# Reference Manual

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# Contents

# Chapter 1

# DSA Konqueror and libframemanager

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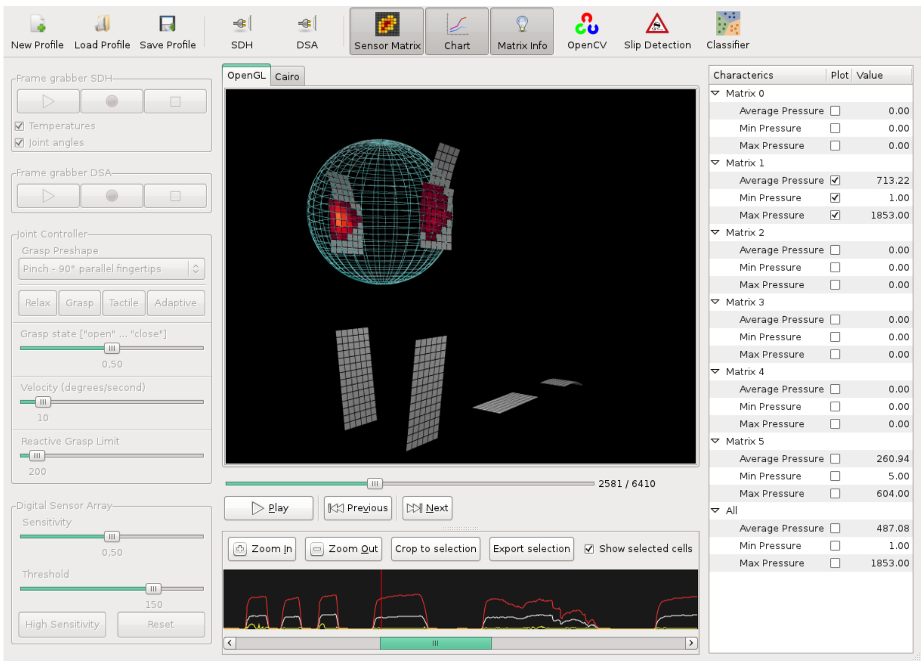


☑ Temperatures
☑ Joint angles

Grasp Preshape: Pinch - 90° parallel fingertips

Grasp state ["open" ... "close"]: 0,50

Velocity (degrees/second): 10

Reactive Grasp Limit: 200

Digital Sensor Array

Sensitivity: 0,50

Threshold: 150

2581 / 6410

☑ Show selected cells

| Characterics | Plot | Value |
|---|---|---|
| Matrix 0 | | |
| Average Pressure | ☐ | 0.00 |
| Min Pressure | ☐ | 0.00 |
| Max Pressure | ☐ | 0.00 |
| Matrix 1 | | |
| Average Pressure | ☑ | 713.22 |
| Min Pressure | ☑ | 1.00 |
| Max Pressure | ☑ | 1853.00 |
| Matrix 2 | | |
| Average Pressure | ☐ | 0.00 |
| Min Pressure | ☐ | 0.00 |
| Max Pressure | ☐ | 0.00 |
| Matrix 3 | | |
| Average Pressure | ☐ | 0.00 |
| Min Pressure | ☐ | 0.00 |
| Max Pressure | ☐ | 0.00 |
| Matrix 4 | | |
| Average Pressure | ☐ | 0.00 |
| Min Pressure | ☐ | 0.00 |
| Max Pressure | ☐ | 0.00 |
| Matrix 5 | | |
| Average Pressure | ☐ | 260.94 |
| Min Pressure | ☐ | 5.00 |
| Max Pressure | ☐ | 604.00 |
| All | | |
| Average Pressure | ☐ | 487.08 |
| Min Pressure | ☐ | 1.00 |
| Max Pressure | ☐ | 1853.00 |

Graphical user interface

**Date**

2015

## 1.1 Introduction

This software package was created during the course of my master thesis "Evaluation of Tactile Sensors" at the Intelligent and Interactive Systems group of the Institute of

Computer Science at the University of Innsbruck. My supervision was Professor Justus Piater, Ph.D.

Libframemanager consists of a frame manager and two separate frame grabbers. One grabber requests and processes the temperatures and axis angles received from the SDH-2 while the other captures the tactile sensor frames from the DSA controller. DSA Konqueror, not to be confused with DSA Explorer by Weiss Robotics, is a graphical user interface or GUI to control the SDH-2, i.e. perform grasps and display the tactile sensor readings. It simplifies the capturing and recording of pressure profiles and offers real-time visualization as well as offline processing. In addition, there are Python bindings to the most frequently used functionalities. See master thesis for details.

## 1.2 License

## 1.3 Installation

cd build

cmake ..

make VERBOSE=1

### 1.3.1 Dependencies

See "dependencies" folder

**C++**:

- SDH Library (patched version, see dependencies/dsa_patch)
- OpenCV
- Eigen 3
- Boost
- Boost.NumPy (extension for Boost.Python that adds NumPy support, see dependencies/Boost.NumPy)

- Gtkmm 2.4 (GUI)
- GtkGLExtmmb (OpenGL extension)

**Python 2.7**:

- numpy
- scipy
- sklearn
- cairo
- PIL

# Chapter 2

# Bug List

**Member SDHUSAGE_DEFAULT** When compiled with VCC then the macros WITH_-ESD_CAN / WITH_PEAK_CAN used above are not available since these are defined in the VCC project settings of the SDHLibrary VCC-Project. Therefore the value of SDHUSAGE_DEFAULT is incorrect and thus the cSDHOptions will display an incomplete usage string when called with -h/--help.

Workaround: use the online help contained in the doxygen documentation: `Online help of demonstration programs`

# Chapter 3

# Class Index

## 3.1 Class Hierarchy

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

# Chapter 4

# Class Index

## 4.1 Class List

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

# Chapter 5

# File Index

## 5.1 File List

Here is a list of all documented files with brief descriptions:

# Chapter 6

# Class Documentation

## 6.1 Calibration Class Reference

Reads an XML file containing the calibration parameters for the High-Sensitivity Mode.

```
#include <calibration.h>
```

### Public Member Functions

- Calibration ()
- void readTemperatureNoise (const std::string &filename)
- TemperatureNoise & getTemperatureNoise (uint matrixID)

### 6.1.1 Detailed Description

Reads an XML file containing the calibration parameters for the High-Sensitivity Mode.

