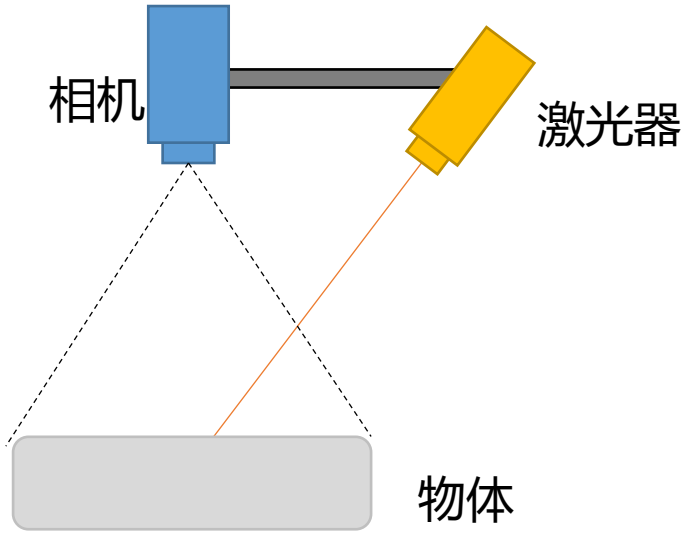
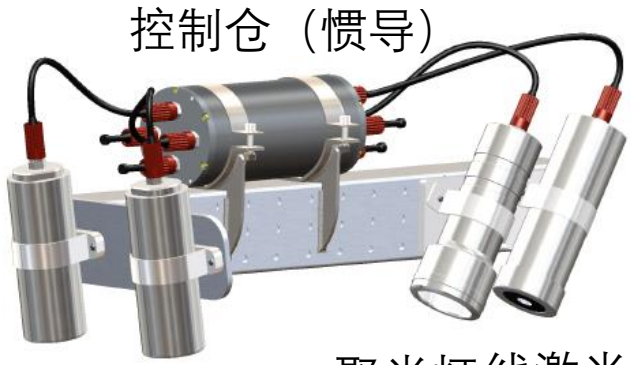
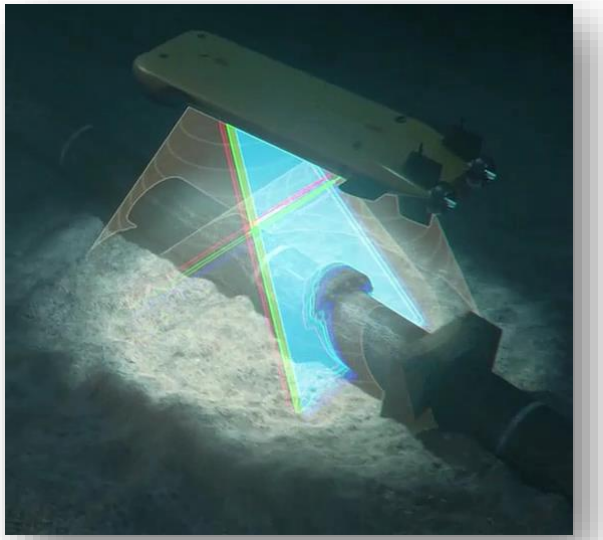
激光三角法

