Target Position Estimation

Minjian Pang

December 11, 2016

1

Fig.1 shows how we define the world frame. Here the world frame's origin is always the same as the camera frame and world frame's axis direction is fixed to North-East-Down. Equ.(1) or (2) transforms a point in image frame to world frame. K is the camera intrinsic matrix and R is the external rotation matrix which can be constructed given pitch, roll(assume to be 0) and pitch angle reading from M100. This is actually a conversion from Euler angles to rotation matrix.
Note that Equ.(1) and (2) are equal up to scale. That's why we use symbol $\sim$ rather than $=$.

$$\overrightarrow{T} = \begin{pmatrix} x_t \\ y_t \\ z_t \end{pmatrix} \sim \mathbf{R}\mathbf{K}^{-1} \begin{pmatrix} u_t \\ v_t \\ 1 \end{pmatrix}, \tag{1}$$

$$\overrightarrow{B} = \begin{pmatrix} x_b \\ y_b \\ z_b \end{pmatrix} \sim \mathbf{R}\mathbf{K}^{-1} \begin{pmatrix} u_b \\ v_b \\ 1 \end{pmatrix}. \tag{2}$$

As you mentioned, this is in fact a triangulation. For example, $\frac{d_0}{h_c} = \frac{P_b}{z_b}$ and $\frac{h_c - h_0}{d_0} = \frac{P_t}{z_t}$. If we assume that the tracked target stands up straight, then $P_b = P_t$ and,

$$\frac{h_0}{d_t} = \frac{||\overrightarrow{T} - \overrightarrow{B}||}{P_b} = \frac{||\overrightarrow{T} - \overrightarrow{B}||}{P_t} \tag{3}$$

To be general,

$$\frac{h_o}{d_t} = ||\frac{\overrightarrow{T}}{P_t} - \frac{\overrightarrow{B}}{P_b}|| \tag{4}$$

These is still triangulation.

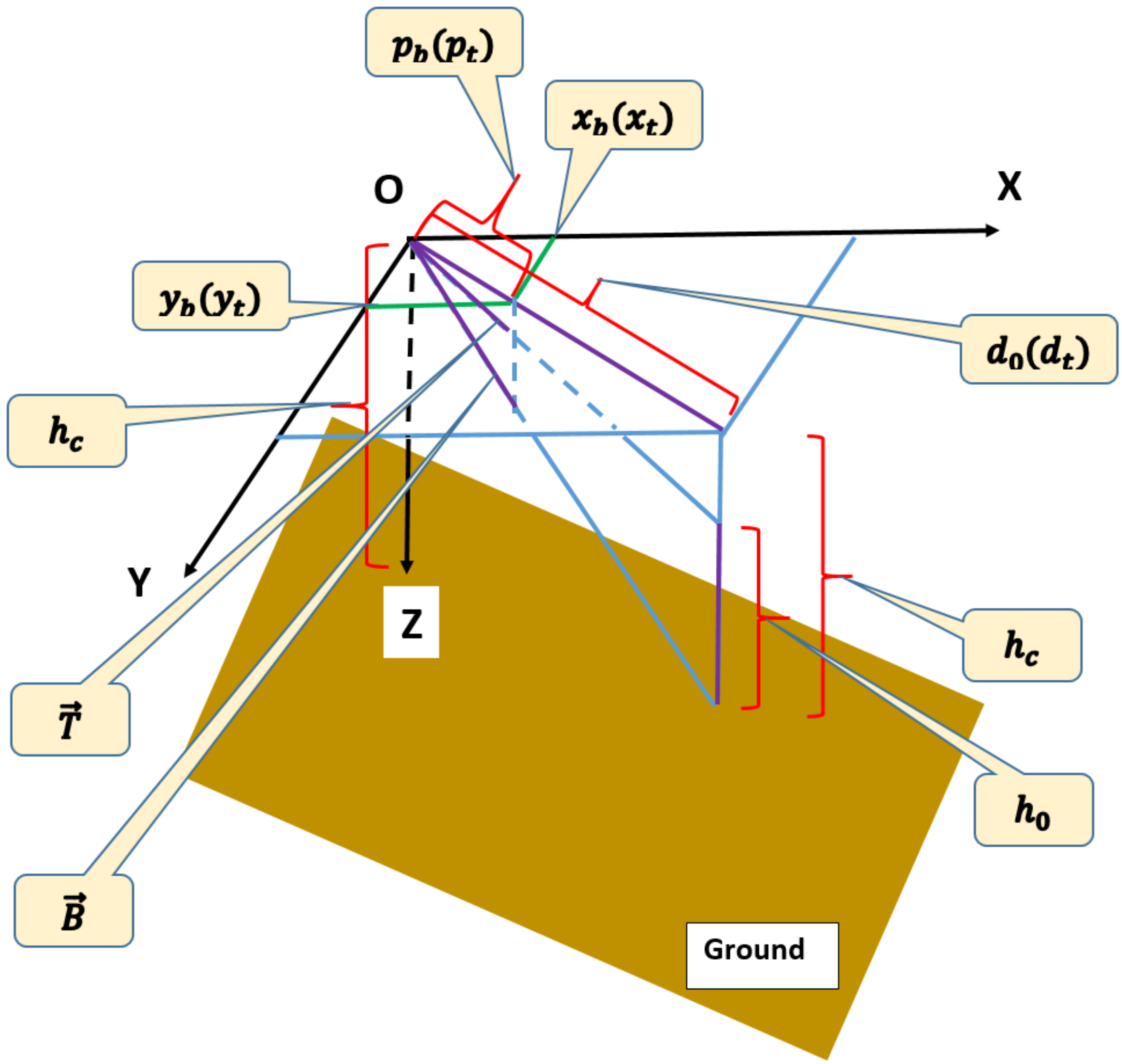

Figure 1: Coordinate