**Note**

Regression parameters were determined with "noise-temperature_calibration.py" Values could be tweaked manually if wear and tear changes the sensor's behavior

### 6.1.2 Constructor & Destructor Documentation

#### 6.1.2.1 Calibration::Calibration ( )

Constructor that immediately imports the file "calibration_temperature_noise.xml"

### 6.1.3 Member Function Documentation

#### 6.1.3.1 TemperatureNoise & Calibration::getTemperatureNoise ( uint *matrixID* )

Returns the calibrated slope, intercept and RMSE of the specified sensor matrix

**Parameters**

| | |
|---|---|
| *matrixID* | Specified sensor matrix |

**Returns**

The linear regression parameters

#### 6.1.3.2 void Calibration::readTemperatureNoise ( const std::string & *filename* )

Reads calibration parameter file

**Parameters**

| | |
|---|---|
| *filename* | The XML file containing the calibrated parameters |

**Returns**

void

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

- calibration.h
- calibration.cpp

## 6.2 Camera Class Reference

Simple camera class similar to the ones used in first-person shooter video games. Based on the OpenGL coordinate system and gluLookAt().

```
#include <camera.h>
```

### Public Member Functions

- Camera (double x, double y, double z)
- Camera (Eigen::Vector3d pos)
- Camera (Eigen::Vector3d pos, Eigen::Vector3d view)
- void setPosition (Eigen::Vector3d pos)
- void setView (Eigen::Vector3d view)
- Eigen::Vector3d getPosition ()
- Eigen::Vector3d getView ()
- void rotateX (double angle)
- void rotateY (double angle)

- void moveX (double distance)
- void moveY (double distance)
- void moveZ (double distance)
- void move (Eigen::Vector3d &direction)
- void setup ()

### 6.2.1 Detailed Description

Simple camera class similar to the ones used in first-person shooter video games. Based on the OpenGL coordinate system and gluLookAt().

**Note**

There is a problem when upVector is colinear to viewVector. To prevent the so called *gimbal lock* , use a camera class based on Quaternions instead.

### 6.2.2 Constructor & Destructor Documentation

#### 6.2.2.1 Camera::Camera ( double *x*, double *y*, double *z* )

Delegating constructor

**Parameters**

| | |
|---|---|
| *x,y,z* | Coordinates of the initial position in 3D space. |

#### 6.2.2.2 Camera::Camera ( Eigen::Vector3d *pos* )

Delegating constructor

**Parameters**

| | |
|---|---|
| *pos* | Coordinate vector of the initial position in 3D space. |

#### 6.2.2.3 Camera::Camera ( Eigen::Vector3d *pos*, Eigen::Vector3d *view* )

Delegating constructor

**Parameters**

| | |
|---|---|
| *pos* | Coordinate vector of the initial position in 3D space. |
| *view* | Initial view vector. |

### 6.2.3 Member Function Documentation

#### 6.2.3.1 Eigen::Vector3d Camera::getPosition ( ) `[inline]`

Returns the current position vector.

**Returns**

The position vector.

#### 6.2.3.2 Eigen::Vector3d Camera::getView ( ) `[inline]`

Returns the current view vector.

**Returns**

The view vector.

#### 6.2.3.3 void Camera::move ( Eigen::Vector3d & *direction* )

Computes the new position vector based on the given direction vector.

**Parameters**

| | |
|---|---|
| *direction* | Distance in xyz-direction (OpenGL coordinate system) |

**Returns**

void

#### 6.2.3.4 void Camera::moveX ( double *distance* )

Moves sideways and computes the new position vector.

**Parameters**

| | |
|---|---|
| *distance* | Distance in x-direction (OpenGL coordinate system) |

**Returns**

void

#### 6.2.3.5 void Camera::moveY ( double *distance* )

Moves forward/backward and computes the new position vector.

**Parameters**

| | |
|---|---|
| *distance* | Distance in y-direction (OpenGL coordinate system) |

**Returns**

void

#### 6.2.3.6 void Camera::moveZ ( double *distance* )

Moves upward/downward and computes the new position vector.

**Parameters**

| | |
|---|---|
| *distance* | Distance in z-direction (OpenGL coordinate system) |

**Returns**

void

#### 6.2.3.7 void Camera::rotateX ( double *angle* )

Computes the new pitch, i.e. the rotation around the rightVector (look up/down).

**Note**

: We won't compute the new up vector since this may lead to a gimbal lock.

**Parameters**

| | |
|---|---|
| *angle* | The rotation angle. |

**Returns**

void

#### 6.2.3.8 void Camera::rotateY ( double *angle* )

Computes the new Yaw, i.e. the rotation around the upVector (look left/right).

**Parameters**

| | |
|---|---|
| *angle* | The rotation angle. |

**Returns**

void

#### 6.2.3.9 void Camera::setPosition ( Eigen::Vector3d *pos* )

(Re)sets the current position vector.

**Parameters**

| | |
|---|---|
| *pos* | Coordinate vector of the position in 3D space. |

**Returns**

void

#### 6.2.3.10 void Camera::setup ( )

Final step: executes gluLookAt().

**Returns**

void

#### 6.2.3.11 void Camera::setView ( Eigen::Vector3d *view* )

(Re)sets the current view vector.

**Parameters**

| | |
|---|---|
| *view* | View vector. |

**Returns**

void

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

- camera.h
- camera.cpp

## 6.3 Chebyshev Class Reference

Computes discrete Chebyshev polynomaials and thereon based image moments (translation- and rotation invariant).

```
#include <chebyshevMoments.h>
```

### Public Member Functions

- Chebyshev ()
- void initialize (cv::Mat &frame, int pmax_rot)
- void computeInvariants (cv::Mat &frame, int pmax, array_type &T_pq_doubleprime)
- void computeReconstruction (cv::Mat &frame)

### 6.3.1 Detailed Description

Computes discrete Chebyshev polynomaials and thereon based image moments (translation- and rotation invariant).

**Note**

See Chapter 6.6, Chebyshev moments of my thesis for used formulas and further details. Based on publications by Mukundan et al. as well as "Moments and Moment Invariants in Pattern Recognition", Jan Flusser, Barbara Zitova and Tomas Suk. The look-up table approach is following: "Symmetric image recognition by Tchebichef moment invariants", Hui Zhang, Xiubing Dai, Pei Sun, Hongqing Zhu, and Huazhong Shu.

### 6.3.2 Constructor & Destructor Documentation

#### 6.3.2.1 Chebyshev::Chebyshev ( ) `[inline]`

Constructor

### 6.3.3 Member Function Documentation

#### 6.3.3.1 void Chebyshev::computeInvariants ( cv::Mat & *frame*, int *pmax*, array_type & *T_pq_doubleprime* )

Computes discrete translation and rotation invariant Chebyshev moments

**Note**

In order to compute rotation invariant moments of order p, "normal" moments of order 2∗(pmax_rot-1)+1 are needed.

**Parameters**

| | | |
|---|---|---|
| `in` | *frame* | Reference to the tactile image. |
| `in` | *pmax* | Maximum invariant moment order. |
| `out` | *T_pq_-doubleprime* | Reference to final rotation and translation invariant Chebyshev moments. |

**Returns**

void

#### 6.3.3.2 void Chebyshev::computeReconstruction ( cv::Mat & *frame* )

Performs a reconstruction from moments assuming computeInvariants() has been executed before.

**Parameters**

| | | |
|---|---|---|
| `out` | *frame* | Reference to the reconstructed image. |

**Returns**

void

#### 6.3.3.3 void Chebyshev::initialize ( cv::Mat & *frame*, int *pmax_rot* )

Initializes look-up tables that stay the same as long as the image size and moment order does not change.

