

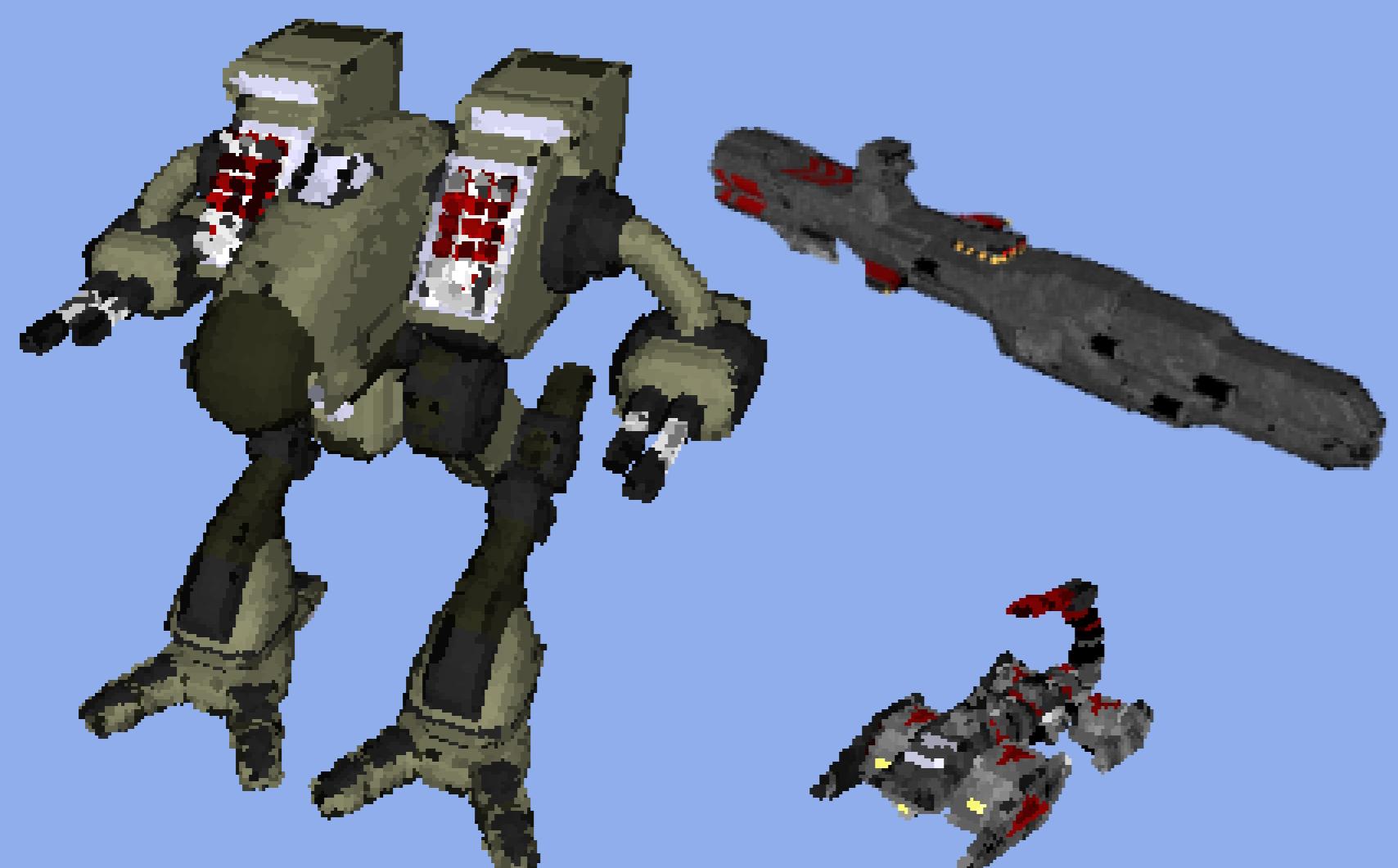
# Finding Surface Normals From Voxels

