Glossary

Image formation

Depth of field	distance between the nearest and farthest objects in a scene that appear acceptably sharp in an image
Field of view	angular portion of 3D scene seen by the camera
Focal length	distance from C to F
Focal point	point of intersection of light rays parallel to optical axis of convex lens
Object distance	distance from object to C
Optical axis	line through C and its projection onto the image plane
Principal point	intersection of the optical axis with the image plane

Multiple view geometry

Baseline	distance between the optical centers of two cameras

Symbols

Frame transformation

$\mathcal{C}$	potentially moving camera reference frame
$\mathcal{A}$	arbitrary reference frame
${}_{\mathcal{A}}\mathbf{e}_x^{\mathcal{B}}$	x basis vector of $\mathcal{B}$ (expressed in $\mathcal{A}$)
${}_{\mathcal{A}}\mathbf{e}_y^{\mathcal{B}}$	y basis vector of $\mathcal{B}$ (expressed in $\mathcal{A}$)
${}_{\mathcal{A}}\mathbf{e}_z^{\mathcal{B}}$	z basis vector of $\mathcal{B}$ (expressed in $\mathcal{A}$)
$\mathcal{B}$	arbitrary reference frame
$\mathbf{T}_{\mathcal{AB}}$	homogeneous transformation from $\mathcal{B}$ to $\mathcal{A}$
$Y^{\mathcal{A}}$	y coordinate of ${}_{\mathcal{A}}\mathbf{P}$
${}_{\mathcal{A}}\tilde{\mathbf{P}}$	homogeneous coordinate vector of P (expressed in $\mathcal{A}$)
$X^{\mathcal{A}}$	x coordinate of ${}_{\mathcal{A}}\mathbf{P}$
$Z^{\mathcal{A}}$	z coordinate of ${}_{\mathcal{A}}\mathbf{P}$
${}_{\mathcal{A}}\mathbf{P}$	coordinate vector of P (expressed in $\mathcal{A}$)
P	arbitrary point in 3D
$\mathbf{R}_{21}$	passive elementary rotation (about a single axis) from an intermediate reference frame 1 to 2
$\mathbf{R}_{\mathcal{A}2}$	passive elementary rotation (about a single axis) from an intermediate reference frame 2 to $\mathcal{A}$
$\mathbf{R}_{\mathcal{AB}}$	passive rotation matrix from $\mathcal{B}$ to $\mathcal{A}$
$\mathbf{R}_{1\mathcal{B}}$	passive elementary rotation (about a single axis) from $\mathcal{B}$ to an intermediate reference frame 1
${}_{\mathcal{A}}\mathbf{t}_{\mathcal{AB}}$	translation from origin of $\mathcal{A}$ to origin of $\mathcal{B}$ (expressed in $\mathcal{A}$)

$\mathcal{W}$	fixed, stationary world reference frame

Image formation

L	size of aperture
e	distance from C to focal plane
δ	distance from focal plane to image plane
α_u, α_v	focal lengths expressed in pixels
f	focal length
F	focal point
$\mathbf{K}$	calibration/intrinsic parameter matrix
Z	object distance
Z_c	optical axis
C	optical center/center of projection
k_u	inverse of pixel size along x (pixel conversion factor)
k_v	inverse of pixel size along y (pixel conversion factor)
x	x coordinate p (expressed in image frame)
x	y coordinate p (expressed in image frame)
$\tilde{\mathbf{p}}$	homogeneous coordinate vector of p (expressed in pixel frame)
$\tilde{\bar{\mathbf{p}}}$	homogeneous unit-plane normalized coordinate vector of p (expressed in pixel frame)
$\bar{\mathbf{p}} = [\bar{u} \ \bar{v}]^\top$	unit-plane normalized coordinate vector of p (expressed in pixel frame)
$\mathbf{p} = [u \ v]^\top$	coordinate vector of p (expressed in pixel frame)
p	P projected onto image plane
u_O	horizontal coordinate of O (expressed in image frame)
v_O	vertical coordinate of O (expressed in image frame)
O	principal point

Calibration

$\mathbf{H}$	homography

Filtering

$\mathbf{G}_\sigma$	gaussian filter
$\mathbf{H}[u, v]$	filter/kernel/mask/template
$\mathbf{I}'[x, y]$	intensity of filtered image pixel (x, y)
$\mathbf{I}[x, y]$	intensity of original image pixel (x, y)

Feature detection

R	cornerness function
k	magic number for Harris detector $\in [0.04, 0.15]$
$\mathbf{M}$	second moment matrix

