COLA

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Contents

Chapter 1

Hierarchical Index

1.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 2

Class Index

2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 3

Class Documentation

3.1 COLA::DrawTools Class Reference

DrawTools is a class containing useful utilities for drawing outputs from COLA.

`#include <DrawTools.h>`

Public Member Functions

- void DrawFlowPoint (cv::Mat &output, cv::Mat &input_frame, FlowPoint &flow_vector)

  DrawFlowPoint is used to plot a plot point on an image.
- void DrawMatches (cv::Mat &output, FrameDescriptor &train, FrameDescriptor &query, FlowField &field)

  DrawMatches is used to plot matches from a COLA::FlowField onto an output buffer.
- void DrawTau (cv::Mat &output, COLA::TauMat &tau_field)

  DrawTau is used to plot a Tau point on an image.

3.1.1 Detailed Description

DrawTools is a class containing useful utilities for drawing outputs from COLA.

The Drawtools class provides functions for drawing matches, flow points, and tau fields

3.1.2 Member Function Documentation

3.1.2.1 void COLA::DrawTools::DrawFlowPoint (cv::Mat & *output*, cv::Mat & *input_frame*, FlowPoint & *flow_vector*)

DrawFlowPoint is used to plot a plot point on an image.

Parameters

&output	Contains a reference to the output frame we will write to.
&input_frame	Contains a reference to the output buffer
&flow_vector	Contains a flow vector reference that will be plotted on the output buffer.

3.1.2.2 void COLA::DrawTools::DrawMatches (cv::Mat & *output*, FrameDescriptor & *train*, FrameDescriptor & *query*, FlowField & *field*)

DrawMatches is used to plot matches from a COLA::FlowField onto an output buffer.

Parameters

output	contains a reference to the output frame we will write to.
train	Source of the train portion of the match set from
query	Source of the query portion of the match set from
field	The field that will be used to source the matches for the given frame set.

3.1.2.3 void COLA::DrawTools::DrawTau (cv::Mat & *output*, COLA::TauMat & *tau_field*)

DrawTau is used to plot a Tau point on an image.

Parameters

&output	Contains a reference to the output frame we will write to.
&tau_field	A reference to the tau field to be plotted

The documentation for this class was generated from the following files:

- include/COLA/DrawTools.h
- src/DrawTools.cpp

3.2 COLA::FeatureTracker Class Reference

Track features between frame pairs.

`#include <FeatureTracker.h>`

Public Member Functions

- FeatureTracker (unsigned int maxFeatures=1000)

  FeatureTracker Constructor, initializes the image algorithms and sets max features to track. We use max features as a means of constraining the computational complexity of the algorithm. FeatureTracker will save the first n features until maxFeatures is reached.
- virtual ~FeatureTracker ()

  Destructor.
- bool generateDescriptors (COLA::FrameDescriptor &frameDescriptor)

  Generate the descriptors for a given frame.
- bool frameMatcher (COLA::FrameDescriptor &train, COLA::FrameDescriptor &query, COLA::FlowField &field)

  frameMatcher creates a COLA::FlowField for a pair of COLA::FrameDescriptors

3.2.1 Detailed Description

Track features between frame pairs.

This is the feature tracker used by COLA. We can select different algorithms for use in the tracker by assigning an instance to the relevant pointer in the constructor. It is assumes that all descriptors inherit the relevant interfaces from OpenCV.

3.2.2 Constructor & Destructor Documentation

3.2.2.1 COLA::FeatureTracker::FeatureTracker (unsigned int *maxFeatures* = 1000)

FeatureTracker Constructor, initializes the image algorithms and sets max features to track. We use max features as a means of constraining the computational complexity of the algorithm. FeatureTracker will save the first n features until maxFeatures is reached.