**Note**

In order to compute rotation invariant moments of order p, "normal" moments of order 2∗(pmax_rot-1)+1 are needed.

**Parameters**

| | | |
|---|---|---|
| `in` | *frame* | Reference to the tactile image. |
| `in` | *pmax_rot* | Maximum rotation invariant moment order. |

**Returns**

void

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

- chebyshevMoments.h
- chebyshevMoments.cpp

## 6.4 Colormap Class Reference

Manages colors and colormaps.

`#include <colormap.h>`

### Public Member Functions

- float interpolate (float value, float f0, float f1, float x0, float x1)

  *Linear interpolation.*
- RGB hsl2rgb (HSL &hsl)

  *Conversion from HSL to RGB color space.*
- HSL rgb2hsl (RGB &rgb)

  *Conversion from RGB to HSL color space.*
- float limitColorRange (float value, float low, float high)

- RGB getColorFromColormap (vector< RGB > &colormap, float value, InterpMethod interpolationMethod=HSL_INTERPOLATION)
- void createColorTable (ColorGradient colorGradient, int nColors)
- RGB & getColorFromTable (int position)

### 6.4.1 Detailed Description

Manages colors and colormaps.

### 6.4.2 Member Function Documentation

#### 6.4.2.1 void Colormap::createColorTable ( ColorGradient *colorGradient,* int *nColors* )

Creates a predefined colormap.

**Parameters**

| | |
|---|---|
| *colorGradient* | Name (enum) of the actual colormap. |
| *nColors* | Number of Colors. |

**Returns**

void

#### 6.4.2.2 RGB Colormap::getColorFromColormap ( vector< RGB > & *colormap,* float *value,* InterpMethod *interpolationMethod* = HSL_INTERPOLATION )

Interpolates color between neighboring colors of a colormap.

**Parameters**

| | |
|---|---|
| *colormap* | The colormap, a vector of colors. |
| *value* | The desired color in the range [0.0, 1.0]. |
| *interpolationMethod* | The interpolation method, HSL_INTERPOLATION or RGB_-INTERPOLATION. |

**Returns**

The resulting color in RGB.

#### 6.4.2.3 RGB & Colormap::getColorFromTable ( int *position* )

Returns entry of the colormap at specified position.

**Parameters**

| | |
|---|---|
| *position* | Position of the color in the colormap. |

**Returns**

A reference to the requested RGB struct.

#### 6.4.2.4 RGB Colormap::hsl2rgb ( HSL & *hsl* )

Conversion from HSL to RGB color space.

Range: h[0..1], s[0..1], l[0..1], r[0..1], g[0..1], b[0..1]

**Parameters**

| | |
|---|---|
| *hsl* | Reference to HSL struct |

**Returns**

Resulting RGB struct.

#### 6.4.2.5 float Colormap::interpolate ( float *value*, float *f0*, float *f1*, float *x0*, float *x1* )

Linear interpolation.

| f1 |-----------------∗ | . | | . | ? |---------X | | . | | f0 |---∗ | | |.__|______|________|_____. x0 value x1

**Note**

*x0* has to be smaller than *x1*

**Parameters**

| | |
|---|---|
| *value* | Value between *x0* and *x1* |
| *f0,f1* | Function values at supporting points. |
| *x0,x1* | Supporting points. |

**Returns**

Interpolated function value.

#### 6.4.2.6 float Colormap::limitColorRange ( float *value*, float *low*, float *high* )

Clamps value to [low..high].

**Parameters**

| | |
|---|---|
| *value* | The value to be clamped. |
| *low* | The lower limit. |
| *high* | The upper limit. |

**Returns**

The clamped value.

#### 6.4.2.7 HSL Colormap::rgb2hsl ( RGB & *rgb* )

Conversion from RGB to HSL color space.

Range: h[0..1], s[0..1], l[0..1], r[0..1], g[0..1], b[0..1]

**Parameters**

| | |
|---|---|
| *rgb* | Reference to RGB struct. |

**Returns**

Resulting HSL struct.

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

- colormap.h
- colormap.cpp

## 6.5 Controller Class Reference

Implements the controller of the GUI's model–view–controller (MVC) pattern.

```
#include <controller.h>
```

### Public Member Functions

- Controller (int argc, char ∗argv[])
- bool isAvailableSDH ()
- bool isAvailableDSA ()
- void connectSDH ()
- void connectDSA ()
- void disconnectSDH ()
- void disconnectDSA ()
- bool isConnectedSDH ()
- bool isConnectedDSA ()
- void loadProfile (const std::string &filename)
- cDSA ∗ getDSA ()

  *Getter/Setter.*
- cSDH ∗ **getSDH** ()
- FrameManager ∗ **getFrameManager** ()
- FrameGrabberDSA ∗ **getFrameGrabberDSA** ()
- FrameGrabberSDH ∗ **getFrameGrabberSDH** ()

- guiRenderer $*$ **getRenderer** ()
- void **setRenderer** (guiRenderer $*$r)
- boost::filesystem::path **getProfilePath** ()
- std::string **getProfilePathName** ()
- std::string **getProfileDirectory** ()
- std::string **getProfileName** ()
- std::string **getProfileBaseName** ()
- std::string **getProfileExtension** ()
- Calibration & **getCalibration** ()
- vector< double > getPreshape (int graspID, double closeRatio)
- void grasp (int graspID, double closeRatio, double velocity)
- boost::tuple< bool, float > graspReactive (int graspID, double velocity, double limit)

### 6.5.1 Detailed Description

Implements the controller of the GUI's model–view–controller (MVC) pattern.

**Note**

In case the GUI is not of interest for your project, this class may still serve as an example application.

### 6.5.2 Constructor & Destructor Documentation

#### 6.5.2.1 Controller::Controller ( int *argc,* char $*$ *argv[]* )

Constructor automatically initializes a whole lot of different subsystems

**Note**

You will have to change the hard-coded serial numbers according to your SDH-2

### 6.5.3 Member Function Documentation

#### 6.5.3.1 void Controller::connectDSA ( )

Creates an instance of the DSA controller and tries to open the communication.

**Returns**

void

#### 6.5.3.2 void Controller::connectSDH ( )

Creates an instance of the SHD-2 and tries to open the communication.

**Returns**

void

#### 6.5.3.3 void Controller::disconnectDSA ( )

Disconnects the DSA controller and deletes the instance.

**Returns**

void

#### 6.5.3.4 void Controller::disconnectSDH ( )

Disconnects the SDH-2 and deletes the instance.

**Returns**

void

#### 6.5.3.5 vector< double > Controller::getPreshape ( int *graspID*, double *closeRatio* )

Gets joint angles of preshaped grasp

**Parameters**

| | |
|---|---|
| *graspID* | The graspID, see source for description. |
| *closeRatio* | Open/Close ratio in the range [0.0, 1.0]. |

**Returns**

void

#### 6.5.3.6 void Controller::grasp ( int *graspID*, double *closeRatio*, double *velocity* )

Reimplementation of the SDHLibrary's grasping routine.

