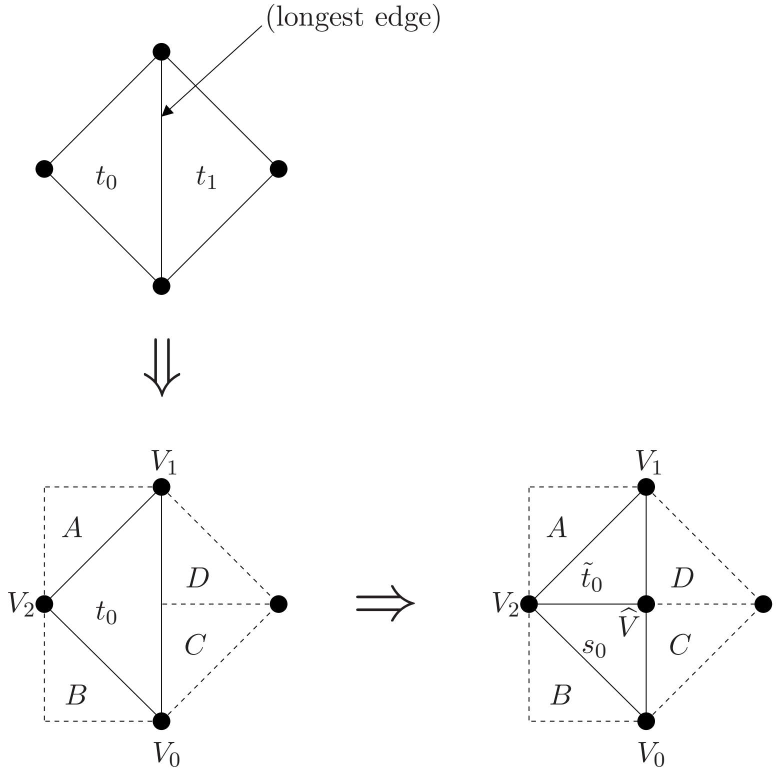

Figure 1: Diagram of bisection process for terminal triangle pair. The initial pair consists of two triangles t_0, t_1 that share a longest edge. The initial neighbors of t_0 are the triangles labeled A, B, t_1. Assuming that t_1 has already been bisected into triangles C, D, we see an intermediate stage for bisecting t_0. We then replace t_0 by triangles $\tilde{t}_0$ and s_0 whose neighbors are adjusted accordingly.

1 Bisection Diagrams

1.1 2-D Bisection of Terminal Triangle Pair

Assume we are given a terminal pair of triangles that share a longest edge (see Figure 1). Bisecting the longest edge adds a new vertex with global index denoted $\widehat{V}$. To better explain the bisection of the adjacent triangles, we assume that t_1 is already bisected into two triangles labeled C, D.

To bisect the triangle t_0, we must replace the triangle connectivity data of t_0 with the connectivity data of $\tilde{t}_0$, followed by adding a new triangle to the mesh, namely s_0. We then change the neighbors of t_0 to those of $\tilde{t}_0$, and add the neighbors of s_0 to the neighbor list. Finally, we adjust the neighbors of A and B to correctly correspond to the new mesh. This is summarized as follows.

$$\begin{aligned} &\text{triangle connectivity of } \tilde{t}_0 = [\widehat{V}, V_1, V_2], \quad \text{neighbor connectivity of } \tilde{t}_0 = [A, s_0, D] \\ &\text{triangle connectivity of } s_0 = [\widehat{V}, V_2, V_0], \quad \text{neighbor connectivity of } s_0 = [B, C, \tilde{t}_0] \end{aligned} \tag{1}$$

Note that the global triangle index of t_0 and $\tilde{t}_0$ is identical, since we simply *replaced* t_0 by $\tilde{t}_0$. This means that the neighbor data for triangle A does not need to be changed. However, we must update the neighbors of triangle B, i.e. if B's kth neighbor was t_0 before the bisection, then B's kth neighbor after bisection should be s_0.

Note: the process for bisecting t_1 is exactly the same as for t_0; just rotate the diagrams in Figure 1 by 180°. In other words, triangle C is really $\tilde{t}_1$, and D is s_1.