Basics of Sensor Fusion

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1 Homework 1

Measure azimuth and elevation angles to each of the corners. Write the resulting model in form $y = g(x) + r$.

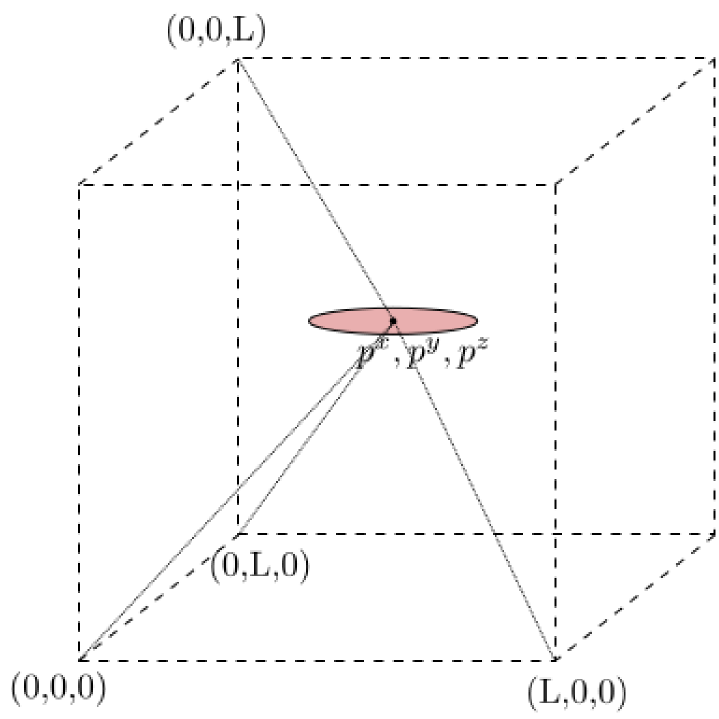

Figure 1: Drone positioning problem

Azimuth and elevation is presented in figure 2
One way of solving is:

