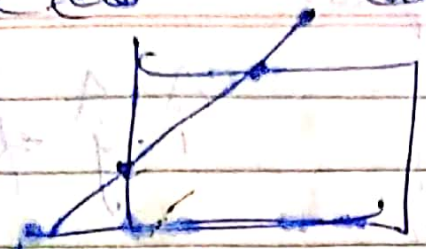
Cyrus Beck / Liang Barsky Line Clipping

Mathematician



2 Times Coben

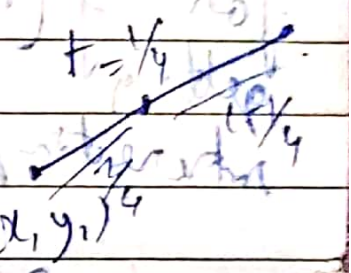
Based on Line parametric eq -

(x_1, y_1) (x_2, y_2)

t - range $0 \le t \le 1$

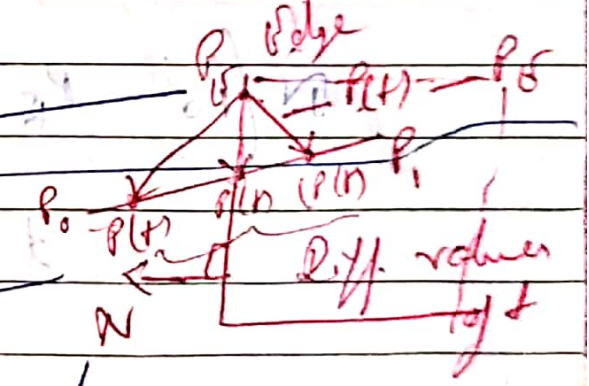
Starting $t = 0$ (x_1, y_1)

(x_2, y_2) $(t = 1)$



$x = 3/4\, x_1 + 1/4\, x_2$

$y = 3/4\, y_1 + 1/4\, x_2$



Cyrus Beck Line Clipping —

Better than Coben with Parametric eq.

$P(t) = P_0 + t(P_1 - P_0)$ —— (1)

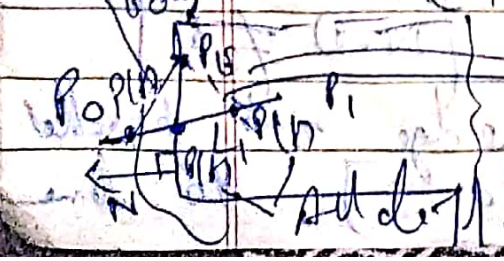
$[t = 0 - 1]$

$P(0) = P_0$

$P(1) = P_1$

$t = 0$

$f(N, P_E) > 0$



$f(N, P_E) < 0$

Scanned with CamScanner

(1) $x = (1-t)x_1 + t x_2$

$y = (1-t)y_1 + t y_2$

Parametric eq. of line

$x = x_1 - x_1(t) + t x_2 = x_1 + t(x_2 - x_1) = x_1 + t\Delta x$

$y = y_1 - y_1(t) + t y_2 = y_1 + t(y_2 - y_1) = y_1 + t\Delta y$

$$\begin{bmatrix} x_{v_{min}} \le x \le x_{v_{max}} \\ y_{v_{min}} \le y \le y_{v_{max}} \end{bmatrix}$$ Inequality for line Clip

$$x_{v_{min}} \le x_1 + t\Delta x \le x_{v_{max}}$$

$$y_{v_{min}} \le y_1 + t\Delta y \le y_{v_{max}}$$

$x_1 + t\Delta x \ge x_{v_{min}}$

$\le x_{v_{max}}$

$y_1 + t\Delta y \ge y_{v_{min}}$

$\le y_{v_{max}}$

$t\Delta x \ge x_{v_{min}} - x_1$

$t\Delta x \le x_{v_{max}} - x_1$

$t\Delta y \ge y_{v_{min}} - y_1$

$t\Delta y \le y_{v_{max}} - y_1$

$-t\Delta x \le x_1 - x_{v_{min}}$

$t\Delta x \le x_{v_{max}} - x_1$

$-t\Delta y \le y_1 - y_{v_{min}}$

$t\Delta y \le y_{v_{max}} - y_1$

Generalized

$t p_k \le q_k$ $(k = 1, 2, 3, 4)$

$p_1 = -\Delta x$ $q_1 = x_1 - x_{v_{min}}$

$p_2 = \Delta x$ $q_2 = x_{v_{max}} - x_1$

$p_3 = -\Delta y$ $q_3 = y_1 - y_{v_{min}}$

$p_4 = \Delta y$ $q_4 = y_{v_{max}} - y_1$

Steps — (1) find points (x_1, y_1) to (x_2, y_2)

(2) Δx, Δy, p_1, p_2, p_3, p_4, q_1, q_2, q_3, q_4

(3) $t_1 = 0$, $t_2 = 1$

(i) if $p_k = 0$ $(k = 1, 2, 3, 4)$ line parallel to window

(ii) if $q_k < 0$ ——— line outside

(iii) for non zero value of p_k

if $p_k < 0$ (0, 1)

$t_1 = \max\left(0, q_k/p_k\right)$

else $p_k > 0$

$t_2 = \min\left(1, \frac{q_k}{p_k}\right)$

$t_1 > t_2$ line completely outside → reject

(x, y)

$x = x_1 + t\Delta x$

$y = y_1 + t\Delta y$

Windows A(20, 20) B(90, 20) C(90, 70), D(20, 70)

P_1 (10, 30) P_2 (80, 90)

Ex — $(x_1, y_1) \rightarrow (10, 30)$

$(x_2, y_2) \rightarrow (80, 90)$

$\Delta x = 80 - 10 = 70$

$\Delta y = 90 - 30 = 60$

$t = 0$ to 1

$p_1 = -\Delta x = -70$

$p_2 = \Delta x = 70$

$p_3 = -\Delta y = -60$

$p_4 = \Delta y = 60$

$q_1 = x_1 - x_{2s_{min}} - (\text{Min. Window size})$

$= 10 - 20$

$= -10$

$x_{2s_{min}} = 20$

$x_{2s_{max}} = 90$

$y_{2s_{min}} = 20$

$y_{2s_{max}} = 70$

(27)

$q_2 = 90 - 10 = 80$

$q_3 = 30 - 20 = 10$

$q_4 = 70 - 30 = 40$

$p_1, p_3 < 0$

$p_2, p_4 > 0$

$t_1 = \max\left(0, \frac{q_1}{p_1}, \frac{q_3}{p_3}\right)$

$= \max\left(0, \frac{-10}{-70}, \frac{10}{-60}\right)$

$= \max\left(0, 1/7, -1/6\right)$

$t_1 = 1/7$

$t_2 = \min\left(1, \frac{q_2}{p_2}, \frac{q_4}{p_4}\right)$

$= \min\left(1, 80/70, 40/60\right)$

$= \min\left(1, 8/7, 2/3\right)$

$t_2 = 2/3$

t_1 —

$x = x_1 + t\Delta x$

$= 10 + 1/7 \times 70$

$= 20$

$y = y_1 + t\Delta y$

$= 30 + 1/7 \times 60$

$= 38.57$

t_2 —

$x = x_1 + t\Delta x$

$= 10 + 2/3 \times 70$

$= 56.67$

$y = y_1 + t\Delta y$

$= 30 + 2/3 \times 60$

$= 70$

$(20, 38.57) \longrightarrow (56.67, 70)$

P_1' P_2'