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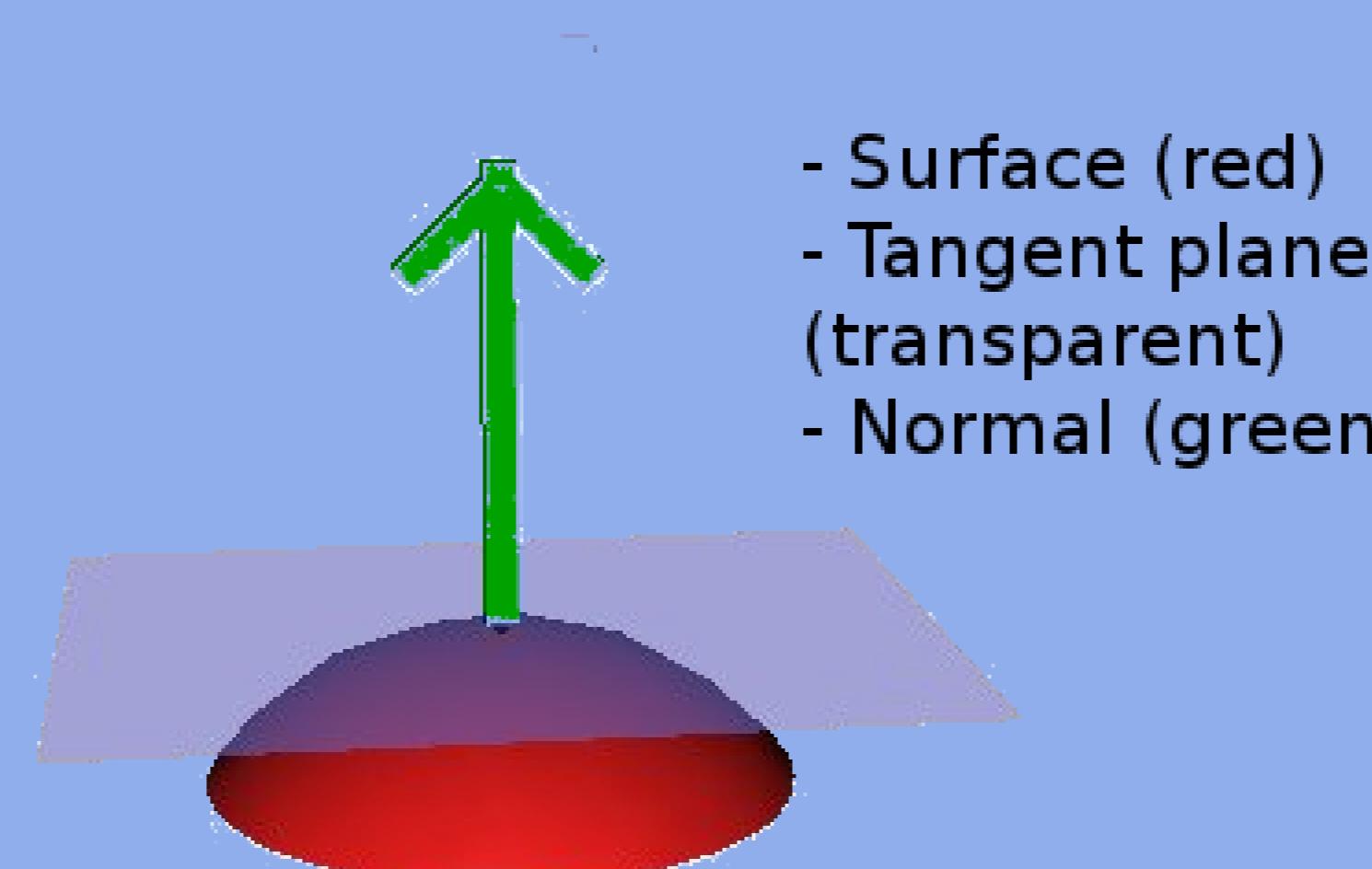
## 1. Objective:

Find the surface normals from volumetric models without the knowledge of the shape



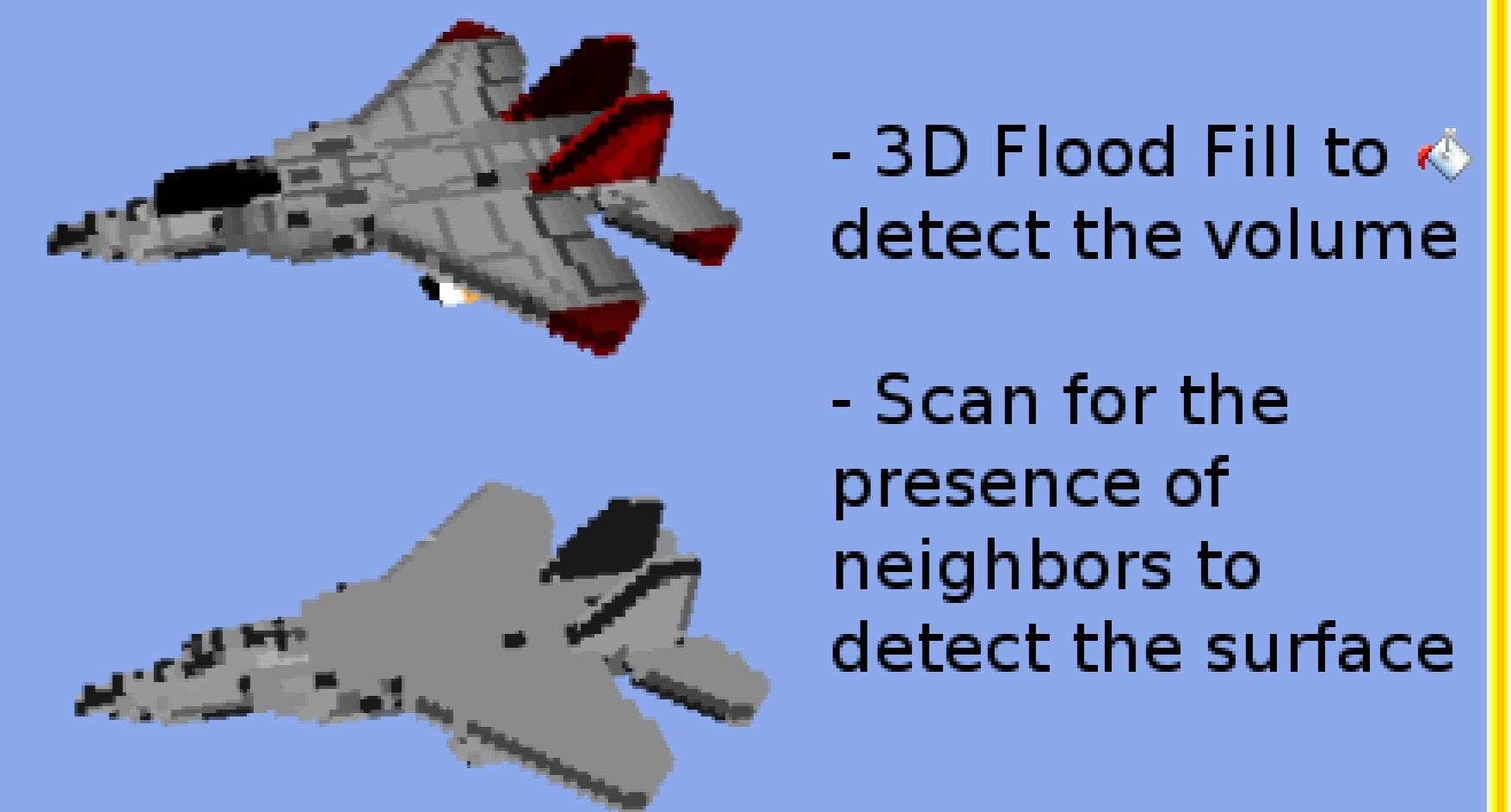
## 2. Overview:

This technique finds the surface normal of a voxel by finding the tangent plane from its 'derivative'.