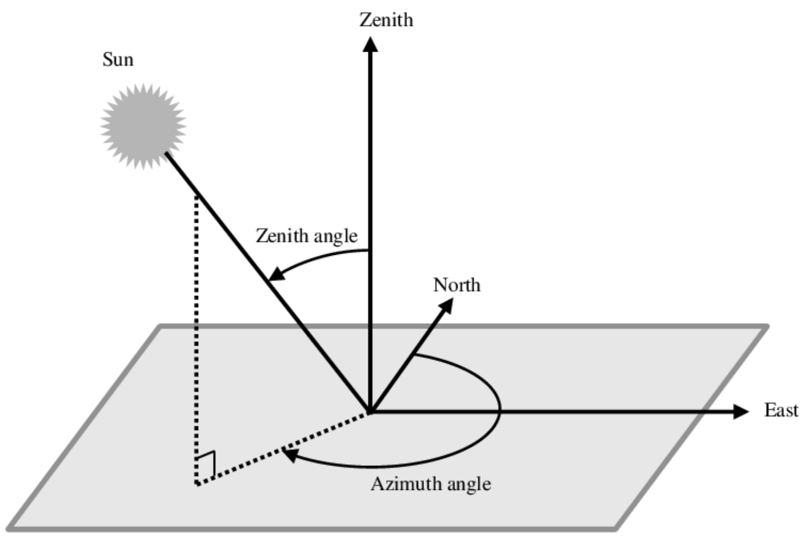

Figure 2: Azimuth and Elevation

$$y_1 = atan_2(p^y, p^x) + r_1 \tag{1}$$

$$y_2 = \pi - atan_2(p^y, L - p^x) + r_2 \tag{2}$$

$$y_3 = -\pi + atan_2(L - p^y, L - p^x) + r_3 \tag{3}$$

$$y_4 = -atan_2(p^y, p^x) + r_4 \tag{4}$$

$$y_5 = atan_2(p^y, p^x) + r_5 \tag{5}$$

$$y_6 = \pi - atan_2(p^y, L - p^x) + r_6 \tag{6}$$

$$y_7 = -\pi + atan_2(L - p^y, L - p^x) + r_7 \tag{7}$$

$$y_8 = -atan_2(L - p^y, p^x) + r_8 \tag{8}$$

$$y_9 = atan_2(p^z, \sqrt{(p^x)^2 + (p^y)^2}) + r_9 \tag{9}$$

$$y_{10} = atan_2(p^z, \sqrt{(L - p^x)^2 + (p^y)^2}) + r_{10} \tag{10}$$

$$y_{11} = atan_2(p^z, \sqrt{(L-p^x)^2 + (L-p^y)^2}) + r_{11} \tag{11}$$

$$y_{12} = atan_2(p^z, \sqrt{(p^x)^2 + (L-p^y)^2}) + r_{12} \tag{12}$$

$$y_{13} = -atan_2(1-p^z, \sqrt{(p^x)^2 + (p^y)^2}) + r_{13} \tag{13}$$

$$y_{14} = -atan_2(1-p^z, \sqrt{(L-p^x)^2 + (p^y)^2}) + r_{14} \tag{14}$$

$$y_{15} = -atan_2(1-p^z, \sqrt{(L-p^x)^2 + (L-p^y)^2}) + r_{15} \tag{15}$$

$$y_{16} = -atan_2(1-p^z, \sqrt{(p^x)^2 + (L-p^y)^2}) + r_{16} \tag{16}$$

Second way:

$$y_1 = \overbrace{atan_2(s_1^y - p^y, s_1^x - p^x)}^{azimuth} + \overbrace{atan_2(s_1^z - p^z, s_1^y - p^y)}^{elevation} + r_1 \tag{17}$$

$$y_2 = atan_2(s_2^y - p^y, s_2^x - p^x) + atan_2(s_2^z - p^z, s_2^y - p^y) + r_2 \tag{18}$$

$$y_3 = atan_2(s_3^y - p^y, s_3^x - p^x) + atan_2(s_3^z - p^z, s_3^y - p^y) + r_3 \tag{19}$$

$$y_4 = atan_2(s_4^y - p^y, s_4^x - p^x) + atan_2(s_4^z - p^z, s_4^y - p^y) + r_4 \tag{20}$$

$$y_5 = atan_2(s_5^y - p^y, s_5^x - p^x) + atan_2(s_5^z - p^z, s_5^y - p^y) + r_5 \tag{21}$$

$$y_6 = atan_2(s_6^y - p^y, s_6^x - p^x) + atan_2(s_6^z - p^z, s_6^y - p^y) + r_6 \tag{22}$$

$$y_7 = atan_2(s_7^y - p^y, s_7^x - p^x) + atan_2(s_7^z - p^z, s_7^y - p^y) + r_7 \tag{23}$$

$$y_8 = atan_2(s_8^y - p^y, s_8^x - p^x) + atan_2(s_8^z - p^z, s_8^y - p^y) + r_8 \tag{24}$$

where (p^x, p^y, pz) are coordinates of the drone, and (s_i^x, s_i^y, s_i^z) are coordinates of the corners, $\forall i = 1, ..., 8$

$$\overbrace{\begin{bmatrix} y_1 \\ \vdots \\ y_8 \end{bmatrix}}^{y} = \overbrace{\begin{bmatrix} atan_2(s_1^y - p^y, s_1^x - p^x) + atan_2(s_1^z - p^z, s_1^y - p^y) \\ \vdots \\ atan_2(s_8^y - p^y, s_8^x - p^x) + atan_2(s_8^z - p^z, s_8^y - p^y) \end{bmatrix}}^{g(x)} + \overbrace{\begin{bmatrix} r_1 \\ \vdots \\ r_8 \end{bmatrix}}^{r}$$