IMAGE GRADIENT

HYUN SOO PARK
**Image Partial Differential**

\[ I \]

\[ \frac{\partial I}{\partial u} \]

\[ \frac{\partial I}{\partial v} \]
Image Gradient

\[ \frac{df(x)}{dx} \]
**Image Gradient**

\[
\frac{df(x)}{dx}
\]

Gradient

\[
\nabla I = \frac{\partial I(x,y)}{\partial x} \mathbf{i} + \frac{\partial I(x,y)}{\partial y} \mathbf{j}
\]

def) a multivariate generalization of the derivative.
**Image Gradient**

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\[
\frac{\partial I}{\partial u} = \frac{\partial I}{\partial v} =
\]

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**Image Gradient**

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Magnitude of the gradient is proportional to contrast change rate

\[ \frac{\partial I}{\partial u} = 0 \quad \frac{\partial I}{\partial v} = c_1 \]

\[ \frac{\partial I}{\partial u} = 0 \quad \frac{\partial I}{\partial v} = c_2 \]

\[ c_1 < c_2 \]
**Image Gradient**

\[ \nabla I = \frac{\partial I(x,y)}{\partial x} \mathbf{i} + \frac{\partial I(x,y)}{\partial y} \mathbf{j} \]

Direction of the gradient is greatest rate of increase.
**Image Gradient**

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Direction of the gradient is greatest rate of increase.

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\[ \frac{\partial I}{\partial u} = c_2 \quad \frac{\partial I}{\partial v} = 0 \]
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Direction of the gradient is greatest rate of increase.

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\[ \frac{\partial I}{\partial u} = c_3 \quad \frac{\partial I}{\partial v} = c_3 \]
**Image Gradient Magnitude**

\[
\frac{\partial I}{\partial u} \quad \frac{\partial I}{\partial v}
\]

\[
\| \nabla I \| = \sqrt{\left( \frac{\partial I}{\partial u} \right)^2 + \left( \frac{\partial I}{\partial v} \right)^2}
\]
\[ \frac{\partial I}{\partial u}, \frac{\partial I}{\partial v} \]

\[ \angle \nabla I = \tan^{-1} \left( \frac{\partial I}{\partial v} / \frac{\partial I}{\partial u} \right) \]
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**Image Gradient Direction**

Angle with gradient magnitude thresholding
IMAGE GRADIENT DIRECTION

Angle with gradient magnitude thresholding
**Image Gradient**

$I$

$\|\nabla I\|$  

$\angle \nabla I$
Image Gradient
ILLUMINATION INVARIANT GRADIENT