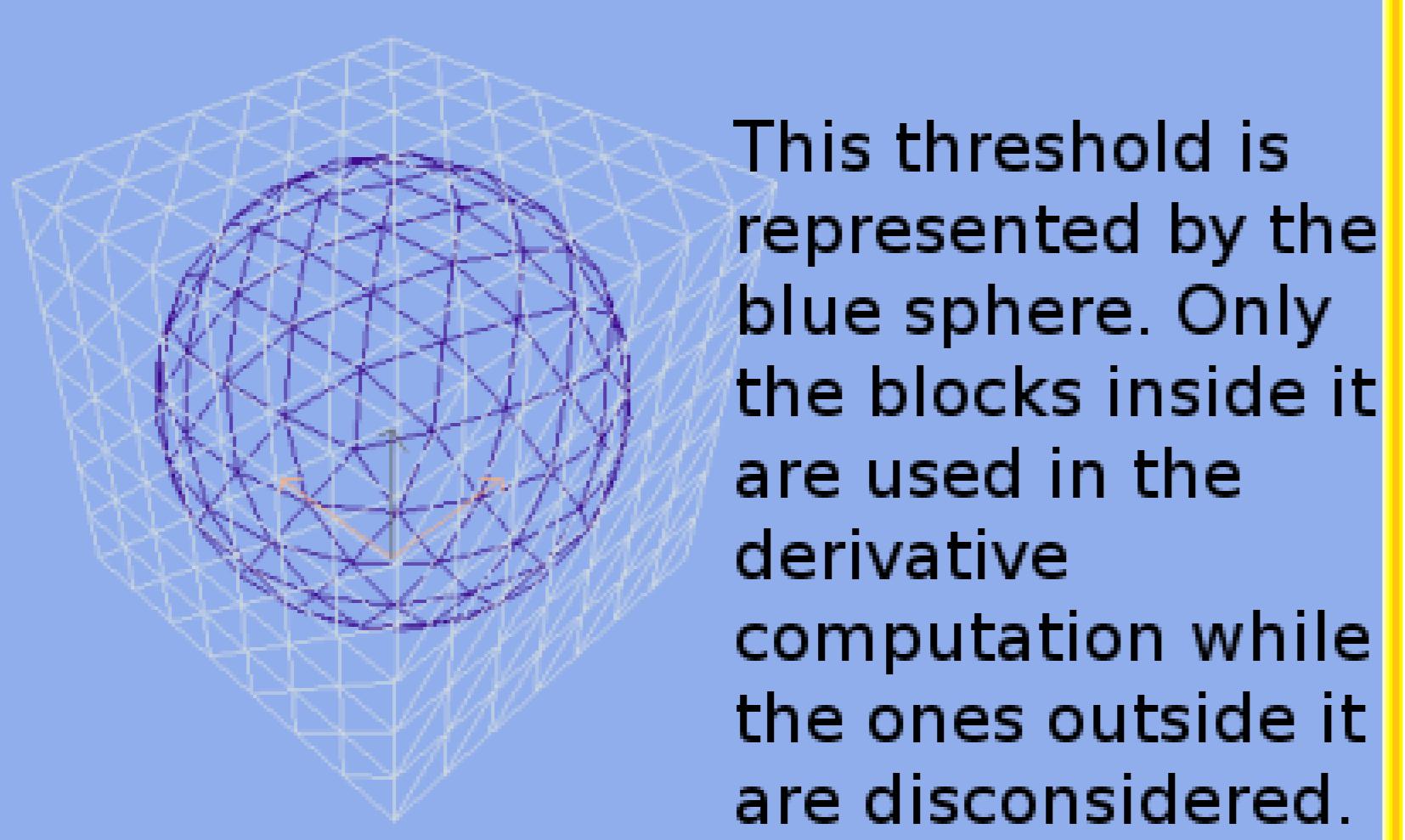
## 2.1. Classifying Voxels:

Distinguish the voxels that are part of the surface or of the volume from the others.



