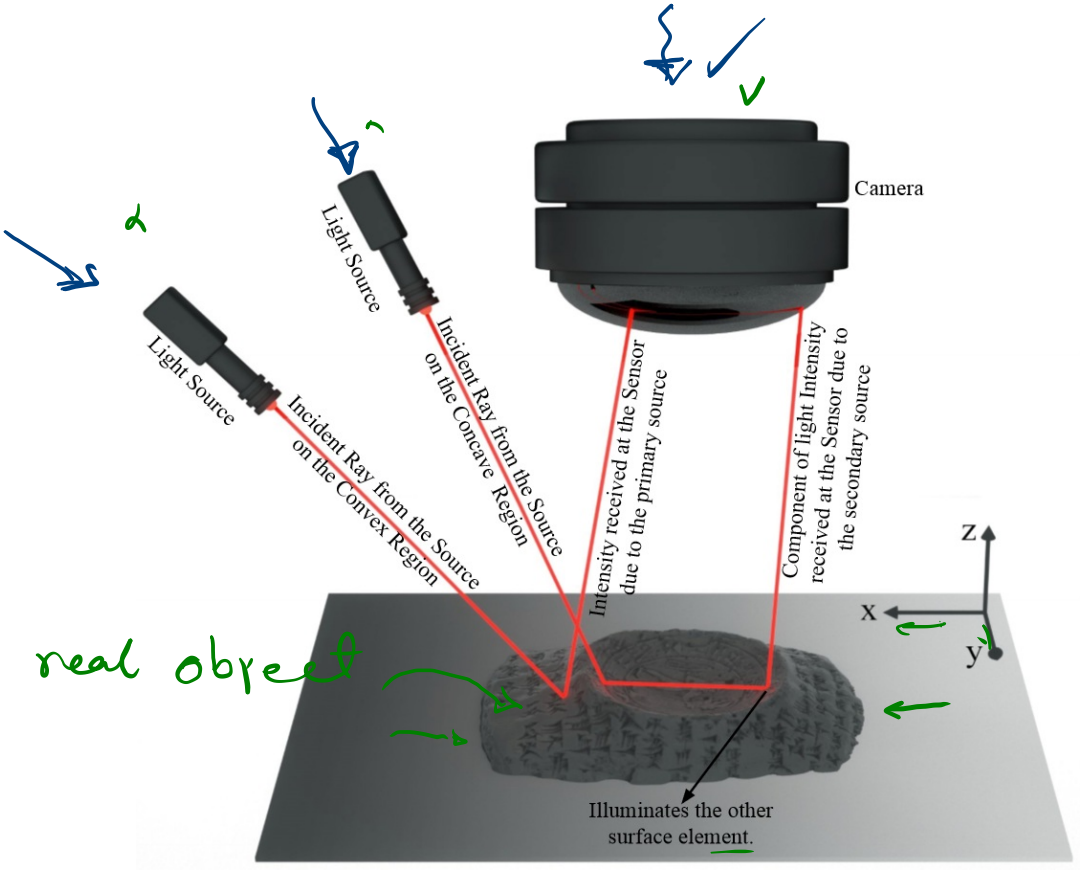
Depth map extraction!

photometric stereo





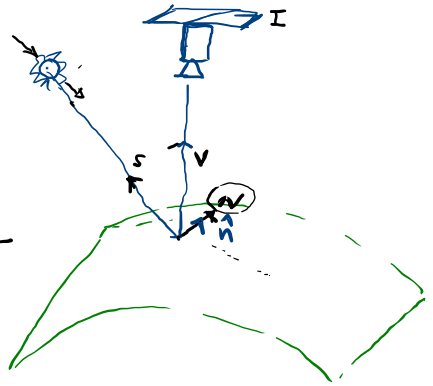

z
x
y


Camera
Light Source
Incident Ray from the Source on the Concave Region
Light Source
Incident Ray from the Source on the Convex Region
Intensity received at the Sensor due to the primary source
Component of light Intensity received at the Sensor due to the secondary source
z
x
y
Illuminates the other surface element.

Source.

s: unit vector

v: viewing direction



$z = f(x, y)$

$\nabla f(x, y) = \left(\frac{\partial f}{\partial x}(x_0, y_0), \frac{\partial f}{\partial y}(x_0, y_0) \right)$

