◇ Problem Statement ◇

Given a test line $\ell(\mathbf{D}, \mathbf{d})$ and cone $\mathcal{C}(\mathbf{V}, \mathbf{v}, \alpha)$, determine the point of intersection by computing a t such that point $\mathbf{D} + t\mathbf{d}$ lies on $\mathcal{C}(\mathbf{V}, \mathbf{v}, \alpha)$ or show that no intersection exists.

[1]In this exposition, $\|\mathbf{d}\| = 1$ holds for any direction vector $\mathbf{d}$.

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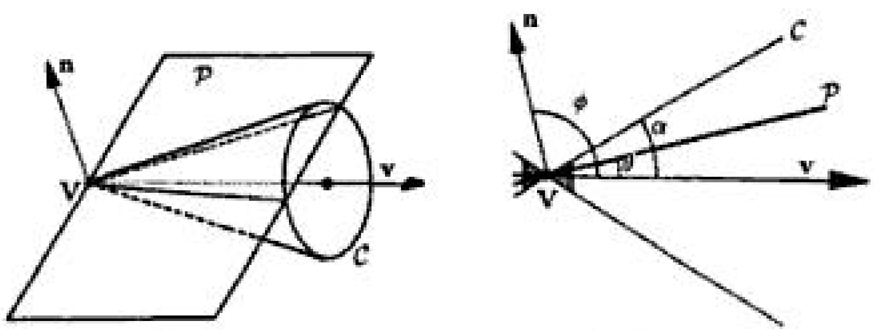

(a) (b)

Figure 1. The normal vector **n** of plane $\mathcal{P}$.

◇ The Algorithm ◇

If $\mathbf{V} \in \ell$, the intersection point is $\mathbf{V}$. Therefore, in what follows, $\mathbf{V} \notin \ell$ holds.

Consider the plane $\mathcal{P}$ determined by $\mathbf{V}$ and ℓ. Its normal vector is $\mathbf{n} = \mathbf{d} \otimes \overrightarrow{DV}$. However, if $\mathbf{v} \cdot \mathbf{n} > 0$, $\mathbf{n}$ is reversed. This ensures that $\mathcal{P}$ lies "between" $\mathbf{n}$ and $\mathbf{v}$ (Figure 1). Therefore, the desired plane is $\mathcal{P}(\mathbf{V}, \mathbf{n})$. Since $\mathcal{P}$ contains $\mathbf{V}$, $\mathcal{P} \cap \mathcal{C}$ is either a point (i.e., $\mathbf{V}$), or consists of one or two lines. In the following, the computation of $\ell \cap \mathcal{C}$ will be reduced to the computation of $\ell \cap (\mathcal{P} \cap \mathcal{C})$. In other words, the intersection lines of $\mathcal{P} \cap \mathcal{C}$ will be computed and intersected with ℓ. However, prior to the intersection computation, a disjoint test is needed.