## 2.2. Tangent Plane:

The tangent plane will be parallel to the derivative computed with the neighbor voxels within a threshold.



## 2.2. Tangent Plane:

The farther a voxel is from the center of a surface, the lower its effect in the normal vector of the center.

$$f(X_p, Y_p, Z_p) = 1/\sqrt{((X_c - X_p)^2 + (Y_c - Y_p)^2 + (Z_c - Z_p)^2)}$$

Computing the partial derivatives:

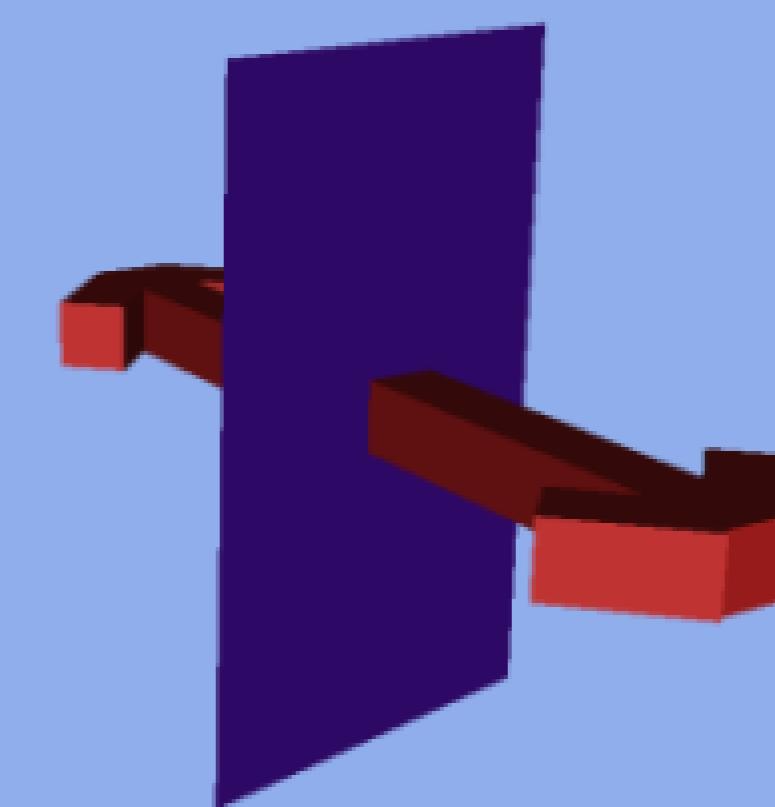
$$\partial F / \partial X_p = 3(X_c - X_p)/(\sqrt{(X_p - X_c)^2 + (Y_p - Y_c)^2 + (Z_p - Z_c)^2})^3$$

$$\partial F / \partial Y_p = 3(Y_c - Y_p)/(\sqrt{(X_p - X_c)^2 + (Y_p - Y_c)^2 + (Z_p - Z_c)^2})^3$$

$$\partial F / \partial Z_p = 3(Z_c - Z_p)/(\sqrt{(X_p - X_c)^2 + (Y_p - Y_c)^2 + (Z_p - Z_c)^2})^3$$

