STL slicing algorithm

Step - I

- Generated STL file from NX read in matlab
- changed the build orientation of the part.
- 30° rotation about x-axis and 45° rotation about y-axis.
- plotted the STL file of the rotated part.

Step - II

- To find the maximum and minimum value of z-co-ordinate amongst all the Vertices to know the z-limits for slicing the STL file
- In this case, slicing is performed at the $z = 5mm$ and $z = 30mm$

Step - III

- To find all the facets amongst the generated STL file for which slicing height lies in between minimum (z_1, z_2, z_3) and max $(z_1\ z_2\ z_3)$
- If above condition is satisfied, consider this facet for the intersection.
- At this point, no. of facets compared to the generated STL file in the beginning will be lesser and from here on consider only this facets which has satisfied the condition.

- step IV

for each facet, check for intersection of all the three edges at the slicing height (i.e at $z=5mm$ and $z-30mm$)

Equation of line has been considered for each edge in a single facet and same is repeated for all the facets.

$$z_{\text{slicing plane}} = z_1 + t_1 (z_2 - z_1)$$
$$z\ \text{slicing plane} = z_2 + t_2 (z_3 - z_2)$$
$$z\ \text{slicing plane} = z_3 + t_3 (z_1 - z_3)$$

where,

t_1, t_2, t_3 are the intersection points for all the three faces respectively.

In this case, for every face we will get a ~~3x3~~ vector of dimension [1x3] which stores t_1, t_2 and t_3 values.

- step - V

Now, after finding t_1, t_2 and t_3, substitute this values in the equation of line.

Now, every edge will have intersection point r, which is a vector of dimension [1x3].

If $t_1 >= 0$ and $t_1 \leq 1$

$$X\ \text{slicing plane edge } 1 = X_1 + t_1 (X_2 - X_1) \quad - (1)$$
$$Y\ \text{slicing plane edge } 1 = Y_1 + t_1 (Y_2 - Y_1) \quad - (2)$$
$$z\ \text{slicing plane edge } 1 = z_1 + t_1 (z_2 - z_1) \quad - (3)$$

Intersection point r_edge 1 = [(1), (2), (3)]

This condition is simulated for the other two edges with t_2 and t_3 respectively.
If any intersection point from t_1, t_2 and t_3 is not in between the limit [0-1] then intersection point 'r' for that face is zero.
After executing this, we will get [3x3] matrix of the intersection points per face and amongst the entries in [3x3] matrix, one of the rows will be zero depending on t_1, t_2 and t_3.

Step - VI
In this case, no special case is reported.
However, there are two special cases in general
i) Facets with repeated intersection points.
ii) STL facet with one intersection.

Step VII
i) All the intersected points in the sequence are arranged to form a contour.
ii) Since the given component does not have any discontinuity, multiple contours won't exist.
iii) Slicing has been performed at the given slicing height
iv) Slicing area is calculated for the slice with the formula,

$$SA_i = \left(\frac{1}{2}\right) \hat{n} \left(a_i \times a_{i+1}\right), \text{ where } a_i = P_i - P_m$$

$\hat{n}$ ↳ unit normal

$m \Rightarrow$ last point

$$\text{Total area} = \left| \sum_{i=1}^{m-2} SA_i \right|$$