Feature matching

d_1	distance from closest descriptor
d_2	distance from second closest descriptor
s	number of layers per scale octave (SIFT)

Multiple view geometry

b	baseline
$\mathbf{C}_k$	camera pose at time k
$\mathbf{n}$	epipolar plane normal
$\mathbf{e}_l$	epipole
$\mathbf{E}$	essential matrix
$\mathbf{F}$	fundamental matrix
$(\cdot)_{l,r}$	indices for left and right camera
N	number of (3D) points in SFM
n	number of views in n-view SFM
${}_{\mathcal{W}}\mathbf{C}$	coordinate vectors of C (expressed in $\mathcal{W}$)
$\bar{\mathbf{p}} \equiv {}_{\mathcal{C}}\mathbf{p}$	homogeneous unit-plane normalized coordinate vector of p (expressed in pixel frame)
$\tilde{\mathbf{p}}'$	homogeneous coordinate vector of P projected on rectified image plane (expressed in pixel frame)
$\hat{\mathbf{p}}$	Normalized (to range $[-1,1] \times [-1,1]$) coordinate vector of p (expressed in pixel frame)
$\mathbf{p}'$	coordinate vector of P projected on rectified image plane (expressed in pixel frame)

Tracking

$\mathbf{f}^i$	observed feature position in current image (at position $\mathbf{x}^i$ in template)
$\mathbf{T}[x, y]$	intensity of template image at pixel (x, y)
$\mathbf{W}(\mathbf{x}; \mathbf{p})$	transformation (warp parameterized by $\mathbf{p}$) of template point $\mathbf{x}$

Visual inertial fusion

$\mathbf{g}$	gravity vector (expressed in $\mathcal{W}$)
$\boldsymbol{\omega}$	angular velocity (true value) (expressed in $\mathcal{B}$)
$\tilde{\boldsymbol{\omega}}$	angular velocity measurement (expressed in $\mathcal{B}$)
$\mathbf{q}$	orientation/attitude of IMU (rotation $\mathbf{R}_{\mathcal{W}\mathcal{B}}$)
$\mathbf{b}^A$	accelerometer bias (expressed in $\mathcal{B}$)
$\mathbf{b}^G$	gyroscope bias (expressed in $\mathcal{B}$)
$\mathcal{B}$	body reference frame
$\boldsymbol{\Sigma}_k^i$	covariance of $\mathbf{f}^i$ at time t_k
$\mathbf{z}^i$	observed (2D) features, $i = 1, \ldots, M$
$(\cdot)_k$	index for t_k

$\mathbf{u} = \{\tilde{\boldsymbol{\omega}}, \tilde{\mathbf{a}}\}$	IMU measurements in time interval $[t_{k-1}, t_k]$ (expressed in $\mathcal{B}$)
$\mathbf{L} = \{\mathbf{L}^i\}$	Set of 3D landmarks (expressed in $\mathcal{W}$), $i = 1, \ldots, M$
$\mathbf{a}$	linear acceleration (true value) (expressed in $\mathcal{B}$)
$\tilde{\mathbf{a}}$	linear acceleration measurement (expressed in $\mathcal{B}$)
N	number of camera poses/state estimates
$\mathbf{n}^A$	accelerometer additive zero-mean Gaussian white noise (expressed in $\mathcal{B}$)
$\mathbf{n}^G$	gyroscope additive zero-mean Gaussian white noise (expressed in $\mathcal{B}$)
M	number of landmarks/features
$\mathbf{p}$	Position (expressed in $\mathcal{W}$)
$\mathbf{R}_{\mathcal{BW}}$	passive rotation from $\mathcal{W}$ to $\mathcal{B}$
$\boldsymbol{\Lambda}_k$	covariance of $\mathbf{x}_k$ at time t_k
$\mathbf{x} = [\mathbf{p}\ \mathbf{q}\ \mathbf{v}]^\top$	state estimate (expressed in $\mathcal{W}$)
$\mathbf{X} = \{\mathbf{x}_k\}$	Set of state estimates at times t_k, $k = 1, \ldots, N$
σ_b	standard deviation of zero-mean Gaussian noise bias derivative
t_k	time at iteration k
$\pi(\mathbf{x}_k, \mathbf{L}^i)$	perspective projection of $\mathbf{L}^i$ onto image plane (expressed in $\mathcal{C}$ defined by $\mathbf{x}_k$)
$\mathbf{v}$	velocity (expressed in $\mathcal{W}$)

Event-based vision

C	contrast sensitivity

Abbreviations

Initialisms

FOV (field of view)