(a) Gaussian smoothing   **(b)** Sobel   **(c)** non-max. suppression   **(d)** hysteresis threshold

Stages in Canny Edge Detection
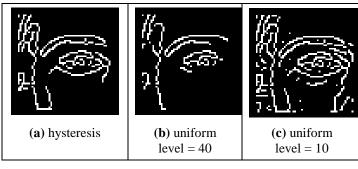

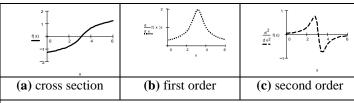**Interpolation in Non-Maximum Suppression**

Hysteresis Thresholding Transfer Function

Action of Non-Maximum Suppression and Hysteresis Thresholding

(a) hysteresis   **(b)** uniform level = 40   **(c)** uniform level = 10

upper=40, lower=10		

Comparing Hysteresis Thresholding with Uniform Thresholding

(a) cross section   **(b)** first order   **(c)** second order

First and Second Order Edge Detection

$$
\begin{aligned}
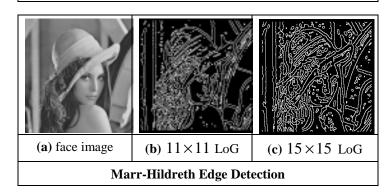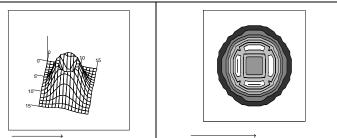\nabla^2 g(x,y) &= \frac{\partial^2 g(x,y)}{\partial x^2} U_x + \frac{\partial^2 g(x,y)}{\partial^2 y} U_y \\
&= \frac{\partial \nabla g(x,y)}{\partial x} U_x + \frac{\partial \nabla g(x,y)}{\partial y} U_y \\
&= \left(\frac{x^2}{\sigma^2}-1\right)\frac{e^{\frac{-(x^2+y^2)}{2\sigma^2}}}{\sigma^2} + \left(\frac{y^2}{\sigma^2}-1\right)\frac{e^{\frac{-(x^2+y^2)}{2\sigma^2}}}{\sigma^2} \\
&= \frac{1}{\sigma^2}\left(\frac{(x^2+y^2)}{\sigma^2}-2\right)e^{\frac{-(x^2+y^2)}{2\sigma^2}}
\end{aligned}
$$

LoG$(4,31)$

Shape of Laplacian of Gaussian Operator

(a) face image   **(b)** 11×11 LoG   **(c)** 15×15 LoG

Marr-Hildreth Edge Detection

(a) relief plot   **(b)** contour plot

Fourier Transform of LoG Operator