## 2.3. The Ray Casting:

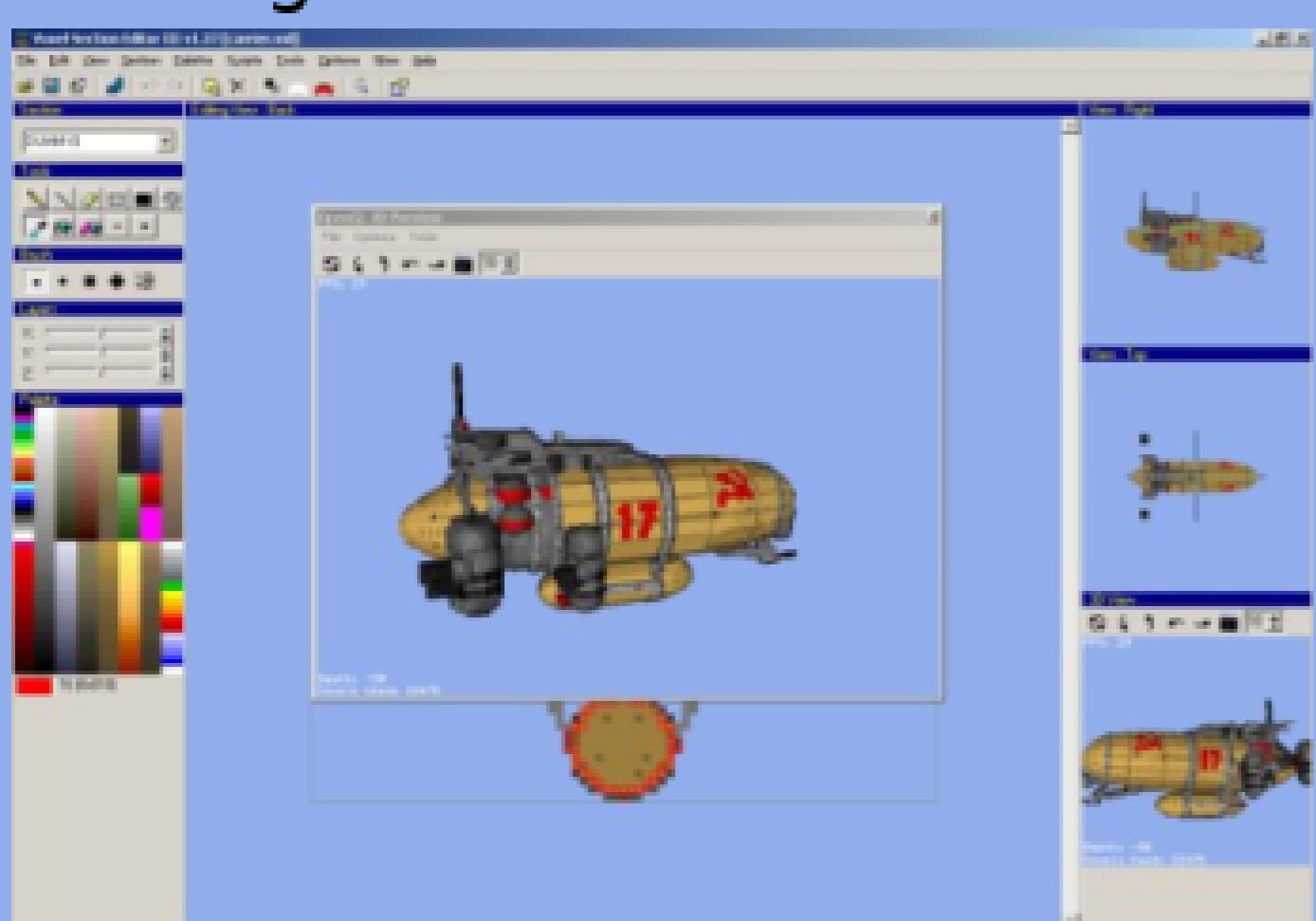
A plane may have two normals and, since the algorithm has no idea of the shape, it does not know which of them is correct.



The final ray casting will decide which of the two normals (red) is the correct one.