This function is non-blocking and continuously queries the axis states itself. Thus, joint angles can be recorded while grasping. In contrast, the original function executes the grasp and only returns when the grasp is completed.

**Parameters**

| | |
|---|---|
| *graspID* | The graspID, see source for description. |

| | |
|---|---|
| *closeRatio* | Open/Close ratio in the range [0.0, 1.0]. |
| *velocity* | The grasping speed. |

**Returns**

void

#### 6.5.3.7 boost::tuple< bool, float > Controller::graspReactive ( int *graspID,* double *velocity,* double *limit* )

Reactive grasping routine similar to grasp() that also takes the tactile sensors into account.

This function is non-blocking and continuously queries the axis states itself. Thus, joint angles can be recorded while grasping. In contrast, the original function executes the grasp and only returns when the grasp is completed.

**Parameters**

| | |
|---|---|
| *graspID* | The graspID, see source for description. |
| *closeRatio* | Open/Close ratio in the range [0.0, 1.0]. |
| *velocity* | The grasping speed. |
| *velocity* | Maximum sensor value limit. |

**Returns**

Tuple of the state of the grasp and maximum sensor value.

#### 6.5.3.8 bool Controller::isAvailableDSA ( )

Reports if a the DSA controller was found.

**Returns**

The state.

#### 6.5.3.9 bool Controller::isAvailableSDH ( )

Reports if the SDH-2 was found.

**Returns**

The state.

#### 6.5.3.10 bool Controller::isConnectedDSA ( )

Reports if a the DSA controller is connected and ready to go.

**Returns**

The state.

#### 6.5.3.11 bool Controller::isConnectedSDH ( )

Reports if a the SDH-2 is connected and ready to go.

**Returns**

The state.

#### 6.5.3.12 void Controller::loadProfile ( const std::string & *filename* )

Opens the specified ∗.dsa file and loads it's contents.

**Parameters**

| | |
|---|---|
| *filename* | The filename of the ∗.dsa profile |

**Returns**

void

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

- controller.h
- controller.cpp

## 6.6 Miniball::CoordAccessor< Pit_, Cit_ > Struct Template Reference

### Public Types

- typedef Pit_ **Pit**
- typedef Cit_ **Cit**

### Public Member Functions

- Cit **operator()** (Pit it) const

**template<typename Pit_, typename Cit_> struct Miniball::CoordAccessor< Pit_, Cit_ >**

The documentation for this struct was generated from the following file:

- Miniball.hpp

## 6.7 Miniball::CoordAccessor$<$ Pit_, Cit_ $*$ $>$ Struct Template Reference

### Public Types

- typedef Pit_ **Pit**
- typedef Cit_ $*$ **Cit**

### Public Member Functions

- Cit **operator()** (Pit it) const

**template$<$typename Pit_, typename Cit_$>$ struct Miniball::CoordAccessor$<$ Pit_, Cit_ $*$ $>$**

The documentation for this struct was generated from the following file:

- Miniball.hpp

## 6.8 cSDHOptions Class Reference

class for command line option parsing holding option parsing results

```
#include <sdhoptions.h>
```

### Public Member Functions

- cSDHOptions (char const $*$option_selection=SDHUSAGE_DEFAULT)
- ~cSDHOptions ()

  *destructor, clean up*
- int Parse (int argc, char $**$argv, char const $*$helptext, char const $*$progname, char const $*$version, char const $*$libname, char const $*$librelease)
- void OpenCommunication (NS_SDH cSDH &hand)

### Public Attributes

- std::string **usage**
- int **debug_level**
- std::ostream $*$ **debuglog**
- int **sdhport**
- char **sdh_rs_device** [MAX_DEV_LENGTH]
- double **timeout**
- unsigned long **rs232_baudrate**
- bool **use_can_esd**

- int **net**
- bool **use_can_peak**
- char **sdh_canpeak_device** [MAX_DEV_LENGTH]
- unsigned long **can_baudrate**
- unsigned int **id_read**
- unsigned int **id_write**
- bool **use_radians**
- bool **use_fahrenheit**
- double **period**
- int **dsaport**
- char **dsa_rs_device** [MAX_DEV_LENGTH]
- bool **do_RLE**
- int **framerate**
- bool **fullframe**
- bool **sensorinfo**
- bool **controllerinfo**
- int **matrixinfo** [6]
- double **sensitivity** [6]
- unsigned int **threshold** [6]
- bool **reset_to_default**
- bool **persistent**
- bool **showdsasettings**
- bool **use_tcp**
- std::string **tcp_adr**
- int **tcp_port**

### Static Public Attributes

- static int const **MAX_DEV_LENGTH** = 32

### 6.8.1 Detailed Description

class for command line option parsing holding option parsing results

### 6.8.2 Constructor & Destructor Documentation

#### 6.8.2.1 cSDHOptions::cSDHOptions ( char const ∗ *option_selection* = `SDHUSAGE_DEFAULT` )

constructor: init members to their default values

**Parameters**

| | |
|---|---|
| *option_-selection* | - string that names the options to include in helptext for online help. With a text including one of the following keywords the corresponding helptext is added to the usage helptext<br>• "general" see sdhusage_general<br>• "sdhcom_serial" see sdhusage_sdhcom_serial<br>• "sdhcom_common" see sdhusage_sdhcom_common<br>• "sdhcom_esdcan" see sdhusage_sdhcom_esdcan<br>• "sdhcom_peakcan" see sdhusage_sdhcom_peakcan<br>• "sdhcom_cancommon" see sdhusage_sdhcom_cancommon<br>• "sdhcom_tcp" see sdhusage_sdhcom_tcp<br>• "sdhother" see sdhusage_sdhother<br>• "dsacom" see sdhusage_dsacom<br>• "dsaother" see sdhusage_dsaother |

### 6.8.3 Member Function Documentation

#### 6.8.3.1 void cSDHOptions::OpenCommunication ( NS_SDH cSDH & *hand* )

convenience function to open the communication of the given *hand* object according to the parsed parameters.

**Parameters**

| | |
|---|---|
| *hand* | - reference to a cSDH object to open |

#### 6.8.3.2 int cSDHOptions::Parse ( int *argc,* char ∗∗ *argv,* char const ∗ *helptext,* char const ∗ *progname,* char const ∗ *version,* char const ∗ *libname,* char const ∗ *librelease* )

parse the command line parameters *argc*, *argv* into members. *helptext*, *progname*, *version*, *libname* and *librelease* are used when printing online help. start parsing at option with index ∗p_option_index parse all options if parse_all is true, else only one option is parsed

**Returns**

the optind index of the first non option argument in argv

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

- sdhoptions.h
- sdhoptions.cpp

## 6.9 Device Class Reference

Simple structure to manage the device, its type and serial number.

```
#include <extension.h>
```

### Public Member Functions

- **Device** (string name, DeviceType type, UInt32 serial)
- **Device** (string name, DeviceType type, UInt32 serial, string format_string)

### Public Attributes

- string **device_name**
- DeviceType **device_type**
- UInt32 **serial_no**
- string **device_format_string**

### 6.9.1 Detailed Description

Simple structure to manage the device, its type and serial number.

