Homework #2
(due midnight, Tuesday, October 7, 2003)

1. **Canny edge detector**: Show that the product of the Canny detection and localization criteria

$$\mathrm{SNR}(f) \times \mathrm{Loc}(f) = \frac{|\int_{-W}^{W} G(-x)f(x)dx|\,|\int_{-W}^{W} G'(-x)f'(-x)dx|}{n_0\sqrt{\int_{-W}^{W} f^2(x)dx}\, n_0\sqrt{\int_{-W}^{W} f'^2(x)dx}}$$

is maximized by $f(x) = G(-x)$.
2. **Canny edge detector**: Rewrite the detection and localization criteria for a filter $f_w(x) = f(x/w)$. Show that the product of the detection and localization criteria is *invariant* to w.
3. **Level sets**: Assume that a particle is moving in 1D according to the equation of motion

$$\frac{dx}{dt} = -\frac{x+t}{t+1}.$$

What is the corresponding $\psi(x,t)$ function? [Hint: Use $\frac{\partial\psi}{\partial t} = -\frac{\partial\psi}{\partial x}\frac{dx}{dt}$.] Plot $\psi(x,t)$ in the interval $[0,1]^2$showing the level sets. Explain the relation between the equation of motion and the level sets of ψ. Please realize that this is a reduced 1D motion embedded in a 2D function.