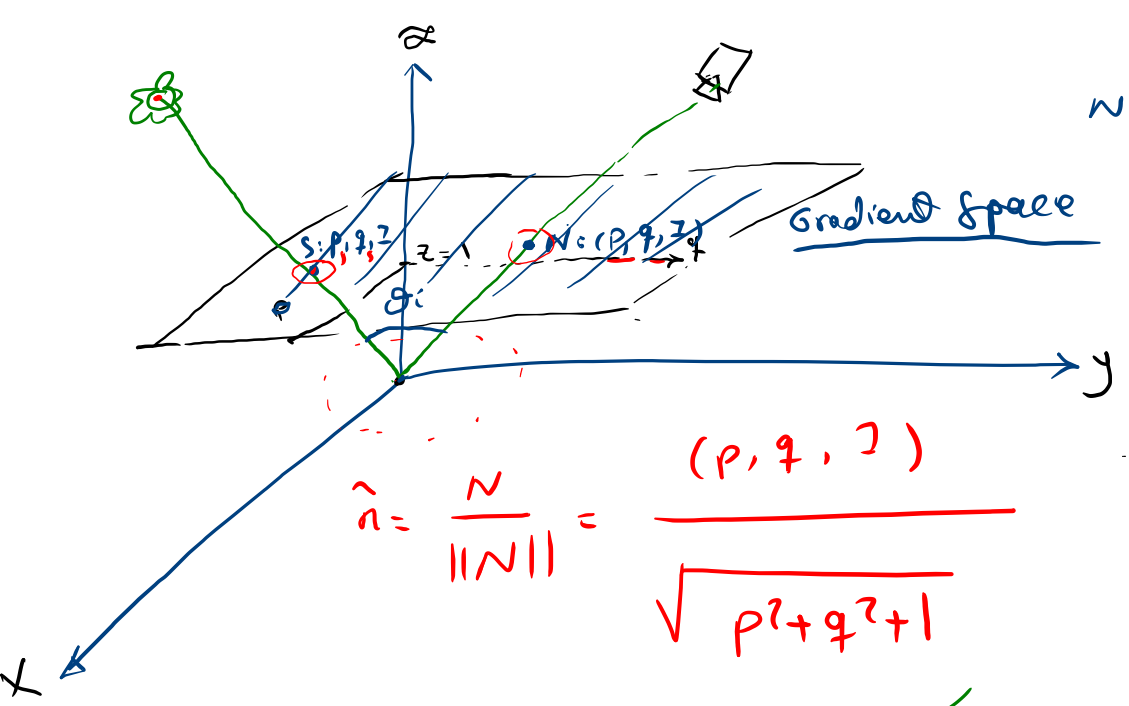
Surface Normal

$N = \left(-\frac{\partial z}{\partial x}, -\frac{\partial z}{\partial y}, \frac{\partial z}{\partial z} \right) \rightarrow N = \left(-\frac{\partial z}{\partial x}, -\frac{\partial z}{\partial y}, 1 \right)$

p q 1

$(p, q, 1)$

$\hat{n} = \frac{N}{\|N\|} = \frac{(p, q, 1)}{\sqrt{(p^2 + q^2 + 1)}}$



$N: (p, q, 1)$

Gradient Space

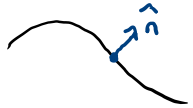
$x, y, z \rightarrow (p, q)$

$$\hat{n} = \frac{N}{\|N\|} = \frac{(p, q, 1)}{\sqrt{p^2 + q^2 + 1}}$$

$$\hat{s} = \frac{S}{\|S\|} = \frac{(p_s, q_s, 1)}{\sqrt{p_s^2 + q_s^2 + 1}}$$

Img
(x, y) ⟶ gradient space (p, q)