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

- extension.h

## 6.10 Ext Class Reference

Extension to the SDH-Library to automatically query all available comports for connected DSA / SDH devices.

```
#include <extension.h>
```

### Classes

- struct sControllerInfo

  *A data structure describing the controller info about the remote DSACON32m controller.*
- struct **sResponse**

  *Data structure for storing responses from the remote DSACON32m controller.*

### Public Types

- enum eDSAErrorCode {

  **E_SUCCESS**, **E_NOT_AVAILABLE**, **E_NO_SENSOR**, **E_NOT_INITIALIZED**,

  **E_ALREADY_RUNNING**, **E_FEATURE_NOT_SUPPORTED**, **E_INCONSISTENT_-DATA**, **E_TIMEOUT**,

  **E_READ_ERROR**, **E_WRITE_ERROR**, **E_INSUFFICIENT_RESOURCES**, **E_-CHECKSUM_ERROR**,

  **E_CMD_NOT_ENOUGH_PARAMS**, **E_CMD_UNKNOWN**, **E_CMD_FORMAT_-ERROR**, **E_ACCESS_DENIED**,

  **E_ALREADY_OPEN**, **E_CMD_FAILED**, **E_CMD_ABORTED**, **E_INVALID_HANDLE**,

  **E_DEVICE_NOT_FOUND**, **E_DEVICE_NOT_OPENED**, **E_IO_ERROR**, **E_INVALID_-PARAMETER**,

  **E_INDEX_OUT_OF_BOUNDS**, **E_CMD_PENDING**, **E_OVERRUN**, **E_RANGE_-ERROR** }

  *Error codes returned by the remote DSACON32m tactile sensor controller.*

### Public Member Functions

- struct Ext::sControllerInfo **SDH__attribute__** ((__packed__))
- Ext (int debug_level, std::list< Device ∗ > &_deviceList)

  *Constructor.*
- ∼Ext ()

  *Destructor: clean up and delete dynamically allocated memory.*
- void Open () throw (ExtException∗)
- void Close () throw (ExtException∗)
- string getComportDriver (const string &tty)
- void addComport (list< string > &comList, list< string > &comList8250, const string &dir)
- void probeSerial8250Comports (list< string > &comList, list< string > com-List8250)
- list< string > listComports ()
- void IdentifyDevices ()

### Friends

- std::ostream & **operator**<< (std::ostream &stream, Ext::sResponse const &re-sponse)

### 6.10.1 Detailed Description

Extension to the SDH-Library to automatically query all available comports for con-nected DSA / SDH devices.

**Note**

Code is partially taken from the SDH-Library

### 6.10.2 Member Function Documentation

#### 6.10.2.1 void Ext::addComport ( list< string > & *comList*, list< string > & *comList8250*, const string & *dir* )

Register the available device Credits go to Søren Holm: `http://stackoverflow.com/questions/2530096/how-`

**Parameters**

| | |
|---|---|
| *comList* | The final list of devices. |
| *comList8250* | A separate list of serial8250-devices |
| *dir* | The device directory |

**Returns**

void

#### 6.10.2.2 void Ext::Close ( ) throw (ExtException∗)

Set the framerate of the remote DSACON32m controller to 0 and close connection to it.

**Returns**

void

#### 6.10.2.3 string Ext::getComportDriver ( const string & *tty* )

Enumeration of available com ports Credits go to Søren Holm: `http://stackoverflow.com/questions/2530096`

**Parameters**

| | |
|---|---|
| *tty* | The tty-path |

**Returns**

The driver name

#### 6.10.2.4 void Ext::IdentifyDevices ( )

Auto-detect available tty devices based on response and serial number

**Returns**

void

#### 6.10.2.5 list< string > Ext::listComports ( )

List available comports Credits go to Søren Holm: http://stackoverflow.com/questions/2530096

**Returns**

The device list

#### 6.10.2.6 void Ext::Open ( ) throw (**ExtException**∗)

(Re-)open connection to DSACON32m controller, this is called by the constructor automatically, but is still useful to call after a call to Close()

**Returns**

void

#### 6.10.2.7 void Ext::probeSerial8250Comports ( list< string > & *comList*, list< string > *comList8250* )

Serial8250-devices must be probe to check for validity Credits go to Søren Holm: http://stackoverflow.c

**Parameters**

| | |
|---|---|
| *comList* | The final list of devices. |
| *comList8250* | A separate list of serial8250-devices |

**Returns**

void

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

- extension.h
- extension.cpp

## 6.11 ExtException Class Reference

Derived exception class for low-level DSA related exceptions.

```
#include <extension.h>
```

### Public Member Functions

- **ExtException** (cMsg const &_msg)

### 6.11.1 Detailed Description

Derived exception class for low-level DSA related exceptions.

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

- extension.h

## 6.12 FeatureExtraction Class Reference

Unifies the computation of features, in detail: The standard deviation, Chebyshev moments and minimal bounding sphere.

```
#include <featureExtraction.h>
```

### Public Member Functions

- FeatureExtraction (FrameManager &fm)
- std::vector< double > computeCentroid (int frameID, int matrixID)
- array_type computeMoments (int frameID, int matrixID, int pmax)
- double computeStandardDeviation (int frameID, int matrixID)
- std::vector< double > computeMiniball (int frameID, double phi0, double phi1, double phi2, double phi3, double phi4, double phi5, double phi6)
- std::vector< double > computeMiniball (int frameID, std::vector< double > &angles)
- std::vector< double > computeMiniballCentroid (int frameID, double phi0, double phi1, double phi2, double phi3, double phi4, double phi5, double phi6)
- std::vector< double > computeMiniballCentroid (int frameID, std::vector< double > &angles)
- std::vector< double > computeMiniballPoints (std::vector< std::vector< double > > &taxels, double phi0, double phi1, double phi2, double phi3, double phi4, double phi5, double phi6)
- std::vector< double > computeMiniballPoints (std::vector< std::vector< double > > &taxels, std::vector< double > &angles)

### 6.12.1 Detailed Description

Unifies the computation of features, in detail: The standard deviation, Chebyshev moments and minimal bounding sphere.

### 6.12.2 Constructor & Destructor Documentation

#### 6.12.2.1 FeatureExtraction::FeatureExtraction ( **FrameManager &** *fm* )

Constructor

### 6.12.3 Member Function Documentation

#### 6.12.3.1 std::vector< double > FeatureExtraction::computeCentroid ( int *frameID*, int *matrixID* )

Computes center of mass (in texel coordinates)

**Parameters**

| | |
|---|---|
| *frameID* | The frameID. |
| *matrixID* | The matrixID. |

**Returns**

The centroid.