## 3. Tests and Results:

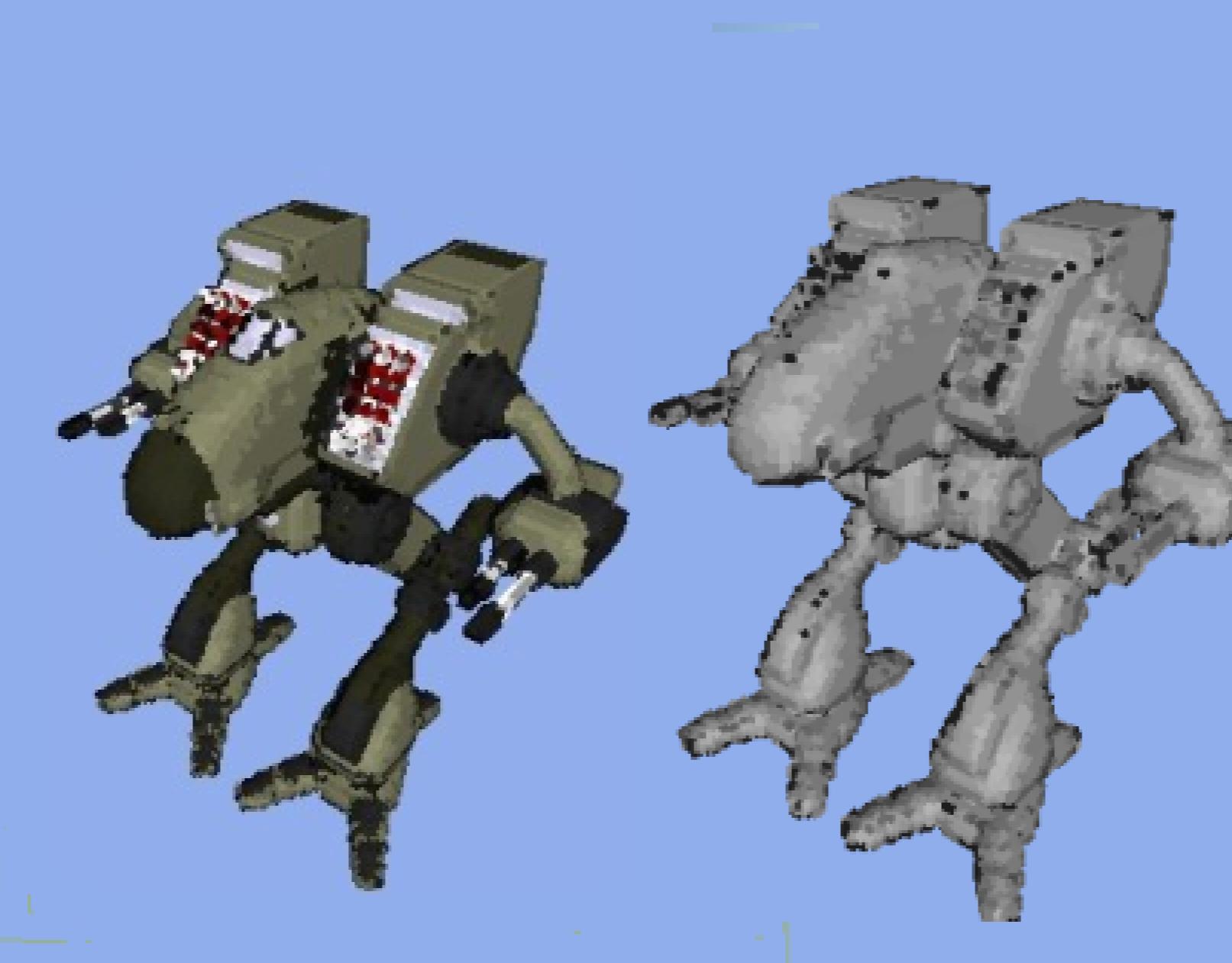
This algorithm was tested with



Voxel Section Editor III 1.37.

