Each 3D-Gaussian defines an ellipsoid, it is important to adaptively generate new ellipsoids. The most important part is to generate the covariance matrix of the Gaussian.

3D-Gaussian and ellipsoid are isomorphic, while ellipsoid can be rotated by scaling the sphere axially, so we can initialization by using a combination of scaling transformation $S$ and rotation transformation $R$ to obtain the covariance matrix $\Sigma$ by letting

$$\Sigma = RSS^TR^T$$

After initialization, the under-reconstruction areas (first situation in \ref{fig:1}), the Gaussian point covers a small area, with great gradient but less value, the Gaussian points are cloned and translation along the gradient direction.

And for the over-reconstruction areas (second situation in \ref{fig:1}), the Gaussian point covers a large area, with great gradient and great value, the Gaussian points are splatted into two Gaussian points with small values, and then translation along the gradient direction.

With the splatting methods, the Gaussian points could better fit the shape of objects.