Parameters

maxFeatures	integer representation of the max features to track

3.2.3 Member Function Documentation

3.2.3.1 bool COLA::FeatureTracker::frameMatcher (COLA::FrameDescriptor & *train*, COLA::FrameDescriptor & *query*, COLA::FlowField & *field*)

frameMatcher creates a COLA::FlowField for a pair of COLA::FrameDescriptors

Parameters

&train	COLA::FrameDescriptor the set of train features
&query	COLA::FrameDescriptor the set of query features
&field	COLA::FlowField the data structure we store the flow field in (the difference between tracked points in train -> query)

3.2.3.2 bool COLA::FeatureTracker::generateDescriptors (COLA::FrameDescriptor & *frameDescriptor*)

Generate the descriptors for a given frame.

Parameters

&frameDescriptor	COLA::FrameDescriptor the query frame to generate descriptors for

The documentation for this class was generated from the following files:

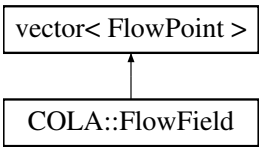
- include/COLA/FeatureTracker.h
- src/FeatureTracker.cpp

3.3 COLA::FlowField Class Reference

A FlowField represents a collection of FlowPoints from the same frame set.

`#include <FlowField.h>`

Inheritance diagram for COLA::FlowField:



Public Member Functions

- FlowField (int size)

  Constructor.
- void reset (void)

  Reset the FlowField This allows us to reset the flow field without releasing the memory allocated to the vector. This is useful when we have an upper bound on the number of possible flow points and do not want to have to reallocate memory in between matchings.

Public Attributes

- vector< vector< cv::DMatch > > matches

3.3.1 Detailed Description

A FlowField represents a collection of FlowPoints from the same frame set.

This is a vector grouping of FlowPoints for a given frame set. This is also used to carry the match vector used by the matcher for determining feature matches from the descriptors

3.3.2 Constructor & Destructor Documentation

3.3.2.1 COLA::FlowField::FlowField (int *size*)

Constructor.

Parameters

size	int the expected size of the flow field (used to pre-allocate the vector)

3.3.3 Member Data Documentation

3.3.3.1 vector<vector<cv::DMatch> > COLA::FlowField::matches

the vector of matches (for use by the matching algorithim)

The documentation for this class was generated from the following files:

- include/COLA/FlowField.h
- src/FlowField.cpp

3.4 COLA::FlowPoint Class Reference

FlowPoint is an object representation of an optical flow vector.

`#include <FlowField.h>`

Public Member Functions

- FlowPoint (cv::Point2f root, cv::Vec2f magnitude)

  FlowPoint Constructor (Pre-Calculated flow vector)
- FlowPoint (cv::Point2f start, cv::Point2f end, float time_delta)

  FlowPoint Constructor (Point Delta form)
- bool operator== (const FlowPoint &other) const

  FlowPoint equivalence operator This operator allows us to compare COLA::FlowPoints.

Public Attributes

- cv::Point2f location
- cv::Vec2f magnitude

3.4.1 Detailed Description

FlowPoint is an object representation of an optical flow vector.

A FlowPoint object represent the location and magnitude of an optical flow point.

3.4.2 Constructor & Destructor Documentation

3.4.2.1 COLA::FlowPoint::FlowPoint (cv::Point2f *root*, cv::Vec2f *magnitude*)

FlowPoint Constructor (Pre-Calculated flow vector)

This constructor is used if we have a flow point we already calculated the magnitude for.

Parameters

root	cv::Point2f the location the flow vector represent the flow for. This is the current location of the feature.
magnitude	cv::Vec2f floating point representation of the x and y portions of the optical flow vector magnitude

3.4.2.2 COLA::FlowPoint::FlowPoint (cv::Point2f *start*, cv::Point2f *end*, float *time_delta*)

FlowPoint Constructor (Point Delta form)

Parameters

start	cv::Point2f the initial feature location
end	cv::Point2f the current (final) location of the feature
time_delta	float the elapsed time (in seconds) between start and end

3.4.3 Member Function Documentation

3.4.3.1 bool COLA::FlowPoint::operator== (const FlowPoint & *other*) const

FlowPoint equivalence operator This operator allows us to compare COLA::FlowPoints.

Parameters

&other	COLA::FlowPoint a reference to the FlowPoint we wish to compare this too.

