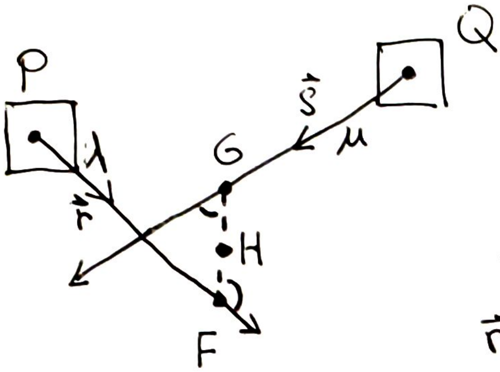
Triangulation

We try to estimate 3D location of points using relative information of our camera(s).

• Triangulation Using Geometric Approach.



• P, Q are view points.
• λ, μ are scalar lines from respective cameras. Show how far to go, along vector.

*Note, as in 3D the lines may not intersect, so we need to find point H where the distance between the two lines is minimal.

$\vec{r}, \vec{s}$ are line vectors, show direction.

Point G : $g = q + \mu s$ Point F : $f = p + \lambda r$

$p = X_{o'}$
$q = X_{o''}$ } Projection centers.

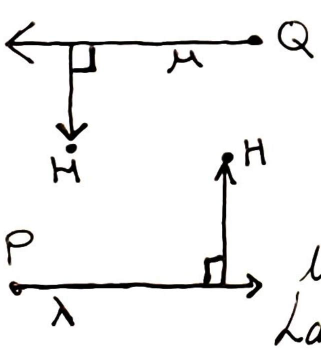
$s = R''^{T}\, {}^{k}x''$ ← Ray direction vectors → $r = R'^{T}\, {}^{k}x'$ *Assuming calibrated camera.

with ${}^{k}x' = (x', y', c)^T$, ${}^{k}x'' = (x'', y'', c)^T$

p, q are known projection centers.

${}^{k}x$ are points in camera coord..

The line between G, and F is orthogonal to both lines λ, and μ.



This leads to multiple constraints.

$(g-f)\cdot r = 0$, and $(g-f)\cdot s = 0$ ① ← *These are correct.

*There is a mistake in a lecture with equations ①.

$(q + \lambda s - p - \mu r)\cdot s = 0$, and $(q + \lambda s - p - \mu r)\cdot r = 0$

Now we have 2 equations, with 2 unknown (λ, μ).

Lastly, we obtain λ, μ by solving the two equations, which leads to G and F. We use them to compute H as the middle of two lines.