#### 6.12.3.2 std::vector< double > FeatureExtraction::computeMiniball ( int *frameID*, double *phi0*, double *phi1*, double *phi2*, double *phi3*, double *phi4*, double *phi5*, double *phi6* )

Compute the minimal bounding sphere of active cells. See overloaded variant.

**Parameters**

| | |
|---|---|
| *frameID* | The frameID. |
| *phi0,phi1,phi2* | Joint angles [phi0 .. phi6]. |

**Returns**

Center and radius of miniball.

#### 6.12.3.3 std::vector< double > FeatureExtraction::computeMiniball ( int *frameID*, std::vector< double > & *angles* )

Compute the minimal bounding sphere of active cells, overloaded variant.

**Parameters**

| | |
|---|---|
| *frameID* | The frameID. |
| *angles* | Joint angles [phi0 .. phi6]. |

**Returns**

Center and radius of miniball.

#### 6.12.3.4 std::vector< double > FeatureExtraction::computeMiniballCentroid ( int *frameID*, std::vector< double > & *angles* )

Compute the minimal bounding sphere based on the per matrix centroid of active cells, overloaded variant.

**Parameters**

| | |
|---|---|
| *frameID* | The frameID. |
| *angles* | Joint angles [phi0 .. phi6]. |

**Returns**

Center and radius of miniball.

#### 6.12.3.5 std::vector< double > FeatureExtraction::computeMiniballCentroid ( int *frameID*, double *phi0*, double *phi1*, double *phi2*, double *phi3*, double *phi4*, double *phi5*, double *phi6* )

Compute the minimal bounding sphere based on the per matrix centroid of active cells. See overloaded variant.

**Parameters**

| | |
|---|---|
| *frameID* | The frameID. |
| *phi0,phi1,phi2* | Joint angles [phi0 .. phi6]. |

**Returns**

Center and radius of miniball.

#### 6.12.3.6 std::vector< double > FeatureExtraction::computeMiniballPoints ( std::vector< std::vector< double > > & *taxels*, std::vector< double > & *angles* )

Compute the minimal bounding sphere based on the specified taxels, overloaded variant.

**Parameters**

| | |
|---|---|
| *taxels* | Vector of specified taxels per matrix . |
| *angles* | Joint angles [phi0 .. phi6]. |

**Returns**

Center and radius of miniball.

#### 6.12.3.7 std::vector< double > FeatureExtraction::computeMiniballPoints ( std::vector< std::vector< double > > & *taxels*, double *phi0*, double *phi1*, double *phi2*, double *phi3*, double *phi4*, double *phi5*, double *phi6* )

Compute the minimal bounding sphere based on the specified taxels. See overloaded variant.

**Parameters**

| | |
|---|---|
| *taxels* | Vector of specified taxels per matrix . |
| *angles* | Joint angles [phi0 .. phi6]. |

**Returns**

Center and radius of miniball.

#### 6.12.3.8 array_type FeatureExtraction::computeMoments ( int *frameID*, int *matrixID*, int *pmax* )

Computes Chebyshev moments

**Parameters**

| | |
|---|---|
| *frameID* | The frameID. |
| *matrixID* | The matrixID. |
| *pmax* | Maximum moment order. |

**Returns**

The Chebyshev moments.

#### 6.12.3.9 double FeatureExtraction::computeStandardDeviation ( int *frameID*, int *matrixID* )

Computes standard deviation of tactile sensor frames (intensity values, not 2D image moments). Only active cells are considered

**Parameters**

| | |
|---|---|
| *frameID* | The frameID. |
| *matrixID* | The matrixID. |

**Returns**

The standard deviation.

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

- featureExtraction.h
- featureExtraction.cpp

## 6.13 FeatureExtractionWrapper Class Reference

Defines Boost.Python wrappers around the FeatureExtraction class. See Python examples for usage.

### Public Member Functions

- **FeatureExtractionWrapper** (FrameManagerWrapper &fmw)
- np::ndarray **computeCentroid** (int frameID, int matrixID)
- double **computeStandardDeviation** (int frameID, int matrixID)
- bp::list **computeStandardDeviationList** (int frameID)
- np::ndarray **computeChebyshevMoments** (int frameID, int matrixID, int pmax)
- bp::list **computeChebyshevMomentsList** (int frameID, int pmax)
- np::ndarray **computeMinimalBoundingSphere** (int frameID, np::ndarray &phi_ndarray)
- np::ndarray **computeMinimalBoundingSphereCentroid** (int frameID, np::ndarray &phi_ndarray)
- np::ndarray **computeMinimalBoundingSpherePoints** (np::ndarray &taxel_ndarray, np::ndarray &phi_ndarray)

### 6.13.1 Detailed Description

Defines Boost.Python wrappers around the FeatureExtraction class. See Python examples for usage.

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

- framemanager_python.cpp

## 6.14 ForwardKinematics Class Reference

Implements forward kinematics for the tactile sensors.

```
#include <forwardKinematics.h>
```

### Public Member Functions

- ForwardKinematics ()
- void setAngles (std::vector< double > &all_angles)
- cv::Matx44d computeTransformationMatrixTaxelXYZ (int m, int y)
- cv::Matx44d computeTransformationMatrixPointOnSensorPlaneXYZ (int m, double y)
- std::vector< double > GetTaxelXYZ (int m, int x, int y)
- std::vector< double > GetPointOnSensorPlaneXYZ (int m, double x, double y)

### 6.14.1 Detailed Description

Implements forward kinematics for the tactile sensors.

The transformations are based on the classic Denavit-Hartenberg convention. The coordinate center is at gripper's base, i.e. in the middle of the equilateral triangle. See Figure 4.4: Isometric projection of my thesis for details. See featureExtraction.cpp for example usage.

**Note**

Written for readability. Let's rely on the look-up table approach and the compiler's optimization.

### 6.14.2 Constructor & Destructor Documentation

#### 6.14.2.1 ForwardKinematics::ForwardKinematics ( )

Constructor automatically creates static transformation matrices

### 6.14.3 Member Function Documentation

#### 6.14.3.1 cv::Matx44d ForwardKinematics::computeTransformationMatrixPointOnSensorPlaneXYZ ( int *m*, double *y* )

Computes transformation matrix of position(_,y) on matrix m

**Parameters**

| | |
|---|---|
| *m* | Matrix index |
| *y* | y-coordinate on sensor matrix (only needed for distal matrix) |

**Returns**

Transformation matrix relative to hand's origin

#### 6.14.3.2 cv::Matx44d ForwardKinematics::computeTransformationMatrixTaxelXYZ ( int *m*, int *y* )

Computes transformation matrix of taxel(_,y) on matrix m

**Parameters**

| | |
|---|---|
| *m* | Matrix index |
| *y* | y-coordinate on sensor matrix (only needed for distal matrix) |

**Returns**

Transformation matrix relative to hand's origin

#### 6.14.3.3 std::vector< double > ForwardKinematics::GetPointOnSensorPlaneXYZ ( int *m*, double *x*, double *y* )

Computes Cartesian coordinates (in mm) of position(x,y) on matrix m

(0.0, 0.0) refers to the center of the top-left taxel(0,0) Meaningful values that actual lie on the sensor plane: Proximal: ([-1.7, 18.7], [-1.7, 45.9]) Distal: ([-1.7, 18.7], [-1.7, 42.5)

**Parameters**

| | |
|---|---|
| *m* | - Matrix index. |
| *x* | - x-coordinate on sensor matrix. |
| *y* | - y-coordinate on sensor matrix. |

**Returns**

Position [x,y,z] relative to hand's origin.

