SSC

In this stage, we calculate every vertex’s screen space coordinate (SSC) in order to tell which tetrahedron(s) does a single pixel cover. Firstly we have known that Camera has a unit vector m\_Forward(CO) pointing at the center of film, two vectors m\_Right and m\_Up as the graph shows with magnitude of half of physical length and width of the film. Given a vertex v in the view, we have its screen projection P with CP = t\*CV (0<t<1). Derive t by solving CO\*OP=0 since m\_Forward is always orthogonal to the screen by initial construction. Then we calculate OP’s projection on m\_Right and m\_Up to obtain its coordinate, and subsequently the coordinate with respect to pixel (e.g lower left corner’s pixel point(0,0), up right corner’s pixel point(1023,1023)).

ComputeIntersectionEffect

-basic idea

We have known which tetrahedron(s) every pixel cover now. Suppose that the ray R\_i,j from camera to pixel(i,j) shoots through tetrahedrons a, b and c, we need to calculate 3 intersection effects: R with a, R with b, R with c individually. The first step calculates 2 intersection points (p\_entry and p\_exit) of the ray and one of the tetrahedrons being shot. \*\*\*The distance between camera and p\_entry is recorded for the sorting phase. The ray’s path is divided into a predefined number (NumOfSamples+1) of line segments. Iterating from p\_entry, the density of this point is interpolated using the 4 vertices of the tetrahedron. The color is determined by color map function.

As the ray travels from p\_entry to p\_exit, the color and intensity contributions can be approximated. The ray starts traveling with full intensity and each segment is assumed to have a uniform color, which is the color of p\_entry. The color contributions of the line segments to the pixel are proportional to the color attributes of the traveled region, the travel distance, the opacity coefficient of the region and the intensity of the ray itself. The ray loses most of its energy while traveling through nontransparent regions; thus later regions have a smaller effect on the final color. After the ray travels through all regions, its final color is recorded.

-interpolation

Accurately calculating the density of a point in or on a tetrahedron is important because poor interpolations may cause significant artifacts. The interpolation process starts by selecting a reference vertex, which can be any one of the tetrahedron’s vertices. Then we have M matrix which contains the coordinates of the other three vertices. The N vector stores the relative position of the input point to the reference vertex. The density vector D contains density differences of the vertices relative to the density of the reference vertices. Then the equation M\*R=D is solved to obtain R vector, which represents a coefficient vector that will give the relative density of a point when multiplied with the relative position vector of that point. Hence R\*N+density of the reference vertex is the final interpolated density of input point.