3.4.4 Member Data Documentation

3.4.4.1 cv::Point2f COLA::FlowPoint::location

The location of the flow point (currently)

3.4.4.2 cv::Vec2f COLA::FlowPoint::magnitude

The magnitude of the flow

The documentation for this class was generated from the following files:

- include/COLA/FlowField.h
- src/FlowField.cpp

3.5 COLA::FrameDescriptor Class Reference

An object to contain all the relevant feature information for a frame.

`#include <FrameDescriptor.h>`

Public Member Functions

- FrameDescriptor (int numberOfFeatures=1000, cv::Rect roi_rect=cv::Rect())

  Constructor.
- void normalizeKeypoints (void)

  Transforms the KeyPoint vector to real-space.
- void reset (void)

  prepare for a new reference frame without deallocating memory

Public Attributes

- cv::Rect roi_rect
- bool roi_set
- cv::Point2f roi_offset
- std::vector< cv::KeyPoint > featurePoints
- cv::Mat descriptors
- int frame_number
- struct timespec timestamp
- cv::Mat refFrame
- cv::Mat * process_frame

3.5.1 Detailed Description

An object to contain all the relevant feature information for a frame.

The FrameDescriptor class is a data structure that represents everything we know about a given frame. It contains the ROI information, source frame, Key Points (where interesting features are located) and the descriptors for those features. It also contains timestamp information useful for determining the elapsed time between frames. This is represented by both timestamp (for real-time implementations) and frame number (for offline video processing). See COLA::Time for more information on how time is tracked by the program. The ROI rectangle is used to create an ROI image from the original frame. This way, we can track the normalization of keypoints with respect to the original image.

3.5.2 Constructor & Destructor Documentation

3.5.2.1 COLA::FrameDescriptor::FrameDescriptor (int *numberOfFeatures* = `1000`, cv::Rect *roi_rect* = `cv::Rect()`)

Constructor.

We initialize a frame descriptor with number of feature and an optional ROI rectangle.

Parameters

numberOf↩ Features	int the maximum number of features to track

roi_rect	cv::Rect the ROI rectangle we will use to generate the sub-image for processing.

3.5.3 Member Function Documentation

3.5.3.1 void COLA::FrameDescriptor::normalizeKeypoints (void)

Transforms the KeyPoint vector to real-space.

This function allows us to transform the keypoints from ROI space to the full image space. This function will only carry out the transform once to prevent accidentally breaking the keypoint vector.

3.5.3.2 void COLA::FrameDescriptor::reset (void)

prepare for a new reference frame without deallocating memory

This resets the state of the frame descriptor by clearing the keypoint vector

3.5.4 Member Data Documentation

3.5.4.1 cv::Mat COLA::FrameDescriptor::descriptors

The matrix of descriptors for the frame keypoints

3.5.4.2 std::vector<cv::KeyPoint> COLA::FrameDescriptor::featurePoints

A vector of keypoints generated by the feature extractor.

3.5.4.3 int COLA::FrameDescriptor::frame_number

A number representing the number of frames since the start of the program

3.5.4.4 cv::Mat* COLA::FrameDescriptor::process_frame

A pointer to the memory location of the frame (or subframe) we are going to run the algorithm on.

3.5.4.5 cv::Mat COLA::FrameDescriptor::refFrame

The original image this descriptor set belongs too.

3.5.4.6 cv::Point2f COLA::FrameDescriptor::roi_offset

The vector representing the offset between the original image and the ROI rectangle

3.5.4.7 cv::Rect COLA::FrameDescriptor::roi_rect

a rectangle representing the Region of Interest (ROI)

3.5.4.8 bool COLA::FrameDescriptor::roi_set

if true, we have set a Region of Interest

3.5.4.9 struct timespec COLA::FrameDescriptor::timestamp

Represents the CPU time when the frame was created. We use this in determining the real elapsed time.

The documentation for this class was generated from the following files:

- include/COLA/FrameDescriptor.h
- src/FrameDescriptor.cpp

3.6 COLA::GlobalFlow Class Reference

Calculates the global flow from a COLA::FlowField.