#### 6.14.3.4 std::vector< double > ForwardKinematics::GetTaxelXYZ ( int *m*, int *x*, int *y* )

Computes Cartesian coordinates (in mm) of taxel(x,y) on matrix m

**Parameters**

| | |
|---|---|
| *m* | - Matrix index. |
| *x* | - x-coordinate on sensor matrix. |
| *y* | - y-coordinate on sensor matrix. |

**Returns**

Position [x,y,z] relative to hand's origin.

#### 6.14.3.5 void ForwardKinematics::setAngles ( std::vector< double > & *all_angles* )

Initializes dynamic transformation matrices

**Parameters**

| | |
|---|---|
| *all_angles* | Angles [phi0 .. phi6] in Radians. |

**Returns**

void

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

- forwardKinematics.h
- forwardKinematics.cpp

## 6.15 FrameGrabberDSA Class Reference

A frame grabber/recorder class for tactile sensor based on boost thread.

```
#include <framegrabberDSA.h>
```

### Public Member Functions

- FrameGrabberDSA (cDSA ∗dsa)
- FrameGrabberDSA (cDSA ∗dsa, FrameManager ∗fm)
- ∼FrameGrabberDSA ()
- void setFrameManager (FrameManager ∗fm)
- void setFramerate (double frameRate)
- void start (double frameRate, bool startPaused=false, bool startRecording=false)
- void execute ()
- void pause ()
- void resume ()
- void finish ()
- void enableRecording ()
- void suspendRecording ()
- bool isRunning ()
- bool isCapturing ()
- bool isRecording ()
- int getFrameNumber ()

### 6.15.1 Detailed Description

A frame grabber/recorder class for tactile sensor based on boost thread.

### 6.15.2 Constructor & Destructor Documentation

#### 6.15.2.1 FrameGrabberDSA::FrameGrabberDSA ( cDSA ∗ *dsa* )

Constructor (not recording yet).

**Parameters**

| | |
|---|---|
| *dsa* | The tactile sensor controller. |

#### 6.15.2.2 FrameGrabberDSA::FrameGrabberDSA ( cDSA ∗ *dsa,* FrameManager ∗ *fm* )

Constructor (without frame manager).

**Parameters**

| | |
|---|---|
| *dsa* | The tactile sensor controller. |

|  |  |
|---|---|
| *fm* | The frame manager. |

#### 6.15.2.3 FrameGrabberDSA::∼FrameGrabberDSA ( )

Deconstructor: Interrupts thread in as soon as possible.

### 6.15.3 Member Function Documentation

#### 6.15.3.1 void FrameGrabberDSA::enableRecording ( )

Automatically request new frames and store them permanently.

**Returns**

void

#### 6.15.3.2 void FrameGrabberDSA::execute ( )

Executes the grabbing / recording thread.

**Returns**

void

#### 6.15.3.3 void FrameGrabberDSA::finish ( )

Stops the grabber thread. Interrupts thread during next wait/sleep state.

**Returns**

void

#### 6.15.3.4 int FrameGrabberDSA::getFrameNumber ( ) `[inline]`

Returns the number of already captured frames.

**Returns**

The number of already captured frames.

#### 6.15.3.5 bool FrameGrabberDSA::isCapturing ( )

Reports if the thread is capturing or not.

**Returns**

The state.

#### 6.15.3.6 bool FrameGrabberDSA::isRecording ( )

Reports if the thread is recording or not.

**Returns**

The state.

#### 6.15.3.7 bool FrameGrabberDSA::isRunning ( )

Reports if the thread is running or paused.

**Returns**

The state.

#### 6.15.3.8 void FrameGrabberDSA::pause ( )

Stop DSA push-mode (if active) and halt thread execution.

**Returns**

void

#### 6.15.3.9 void FrameGrabberDSA::resume ( )

Resume thread execution with current configuration.

**Returns**

void

#### 6.15.3.10 void FrameGrabberDSA::setFrameManager ( FrameManager ∗ *fm* )

Sets the frame manager.

**Parameters**

| | |
|---|---|
| *fm* | The frame manager. |

**Returns**

void

#### 6.15.3.11 void FrameGrabberDSA::setFramerate ( double *frameRate* )

Sets the frame rate.

For frame rates $<$ 30, tactile sensor frames are manually requested (pull mode). Otherwise, the DSA controller switches to an automatic push mode.

**Parameters**

| | |
|---|---|
| *frameRate* | The desired frame rate. |

**Returns**

void

#### 6.15.3.12 void FrameGrabberDSA::start ( double *frameRate*, bool *startPaused* = `false`, bool *startRecording* = `false` )

Initializes DSA Controller and starts the execution of the grabber thread.

For frame rates $<$ 30, tactile sensor frames are manually requested (pull mode). Otherwise, the DSA controller switches to an automatic push mode.

**Parameters**

| | |
|---|---|
| *frameRate* | The desired frame rate. |
| *startPaused* | Should the thread start paused or immediately start grabbing? |
| *startRecording* | Should the grabbing thread immediately start recording? |

**Returns**

void

#### 6.15.3.13 void FrameGrabberDSA::suspendRecording ( )

Pause storing of new frames.

**Returns**

void

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

- framegrabberDSA.h
- framegrabberDSA.cpp

## 6.16 FrameGrabberSDH Class Reference

A frame grabber/recorder class for joint angles and temperatures based on boost thread.

`#include <framegrabberSDH.h>`

### Public Member Functions

- FrameGrabberSDH (cSDH ∗sdh)
- FrameGrabberSDH (cSDH ∗sdh, FrameManager ∗fm)
- ∼FrameGrabberSDH ()
- void setFrameManager (FrameManager ∗fm)
- void setFramerateJointAngles (double frameRate)
- void setFramerateTemperature (double frameRate)
- void setTemperature (bool enable)
- void setJointAngle (bool enable)
- void start (double FPSJointAngles, double FPSTemperature, bool startPaused=false, bool startRecording=false)
- void execute ()
- void pause ()
- void pauseBlocking ()
- void resume ()
- void finish ()
- void enableRecording ()
- void suspendRecording ()
- bool isRunning ()
- bool isCapturing ()
- bool isRecording ()
- int getFrameNumber ()

### 6.16.1 Detailed Description

A frame grabber/recorder class for joint angles and temperatures based on boost thread.

### 6.16.2 Constructor & Destructor Documentation

#### 6.16.2.1 FrameGrabberSDH::FrameGrabberSDH ( cSDH ∗ *sdh* )

Constructor (without frame manager).