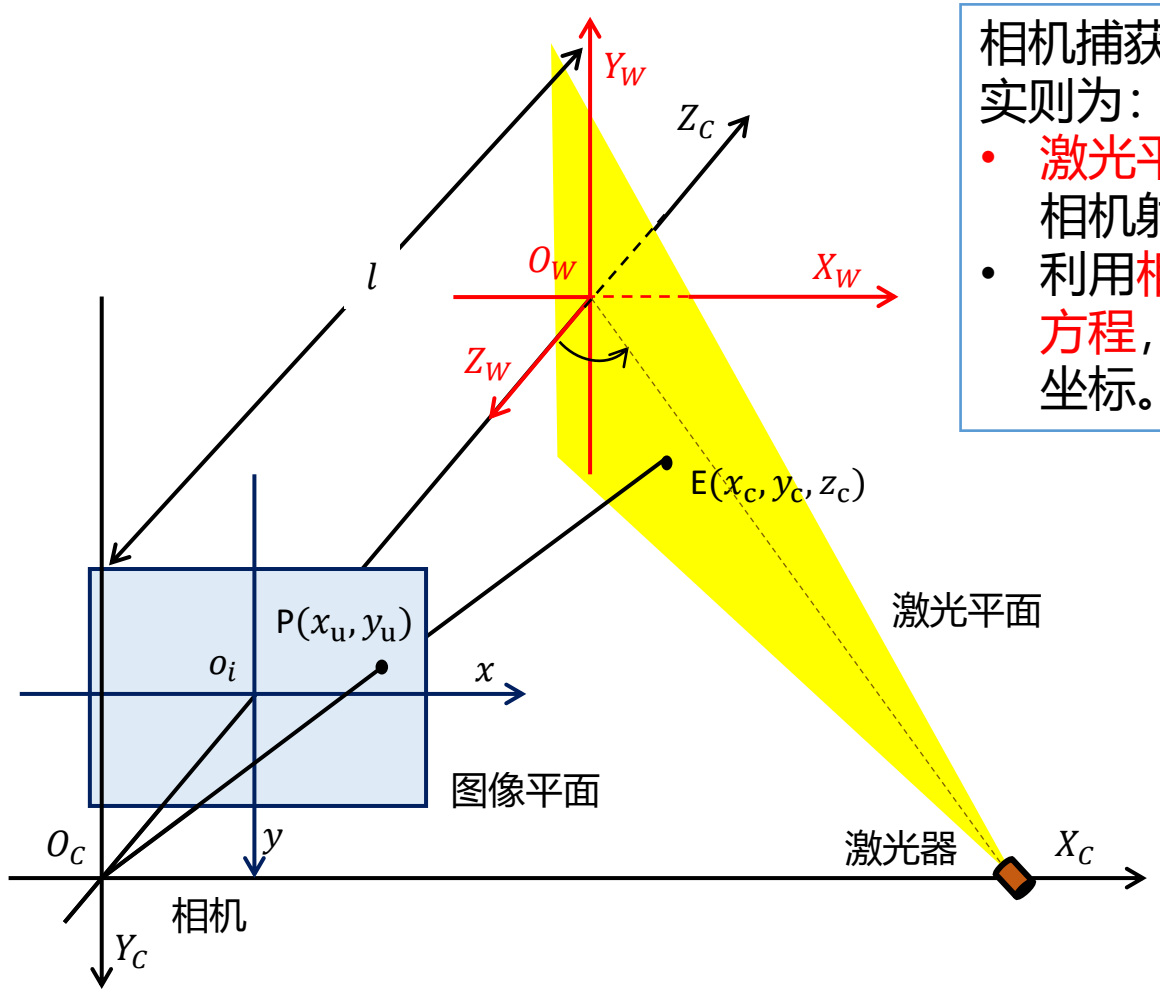
单目激光三角法







单目激光三角法



相机捕获物体表面的激光投影点实则为：

- 激光平面 与 激光点所在像素处的相机射线 的交点。
- 利用相机的标定信息 与 激光平面方程，可求解激光投影点的三维坐标。

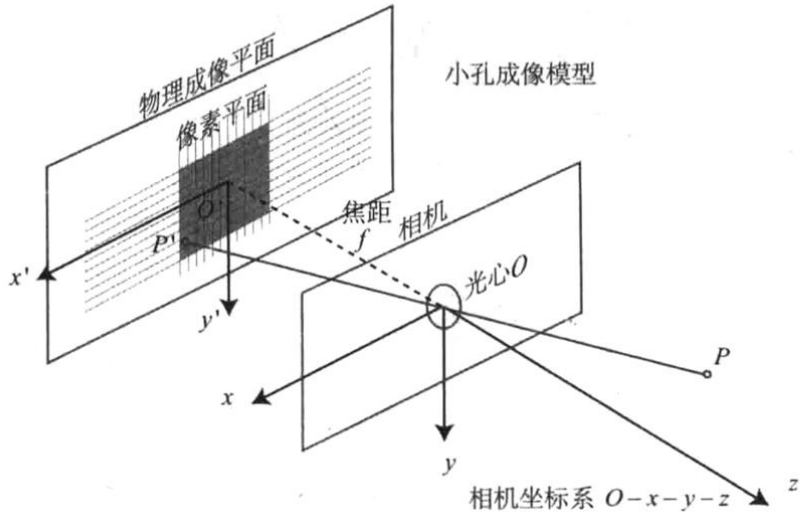
单目激光三角法--重建步骤

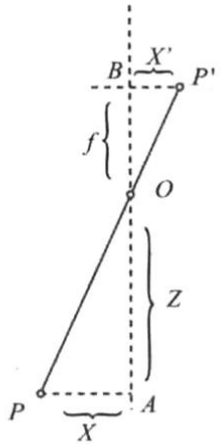
1. 相机标定
2. 激光线提取
3. 激光平面标定
4. 激光三角法

1.相机标定 -- 相机内参

invertible 3x3 camera calibration matrix **K**

$$\begin{pmatrix} \mathrm{X} \\ \mathrm{Y} \\ \mathrm{Z} \\ 1 \end{pmatrix} \mapsto \mathbf{x}_{\mathrm{px}} \sim \begin{pmatrix} \alpha_x \mathrm{X} + \mathrm{Z} x_0 \\ \alpha_y \mathrm{Y} + \mathrm{Z} y_0 \\ \mathrm{Z} \end{pmatrix} = \left[\begin{array}{ccc|c} \alpha_x & 0 & x_0 & 0 \\ 0 & \alpha_y & y_0 & 0 \\ 0 & 0 & 1 & 0 \end{array} \right] \begin{pmatrix} \mathrm{X} \\ \mathrm{Y} \\ \mathrm{Z} \\ 1 \end{pmatrix},$$





1.相机标定 --相机外参