Reflectance map



$\hat{n} \cdot \hat{s} = |n| \, |s| \cos\theta_i$

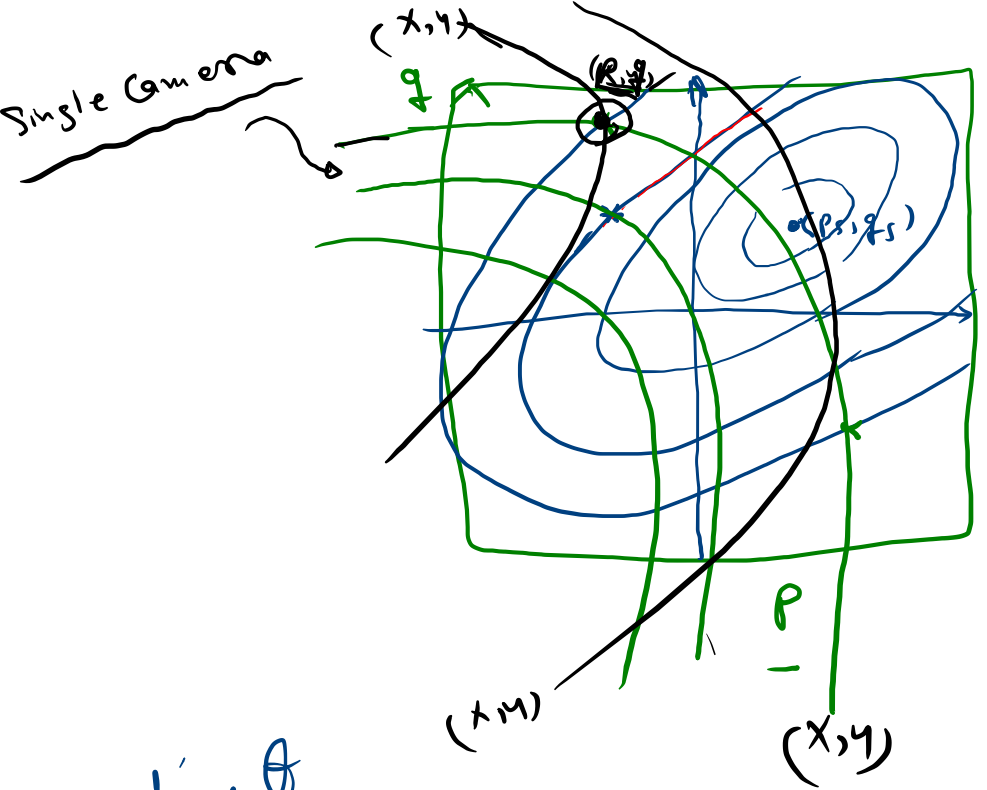
$1 \quad 1$

Equation

$$I(x, y) = \cos\theta_i = \hat{n} \cdot \hat{s}$$

px

$\cos\theta_i = I(x, y) = \hat{n} \cdot \hat{s} = \dfrac{pp_s + qq_s + 1}{\sqrt{p^2 + q^2 + 1}\sqrt{p_s^2 + q_s^2 + 1}}$



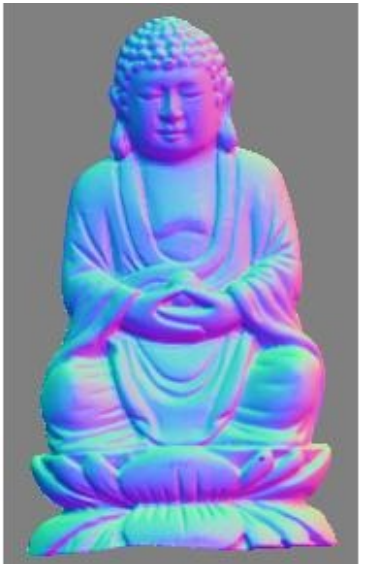
$\hat{n}$

$x, y \leftarrow \hat{n} \leftarrow p, q$

$p, q \rightarrow$ عکس تابع کانتورها

$n_x, n_y, n_z \leftarrow$ بردار نرمال

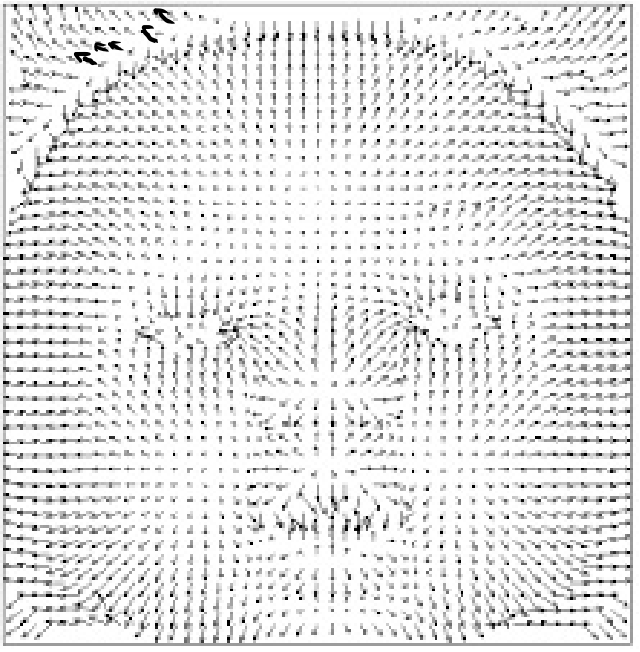
Gradient Space Reflectance map

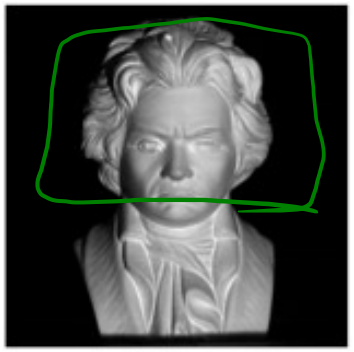





End

photometric stereo



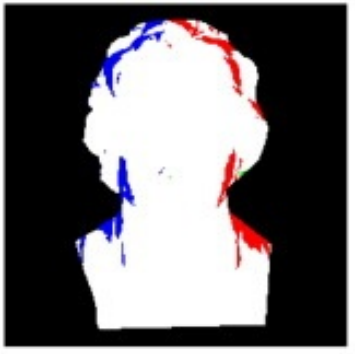


(a) I^1

(b) I^2

(c) I^3

(d)



(e)


img1
Img2
Img3
θ=60
θ=120
θ=180