1. • RGB Red Green Blue

• NTSC (YIQ) National Television Standards Committee.

Y: 提供黑白电视及彩色的 Luminance 即 Brightness

I: Inphase.

Q: Quadrature-Phase. 紫色 → 黄绿色

YCbCr Y: 亮度部分. Cb. Cr为蓝色 红色的浓度偏移量成分.

HSV & HSI: Hue. Saturation Value / Intensity.

CMY & CMYK. Cyan. Magenta. Yellow. black.

2. 使用梯度信息进行边缘检测

图像的位置 (x, y) 处有像素 z(x, y)

$$\nabla f = \begin{bmatrix} \frac{\partial f}{\partial x} \\ \frac{\partial f}{\partial y} \end{bmatrix}$$

幅值 $|\nabla f| = mag(\nabla f) = \left[\left(\frac{\partial f}{\partial x}\right)^2 + \left(\frac{\partial f}{\partial y}\right)^2\right]^{\frac{1}{2}}$

幅角 $\alpha(x,y) = \tan^{-1}\left(\frac{Gx}{Gy}\right)$

对于 RGB 每一个方向都可以求一个梯度值.

$$\nabla f = \begin{bmatrix} \frac{\partial R}{\partial x} & \frac{\partial G}{\partial x} & \frac{\partial B}{\partial x} \\ & & \end{bmatrix}$$

$$\begin{bmatrix} \frac{\partial R}{\partial y} & \frac{\partial G}{\partial y} & \frac{\partial B}{\partial y} \end{bmatrix}$$

令 $u = \frac{\partial R}{\partial x} r + \frac{\partial G}{\partial x} g + \frac{\partial B}{\partial x} b$

$$v = \frac{\partial R}{\partial y} r + \frac{\partial G}{\partial y} g + \frac{\partial B}{\partial y} b$$

$$g_{xx} = u \cdot u = u^T u = \left|\frac{\partial R}{\partial x}\right|^2 + \left|\frac{\partial G}{\partial x}\right|^2 + \left|\frac{\partial B}{\partial x}\right|^2$$

$$g_{yy} = vv = v^T v = \left|\frac{\partial R}{\partial y}\right|^2 + \left|\frac{\partial G}{\partial y}\right|^2 + \left|\frac{\partial B}{\partial y}\right|^2$$

$$g_{xy} = uv = u^T v = \frac{\partial R}{\partial x}\frac{\partial R}{\partial y} + \frac{\partial G}{\partial x}\frac{\partial G}{\partial y} + \frac{\partial B}{\partial x}\frac{\partial B}{\partial y}$$

$$z = f(x, y)$$

$$\frac{\partial z}{\partial \ell} = \frac{\partial f(x,y)}{\partial x}\cos\theta + \frac{\partial f(x,y)}{\partial y}\sin\theta$$

若为 RGB 三通道.

$$\frac{\partial z}{\partial \ell} = \begin{bmatrix} \frac{\partial R}{\partial x} \\ \frac{\partial G}{\partial x} \\ \frac{\partial B}{\partial x} \end{bmatrix}\cos\theta + \begin{bmatrix} \frac{\partial R}{\partial y} \\ \frac{\partial G}{\partial y} \\ \frac{\partial B}{\partial y} \end{bmatrix}\sin\theta$$

$$\max \frac{\partial z}{\partial \ell} = \max \|u\cos\theta + v\sin\theta\|^2$$

$$= \max (u\cos\theta + v\sin\theta)^T (u\cos\theta + v\sin\theta)$$

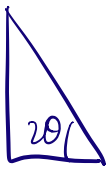
$$= \max (u^T u\cos^2\theta + u^T v\sin\theta\cos\theta + u^T v\sin\theta\cos\theta + v^T v\sin^2\theta)$$

$$= \max \left(u'u\cos^2\theta + v'v\sin^2\theta + 2u'v\sin\theta\cos\theta \right)$$

求导 $-u^Tu\sin 2\theta + v^Tv\sin 2\theta + 2u^Tv\cos 2\theta \overset{!}{=} 0.$

$$\Rightarrow \quad 2u^Tv\cos 2\theta = u^Tu\sin 2\theta - v^Tv\cos 2\theta$$

$$\tan 2\theta = \frac{2u^Tv}{u^Tu - v^Tv}$$



$$\theta = \frac{1}{2}\tan^{-1}\left(\frac{2u^Tv}{u^Tu - v^Tv}\right)$$

$$= \frac{1}{2}\tan^{-1}\left(\frac{2g_{xy}}{g_{xx} - g_{yy}}\right)$$

$$|\nabla f| = \left|\frac{\partial z}{\partial l}\right| = u^Tu\cos^2\theta + v^Tv\sin^2\theta + 2u^Tv\sin\theta\cos\theta$$

$$\cos 2\theta = \cos^2\theta - \sin^2\theta + \sin^2\theta - \sin^2\theta = 1 - 2\sin^2\theta$$

$$\cos 2\theta = \cos^2\theta - \sin^2\theta + \cos^2\theta - \cos^2\theta = 2\cos^2\theta - 1$$

$$|\nabla f| = u^Tu\left(\frac{1+\cos 2\theta}{2}\right) + v^Tv\left(\frac{1-\cos 2\theta}{2}\right) + uv^T\sin 2\theta$$

$$= \sqrt{g_{xx}\left(\frac{1+\cos 2\theta}{2}\right) + g_{yy}\left(\frac{1-\cos 2\theta}{2}\right) + g_{xy}\sin 2\theta}$$

$$= \sqrt{\frac{1}{2}g_{xx} + \frac{1}{2}g_{xx}\cos 2\theta + \frac{1}{2}g_{yy} - \frac{1}{2}g_{yy}\cos 2\theta + g_{xy}\sin 2\theta}$$

$$= \sqrt{\frac{1}{2} g_{xx} + \frac{1}{2} g_{yy} + \frac{1}{2}\left(g_{xx} - g_{yy}\right) \cos 2\theta + g_{xy} \sin 2\theta}$$