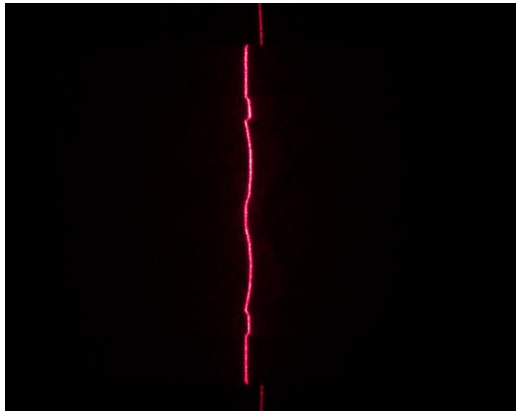
$(x_{px}, y_{px})^T$: Projected Pt in Pixel Coordinates [px] for Camera in Non-canonical Pose

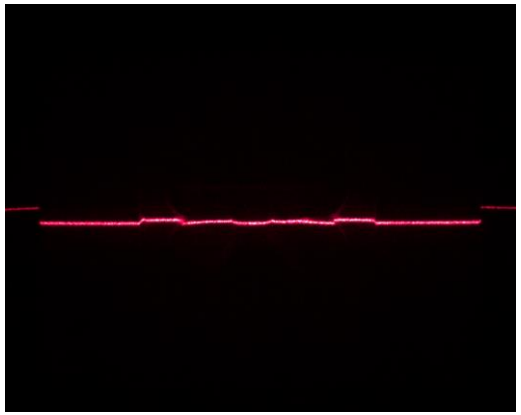
invertible 4x4 world-to-camera rigid body transformation matrix

$$\begin{pmatrix} X \\ Y \\ Z \\ 1 \end{pmatrix} \mapsto \mathbf{x}_{px} \sim \mathbf{PX} = \begin{bmatrix} \alpha_x & 0 & x_0 & 0 \\ 0 & \alpha_y & y_0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} \mathbf{R} & \mathbf{t} \\ \mathbf{0}^\top & 1 \end{bmatrix} \begin{pmatrix} X \\ Y \\ Z \\ 1 \end{pmatrix}$$

We use this decomposition rather than the equivalent and more common $\mathbf{P} = \mathbf{K}[\mathbf{R} \mid \mathbf{t}]$ since it will allow us to reason more easily about combinations of rigid body transformation matrices.