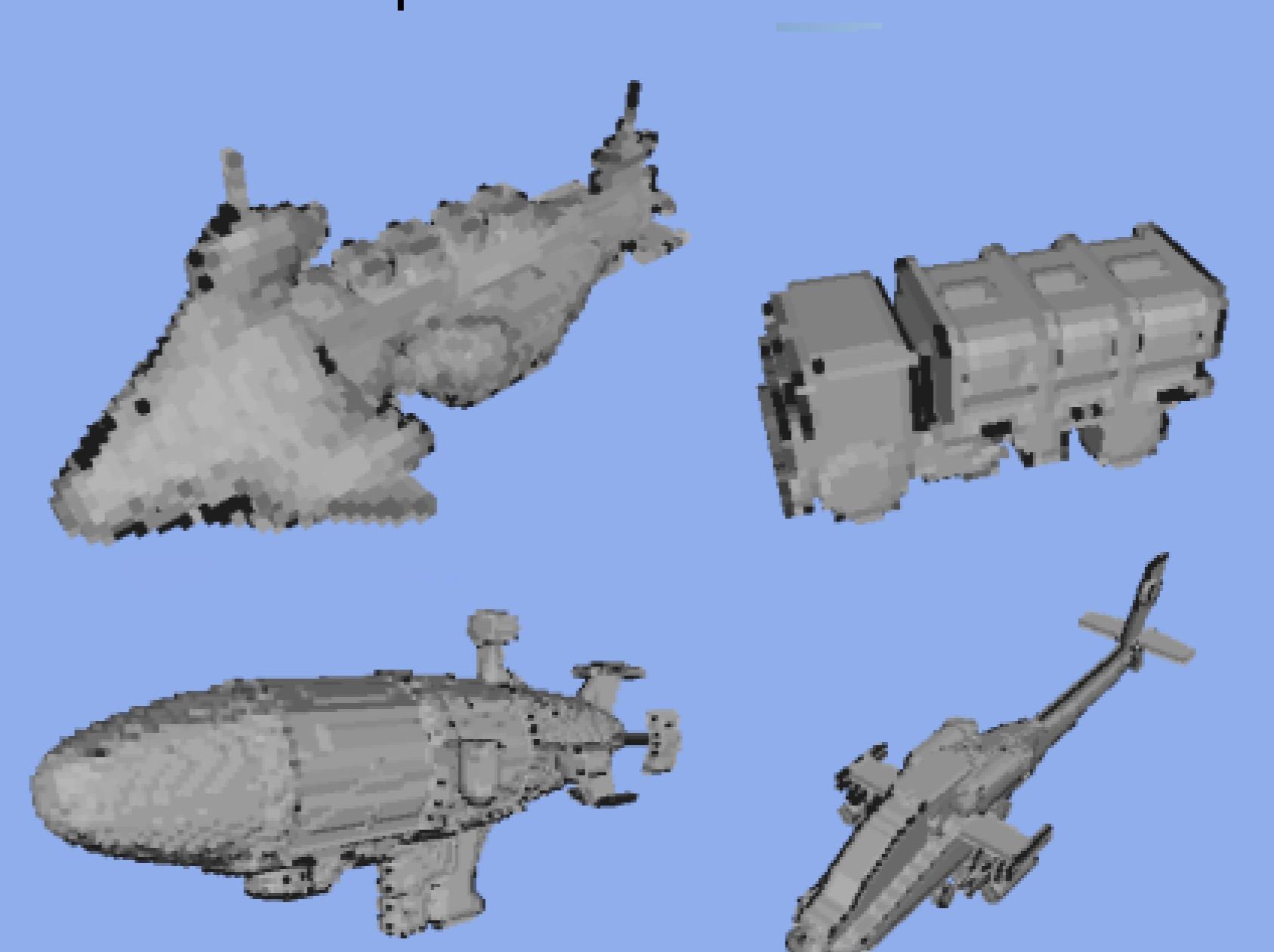
## 3. Tests and Results:

Colour and Normals view modes.



## 3. Tests and Results:

Several Samples.



BELO HORIZONTE - MG - BRAZIL