ECE 470 Lab 4.

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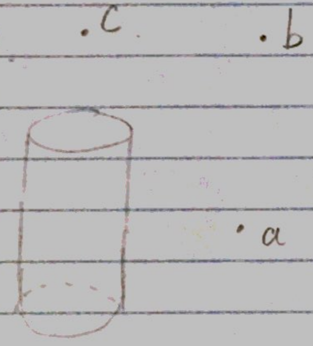
2. Say current position is $\begin{bmatrix} x_i \\ y_i \\ z_i \end{bmatrix} = O_i^o$, d is the closest point at the surface of obstacles

1). $O_i^o - d = \begin{bmatrix} 0 \\ 0 \\ z_i - 32 \end{bmatrix}$ $\quad \|O_i^o - d\| = z_i - 32.$

$$F = \eta_i \left(\frac{1}{z_i - 32} - \frac{1}{\rho_0} \right) \frac{1}{|z_i - 32|^3} [0 \quad 0 \quad z_i - 32].$$

2)



∴ 3 condition.

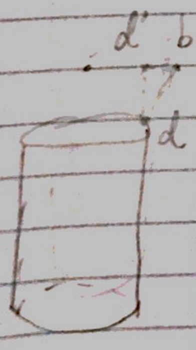
a). $z_i \leq h$

$$\|O_i^o - d\| = \left\| \begin{bmatrix} x_i - x_0 \\ y_i - y_0 \\ 0 \end{bmatrix} \right\| - R = \sqrt{(x_i - x_0)^2 + (y_i - y_0)^2} - R.$$

Centre axis at (x_0, y_0).
Radius is R.

$$O_i^o - d = \begin{bmatrix} x_i - x_0 \\ y_i - y_0 \\ 0 \end{bmatrix} \frac{\|O_i^o - d\|}{\left\| \begin{bmatrix} x_i - x_0 \\ y_i - y_0 \\ 0 \end{bmatrix} \right\|}$$

$$= \begin{bmatrix} x_i - x_0 \\ y_i - y_0 \\ 0 \end{bmatrix} \frac{\sqrt{(x_i - x_0)^2 + (y_i - y_0)^2} - R}{\sqrt{(x_i - x_0)^2 + (y_i - y_0)^2}}$$



b) $z_i > h$, $(x_i - x_0)^2 + (y_i - y_0)^2 > R^2$

$$\|O_i^o - d\| = \sqrt{\left(\sqrt{(x_i - x_0)^2 + (y_i - y_0)^2} - R\right)^2 + (z_i - h)^2}$$

$$O_i^o - d = \begin{bmatrix} x_i - x_0 \\ y_i - y_0 \\ 0 \end{bmatrix} \frac{\sqrt{(x_i - x_0)^2 + (y_i - y_0)^2} - R}{\sqrt{(x_i - x_0)^2 + (y_i - y_0)^2}} + \begin{bmatrix} 0 \\ 0 \\ z_i - h \end{bmatrix}.$$

c) $z_i > h$, $(x_i - x_0)^2 + (y_i - y_0)^2 \le R^2$

$$O_i^o - d = \begin{bmatrix} 0 \\ 0 \\ z_i - h \end{bmatrix} \qquad \|O_i^o - d\| = z_i - h.$$

$$F = \eta_i \left(\frac{1}{\|O_i^o - d\|} - \frac{1}{\rho_0} \right) \frac{1}{\|O_i^o - d\|^3} (O_i^o - d)^T$$

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