`#include <GlobalFlow.h>`

Public Member Functions

- GlobalFlow (cv::Size frame_size)

  Constructor (Pre-allocation)
- COLA::FlowPoint CalculateGlobalFlow (COLA::FlowField &flowField)

  Global Flow calculator.

3.6.1 Detailed Description

Calculates the global flow from a COLA::FlowField.

Sometimes we would like to see the flow of the whole image, we accomplish this by averaging an entire FlowField for a given set of frames.

3.6.2 Member Function Documentation

3.6.2.1 COLA::FlowPoint COLA::GlobalFlow::CalculateGlobalFlow (COLA::FlowField & *flowField*)

Global Flow calculator.

Parameters

&flowField	COLA::FlowField a reference to the flow field we will average to return the global flow vector.

Returns

COLA::FlowPoint the optical flow vector representing the average flow of the image. The location of this vector is assumed to be the camera nodal point.

The documentation for this class was generated from the following files:

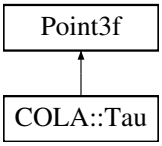
- include/COLA/GlobalFlow.h
- src/GlobalFlow.cpp

3.7 COLA::Tau Class Reference

Calculate the Tau value for a FlowPoint.

`#include <Tau.h>`

Inheritance diagram for COLA::Tau:



Public Member Functions

- Tau (float tau, cv::Point2f location)

  Constructor (Pre-calculated Tau)
- Tau (COLA::FlowPoint &flow_pt, cv::Point2f &nodal)

  Constructor (Calculate Tau from FlowPoint)

Public Attributes

- float tau
- cv::Point2f location
- cv::Point2f nodal

3.7.1 Detailed Description

Calculate the Tau value for a FlowPoint.

Tau is a mathematical representation of the time to collision with an object. Tau is effectively the orthogonal projection of the flow vector onto the nodal point.

$$\tau = \frac{||\vec{AN}||}{||\vec{AN}_{flow}||}$$

3.7.2 Constructor & Destructor Documentation

3.7.2.1 COLA::Tau::Tau (float *tau*, cv::Point2f *location*)

Constructor (Pre-calculated Tau)

Parameters

tau	float the time until impact
location	cv::Point2f the location of the tau point.

3.7.2.2 COLA::Tau::Tau (COLA::FlowPoint & *flow_pt*, cv::Point2f & *nodal*)

Constructor (Calculate Tau from FlowPoint)

This constructor calculates tau from a flow point and specified nodal (in relation to the FlowPoint.

Parameters

&flow_pt	COLA::FlowPoint the flow point we will calculate tau for

&nodal	cv::Point2f the nodal point of the camera (usually the center point of the frame)

3.7.3 Member Data Documentation

3.7.3.1 cv::Point2f COLA::Tau::location

The current location of the point on the image plane

3.7.3.2 cv::Point2f COLA::Tau::nodal

The nodal point of the camera (in reference to the image plane) used to calculate the Tau value

3.7.3.3 float COLA::Tau::tau

The time until collision in seconds

The documentation for this class was generated from the following files:

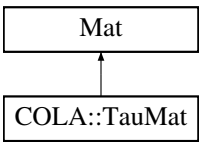
- include/COLA/Tau.h
- src/Tau.cpp

3.8 COLA::TauMat Class Reference

Tau Mat UNSTABLE.

`#include <Tau.h>`

Inheritance diagram for COLA::TauMat:



Public Member Functions

- TauMat (cv::Size mat_size, vector< COLA::Tau > tau_field)
  Constructor (Create from vector<COLA::Tau>)

3.8.1 Detailed Description

Tau Mat UNSTABLE.

