

LESSON 10: CYRUS-BECK ALGORITHM AND COHEN-SUTHERLAND ALGORITHM

Today's Topics

- Cyrus beck algorithm.

Cyrus-Beck Techniques (1978): A Parametric Line

Clipping Algorithm

Cohen-Sutherland algorithm can only trivially accept or reject lines within the given bounding volume; it cannot calculate the exact intersection point. But, the parametric line clipping algorithm can calculate the value of the parameter t , where the two lines intersect. This can be easily understood by looking at the following picture and pseudo code:

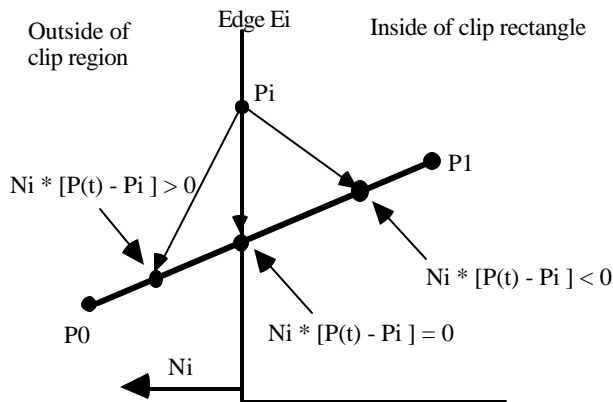


Figure 1: Dot Product for 3 points outside, inside, and on the boundary of the clip region.

The line is parametrically represented by $P(t) = P_0 + t(P_1 - P_0)$

%% Pseudo Code for Cyrus Beck Parametric Line-Clipping Algorithm

```
{
    precalculate Ni and select a Pi for each edge Ei
    for (each line segment to be clipped) {
        if (P1 = P0)
            line is degenerate so clip as a point;
        else {
            D = P1 - P0;
            te = 0;
            tl = 1;
            for (each candidate intersection with
a clip edge) {
                if (Ni * D # 0) {
                    t = - { Ni * [P0 - Pi] } / (Ni * D)
```

```
if (Ni * D > 0)
    tl = min (tl, t);
else
    te = max (te, t);
}
}

if (te > tl)
    return nil;
else
    return P(te) and P(tl) as true clip intersection points;
}
}
```

}

The Cyrus-Beck Algorithm

The basic idea of the algorithm (Cyrus-Beck) is as follows:

The line to be clipped is expressed using its parametric representation. For each edge of the clipping polygon, we are given a point P_e on the edge, and an outward-pointing normal N . (The vertices of the clipping polygon are traversed in the counterclockwise direction.) The objective is to find the t values where the line enters and leaves the polygon (t_E and t_L), or to determine that the line lies entirely outside the polygon.

t_E is initialized to 0; t_L is initialized to 1.

The t values of the intersection points between the line and the clip edges are determined.

For Each t Value:

Classify it as “potentially entering” (PE) or “potentially leaving” (PL). It is potentially entering if P_0P_1 is (roughly) in the direction opposite to the normal; that is, if $(P_1 - P_0) \cdot N < 0$. (Note that this is the denominator of the expression used to compute t .) It is potentially leaving if $(P_1 - P_0) \cdot N > 0$, indicating that the line P_0P_1 is pointing (roughly) in the same direction as the normal.

