Example

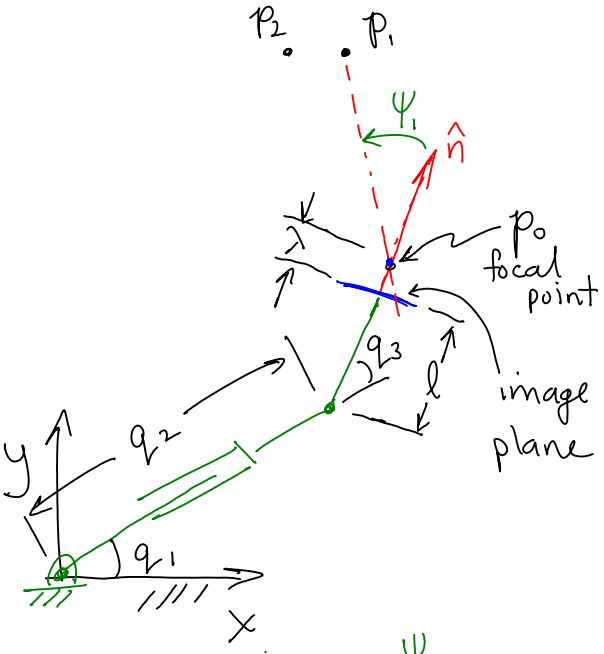
Wednesday, February 06, 2008
8:27 PM

Visual Servoing Example.

(x, y) = world coordinates

$q = (q_1, q_2, q_3)$

= joint displacement variables

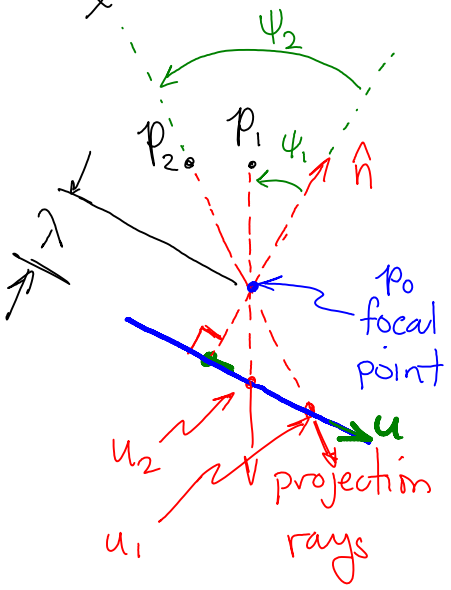


λ = focal length

ℓ = distance from 3rd joint to image line

p_i = feature point i, $i = 1, 2$

ψ = angle between normal to image line and projection ray



u_i = location of feature point projection on image line.

$s_i = p_i - p_0$

Ⓐ Forward Kinematic Map

1) Derive u_i as a function of q, p_i, λ, ℓ (and anything I forgot to include).

2) Derive the Jacobian relating $\dot{u}_i$ and $\dot{q}$

i.e., $\dot{u}_i = J\dot{q}$

3) Derive a basis for the null space of J, $\mathcal{N}(J)$.
What is the physical interpretation of $\dot{q} \in \mathcal{N}(J)$?

(B) Feature space objective function and gradient

Let $f_1 = u_1^2$ and $f_2 = (u_1 - u_2)^2$

1) Derive the gradient of f_i w.r.t. q, $i = 1, 2$.

2) Determine singular configurations, i.e., when the gradient degenerates.