Symbol	Name	Formula	Description / Example
		Homography	
$\tilde{X}_i^c$	Image coordinates	$\tilde{X}_i^c \backsim \tilde{H}_b^c \cdot \tilde{p}_i^b$	
K_c	Calibration matrix, Camera matrix	$K_c = \begin{bmatrix} f_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix}$	If $c_x = c_y = 0$ the camera produces centerd images
$\tilde{x}$	homogenous transformation	$\tilde{x} = K_c * \begin{bmatrix} x \\ y \\ z \end{bmatrix}$	for direction of light rays f.e.
$\tilde{p}_i^b$	Object point		Coordinates on the planar object
E_b^c	Camera extrinsic matrix	$E_b^c = \begin{bmatrix} R_b^c & t_{cb}^c \\ \begin{bmatrix} 0 & 0 & 0 \end{bmatrix} & 1 \end{bmatrix}$	Relative pose between object and camera
E_c^g	Inverse rigid motion matrix	$E_c^g = (E_g^c)^{-1} = \begin{bmatrix} R_g^c & t_{cg}^c \\ \vec{0} & 1 \end{bmatrix} = \begin{bmatrix} R_c^g & -R_c^g t_{cg}^c \\ \vec{0} & 1 \end{bmatrix}$	
R_b^c	Rotation matrix	$R_b^c = \begin{bmatrix} r_x & r_y & r_z \end{bmatrix}$	
t_{cb}^c	Translation vector	$t_c^b = p^c - R_b^c * p^b$	
$\vec{E}_g$	Coordinate frame basis	$\vec{E}_g = \begin{bmatrix} \vec{e}_{g,x} & \vec{e}_{g,y} & \vec{e}_{g,z} \end{bmatrix}$	A coordinate frame consists of a basis and and an origin
$\vec{o}_g$	Origin of the coordinate frame	$\vec{o}$	
$\vec{p}$	Point in the coordinate frame	$\vec{p} = \vec{e}_{g,x} \cdot p_x^g + \vec{e}_{g,y} \cdot p_y^g + \vec{e}_{g,z} \cdot p_z^g + \vec{o}_g$	
$\vec{p}$	Point in the coordinate frame	$\vec{p} = \vec{E}_g \cdot p^g + \vec{o}_g$	
H_b^c	Homography matrix	$H_b^c \backsim K_c \cdot \begin{bmatrix} r_{b,x}^c & r_{b,y}^c & t_{cb}^c \end{bmatrix}$	
$r_{b,x}^c$	Rotation vector x	$r_{b,x}^c = \begin{bmatrix} 0 & -t_{cb,z}^c & t_{cb,y}^c \end{bmatrix}$	
	Object point to image point	$\begin{bmatrix} x_{s,i} \\ y_{s,i} \\ 1 \end{bmatrix} = H_b^c \cdot \tilde{p}_i^b$	
		Hough transform	
x_i, y_i	Image space coordinates	$y_i = m \cdot x_i + c \Leftrightarrow c = -m \cdot x_i + y_i$	Converted to parameter space, lines
θ	Angle of point	θ	angle between x and line in parameter space
ρ	Proper Line Parametrization	$\rho = x\cos(\theta) + y\sin(\theta)$	length of line
ρ		$\rho = \begin{bmatrix} x \\ y \end{bmatrix}^t \cdot n$	Test if a point is on a line
n	normal vector	$n = \begin{bmatrix} \cos(\theta) \\ \sin(\theta) \end{bmatrix}$	Defined by the θ angle
		RANSAC probabilities	
ϵ	Probability of picking an outlier	$\epsilon = \frac{N_{outliers}}{N_{inliers} + N_{outliers}}$	with $N =$ no of, $s =$ points, $n =$ no. of trials
	probability of picking individual inlier	$p = 1 - \epsilon$	
	probability of picking s inliers in sequence	$p = (1 - \epsilon)^s$	
	probability of not picking s inliers in sequence	$p = 1 - (1 - \epsilon)^s$	
	probability of not picking s inliers in sequence of n trials	$p = (1 - (1 - \epsilon)^s)^n$	
	probability of picking at least in one of n trials s inliers in sequence	$p_{success} = 1 - (1 - (1 - \epsilon)^s)^n$	for lines 2 , for circles 3 points are needed
	expected number of trials needed	$n = \frac{log(1 - p_{success})}{log(1 - (1 - \epsilon)^s)}$	

Symbol	Name	Formula	Description / Example
		Geometric transformation	
$\tilde{x}$	Intersection of two lines	$\tilde{x} = \tilde{I_1} \times \tilde{I_2}$	cross product of two lines defines their intersection
$\tilde{I}$	two points lie on the line	$\tilde{I} = \tilde{x_1} \times \tilde{x_2}$	cross product of two points define their collective line
		Matrix basics	
E	unit matrix	$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$	
R^{-1}	Inverse rotational matrix	$R^{-1} = R^T$	
R_x	Rotational matrix around x	$R_x = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos & -\sin \\ 0 & \sin & \cos \end{bmatrix}$	
R_y	Rotational matrix around x	$R_y = \begin{bmatrix} \cos & 0 & \sin \\ 0 & 1 & 0 \\ -\sin & 0 & \cos \end{bmatrix}$	
R_z	Rotational matrix around x	$R_z = \begin{bmatrix} \cos & -\sin & 0 \\ \sin & \cos & 0 \\ 0 & 0 & 1 \end{bmatrix}$	
		Camera calculations	
F	Focal length in $[mm]$	$F = \frac{L * x_{chip}}{2 * W}$	L = Length from sensor to object, W = Width from sensor to object, all in $[mm]$
f_x	Focal length in $[\frac{pixel}{mm}]$	$f_x = \frac{F * x_{pixel}}{x_{chip}}$	x_{pixel} = pixel in x-direction x_{chip} = length of sensor chip in x-direction, analog for f_y with y_{pixel} and y_{chip}
f_x, f_y	Focal length (Assumption)	$f_x = f_y = f$	In some calcuations just assume: focal length is the same in both directions
c_x, c_y	image center coordinates	$c_x = \frac{x_{pixel}}{2}$	optical axis pointing perpendicularly through sensor chip center, analog for f_y with y_{pixel} and y_{chip}