This object is currently not in a stable state, however, it is designed to report the tau values in a matrix normalized to uchar for display

3.8.2 Constructor & Destructor Documentation

3.8.2.1 COLA::TauMat::TauMat (cv::Size *mat_size,* vector< COLA::Tau > *tau_field*)

Constructor (Create from vector<COLA::Tau>)

This constructor creates a TauMat from a tau_field vector of COLA::Tau points

Parameters

mat_size	cv::Size the size of the output matrix (usually same as the frame size)
tau_field	vector<COLA::Tau> a vector of COLA::Tau points

The documentation for this class was generated from the following files:

- include/COLA/Tau.h
- src/Tau.cpp

3.9 COLA::Time Class Reference

How COLA views time.

`#include <Time.h>`

Public Member Functions

- float timeElapsed (COLA::FrameDescriptor &start, COLA::FrameDescriptor &end)

  Returns the elapsed time in seconds.
- bool delay (void)

  burn off remaining time
- void setTime (COLA::FrameDescriptor &frame)

  sets the timestamp for NOW in a given COLA::FrameDescriptor

Static Public Member Functions

- static COLA::Time * Instance (int fps=DEFAULT_FPS, bool live=false)

  Singleton Constructor/Instance Retrieve.

Public Attributes

- bool isLag

Protected Member Functions

- Time (int fps, bool live)

  Constructor (PROTECTED)

3.9.1 Detailed Description

How COLA views time.

COLA::Time is a singleton object that makes a best effort at controlling the flow of time inside the program. For now, this is not written with actual real-time kernel usage. Essentially, the object "burns" time when the loop rate exceeds a pre designated FPS. It also contains a flag set when the loop time is above the current fps (the program is lagging).

Time has two modes, live and offline. The mode setting affects how time will externally report time. In offline mode, we assume that the data source is a video file. Thus, the time elapsed between frames is independent of the programs run time. Thus, time reports the elapsed time between to frames as the difference in frame number multiplied by the inverse of frames per second. In live mode, the object returns the actual clock difference between the two frames.

3.9.2 Constructor & Destructor Documentation

3.9.2.1 COLA::Time::Time (int *fps*, bool *live*) [protected]

Constructor (PROTECTED)

Created a time object. This should never be directly used as the object is meant to be a singleton

Parameters

fps	the frames per second we would like Time to try to maintain
live	sets weather we are operating in real-time (live) mode or offline.

3.9.3 Member Function Documentation

3.9.3.1 bool COLA::Time::delay (void)

burn off remaining time

This function burns off any time remaining in the loop (to match requested FPS) and sets isLag to false. If the time is greater, it returns immediatly with true (lag) and sets isLag to true.

Returns

bool if true, the program is lagging

3.9.3.2 Time * COLA::Time::Instance (int *fps* = DEFAULT_FPS, bool *live* = false) [static]

Singleton Constructor/Instance Retrieve.

Since time is a singleton object, the constructor is made private. Instead, we use use the public Instance method to get the current instantiation, or construct a new instantiation using the supplied arguments. NOTE: if the singleton has already been Instantiated, the arguments fed into instance are ignored.

Parameters

fps	the frames per second we want to run at
live	sets whether the object is in real-time or offline mode. True sets to real-time mode False sets to offline.

Returns

COLA::Time* the pointer to the global singleton instantiation.

3.9.3.3 void COLA::Time::setTime (COLA::FrameDescriptor & *frame*)

sets the timestamp for NOW in a given COLA::FrameDescriptor

This function updates the frame number (number of frames prior since the beginning of execution) (ALWAYS) and the timestamp (ONLY IN LIVE MODE)

Parameters

&frame	the reference to the frame we want to set the time for.

3.9.3.4 float COLA::Time::timeElapsed (COLA::FrameDescriptor & *start*, COLA::FrameDescriptor & *end*)

Returns the elapsed time in seconds.

This function returns the elapsed time in realtime or offline (frame count difference multiplied by inverse FPS) depending on how the original object was instantiated.

Parameters

&start	the earlier frame
&end	the later frame

Returns

float the elapsed time in seconds

3.9.4 Member Data Documentation

3.9.4.1 bool COLA::Time::isLag

Flag set when the program is lagging (i.e. the main loop takes longer to run than the requested FPS).

The documentation for this class was generated from the following files:

- include/COLA/Time.h
- src/Time.cpp