2. 激光线提取



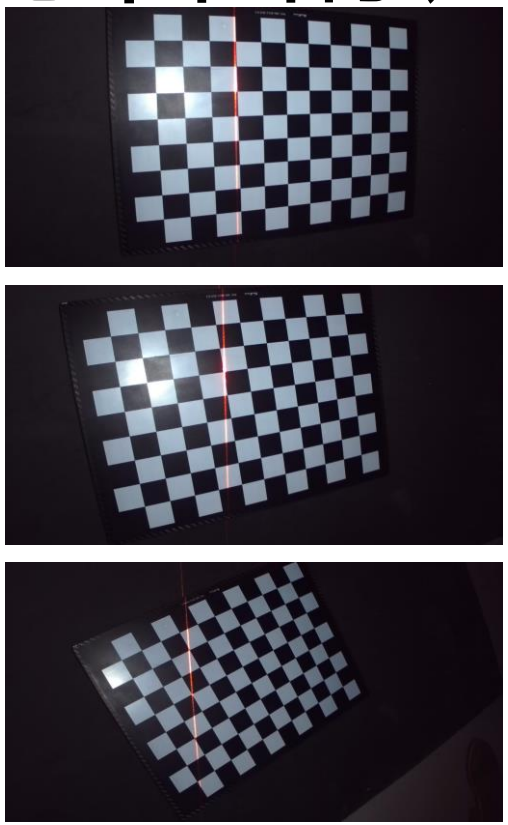


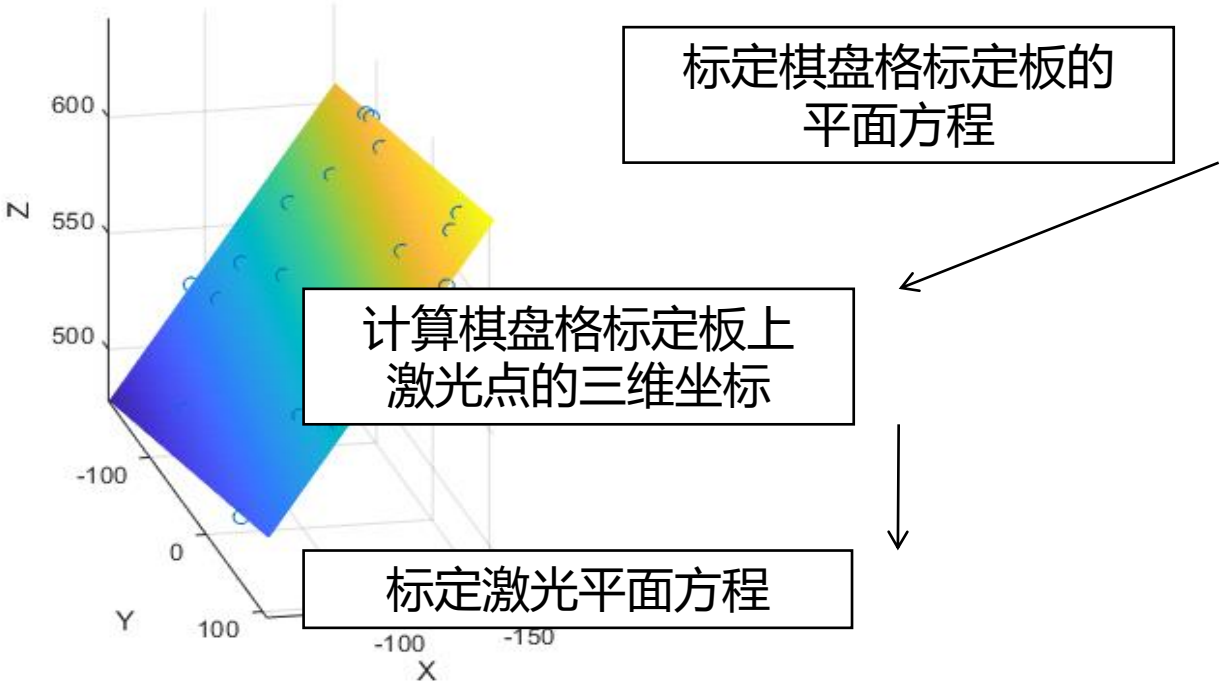
- **自由发挥**

如：基于灰度质心法和骨架的激光中心线提取_SLAM_masterFei的博客-CSDN博客

3.激光平面标定

$$AX_r + BY_r + CZ_r + D = 0$$





标定棋盘格标定板的
平面方程

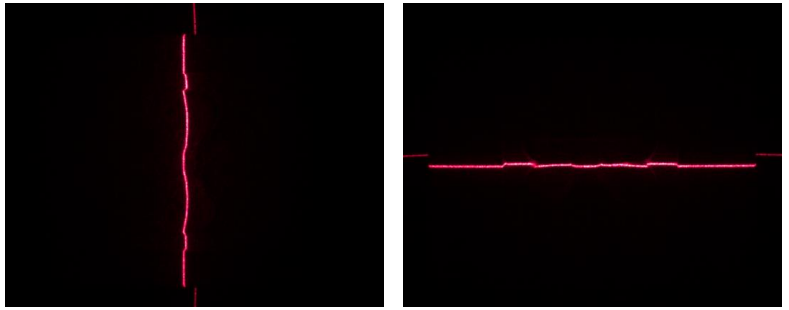
计算棋盘格标定板上
激光点的三维坐标

标定激光平面方程

4. 激光三角法

- 借助光线追踪（相机模型）和激光平面方程，求解激光投影点的三维信息
- 相机模型

$$\begin{cases} X_r = Z_r * x \\ Y_r = Z_r * y \end{cases}$$



- 激光平面

$$AX_r + BY_r + CZ_r + D = 0$$

- 上述方程的联合求解