**Parameters**

| | |
|---|---|
| *sdh* | The SCHUNK SDH-2. |

#### 6.16.2.2 FrameGrabberSDH::FrameGrabberSDH ( cSDH ∗ *sdh,* FrameManager ∗ *fm* )

Constructor (ready to record).

**Parameters**

| | |
|---|---|
| *dsa* | The tactile sensor controller. |
| *fm* | The frame manager. |

#### 6.16.2.3 FrameGrabberSDH::∼FrameGrabberSDH ( )

Deconstructor: Interrupts thread in as soon as possible.

### 6.16.3 Member Function Documentation

#### 6.16.3.1 void FrameGrabberSDH::enableRecording ( )

Automatically request new frames and store them permanently.

**Returns**

void

#### 6.16.3.2 void FrameGrabberSDH::execute ( )

Executes the grabbing / recording thread.

**Returns**

void

#### 6.16.3.3 void FrameGrabberSDH::finish ( )

Stops the grabber thread. Interrupts thread during next wait/sleep state.

**Returns**

void

#### 6.16.3.4 int FrameGrabberSDH::getFrameNumber ( ) [inline]

Returns the number of already captured frames.

**Returns**

The number of already captured frames.

#### 6.16.3.5 bool FrameGrabberSDH::isCapturing ( )

Reports if the thread is capturing or not.

**Returns**

The state.

#### 6.16.3.6 bool FrameGrabberSDH::isRecording ( )

Reports if the thread is recording or not.

**Returns**

The state.

#### 6.16.3.7 bool FrameGrabberSDH::isRunning ( )

Reports if the thread is running or paused.

**Returns**

The state.

#### 6.16.3.8 void FrameGrabberSDH::pause ( )

Halt thread execution.

**Returns**

void

#### 6.16.3.9 void FrameGrabberSDH::pauseBlocking ( )

Halt thread execution and wait for end of transmission.

**Returns**

void

#### 6.16.3.10 void FrameGrabberSDH::resume ( )

Resume thread execution with current configuration.

**Returns**

void

#### 6.16.3.11 void FrameGrabberSDH::setFrameManager ( FrameManager ∗ *fm* )

Sets the frame manager.

**Parameters**

| | |
|---|---|
| *fm* | The frame manager. |

**Returns**

void

#### 6.16.3.12 void FrameGrabberSDH::setFramerateJointAngles ( double *frameRate* )

Sets the frame rate of the joint angle requests.

**Parameters**

| | |
|---|---|
| *frameRate* | The desired frame rate. |

#### 6.16.3.13 void FrameGrabberSDH::setFramerateTemperature ( double *frameRate* )

Sets the frame rate of the joint angle requests.

**Parameters**

| | |
|---|---|
| *frameRate* | The desired frame rate. |

#### 6.16.3.14 void FrameGrabberSDH::setJointAngle ( bool *enable* )

Separate flag to capture/record joint angle readings

**Parameters**

| | |
|---|---|
| *enable* | The capturing state. |

#### 6.16.3.15 void FrameGrabberSDH::setTemperature ( bool *enable* )

Separate flag to capture/record temperature readings

**Parameters**

| | |
|---|---|
| *enable* | The capturing state. |

#### 6.16.3.16 void FrameGrabberSDH::start ( double *FPSJointAngles*, double *FPSTemperature*, bool *startPaused* = `false`, bool *startRecording* = `false` )

Initializes the SDH-2 and starts the execution of the grabber thread.

**Parameters**

| | |
|---|---|
| *FPSJointAn-gles* | The desired joint angle frame rate. |
| *FPSTemper-atureThe* | desired temperature frame rate. |
| *startPaused* | Should the thread start paused or immediately start grabbing? |
| *startRecord-ing* | Should the grabbing thread immediately start recording? |

#### 6.16.3.17 void FrameGrabberSDH::suspendRecording ( )

Pause storing of new frames.

**Returns**

void

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

- framegrabberSDH.h
- framegrabberSDH.cpp

## 6.17 FrameManager Class Reference

The heart of this project.

`#include <framemanager.h>`

### Public Member Functions

- FrameManager ()
- void resetOffline ()
- void resetOnline ()
- void setSDH (cSDH ∗sdh)
- void setDSA (cDSA ∗dsa)
- bool isConnectedSDH ()
- bool isConnectedDSA ()
- void queryDSAInfo ()
- void setSensitivity (uint matrixID, float sensitivity)
- void setThreshold (uint matrixID, float threshold)

- void setFrameGrabberDSA (FrameGrabberDSA ∗fgDSA)
- void setFrameGrabberSDH (FrameGrabberSDH ∗fgSDH)
- sensorInfo & getSensorInfo ()
- matrixInfo & getMatrixInfo (uint i)
- uint getNumMatrices ()
- uint getNumCells ()
- uint getCurrentFrameID ()
- void setCurrentFrameID (uint frameID)
- bool getTSFrameAvailable ()
- void setTSFrameAvailable (bool value)
- bool getJointAngleFrameAvailable ()
- void setJointAngleFrameAvailable (bool value)
- void setLiveFrame ()
- TSFrame & allocateTSFrame ()
- void addTSFrame ()
- void deleteTSFrame (uint frameID)
- void cropToFrames (uint64_t timestamp_from, uint64_t timestamp_to)
- TSFrame ∗ getFrame (uint frameID)
- TSFrame ∗ getCurrentFrame ()
- TSFrame ∗ getFilteredFrame (uint frameID)
- TSFrame ∗ getCurrentFilteredFrame ()
- float getTexel (uint frameID, uint cellID)
- float getTexel (uint frameID, uint m, uint x, uint y)
- float getFilteredTexel (uint frameID, uint cellID)
- float getFilteredTexel (uint frameID, uint m, uint x, uint y)
- uint getFrameCountTS ()
- uint getFrameCountTemperature ()
- uint getFrameCountJointAngles ()
- void requestTemperatureFrame (bool record)
- TemperatureFrame ∗ getTemperatureFrame (uint tempID)
- void requestJointAngleFrame (bool record)
- JointAngleFrame ∗ getJointAngleFrame (uint angleID)
- JointAngleFrame ∗ getCurrentJointAngleFrame ()
- void createTemperatureMapping ()
- void createJointAngleMapping ()
- TemperatureFrame ∗ getCorrespondingTemperature (uint frameID)
- JointAngleFrame ∗ getCorrespondingJointAngle (uint frameID)
- void convertCellIndex (uint cellID, uint &m, uint &x, uint &y)
- uint convertCellIndex (uint m, uint x, uint y)
- void selectCell (uint cellID, bool value)
- bool isSelected (int cellID)
- int getNumSelectedCells ()
- std::vector< bool > & getSelection ()
- std::vector< int > createSelectedCellsIdx ()
- void setDynamicMask (std::vector< bool > &bitmask)
- bool getStaticMask (uint m, uint x, uint y)

- bool getDynamicMask (uint m, uint x, uint y)
- FrameProcessor $*$ getFrameProcessor ()
- void setFilterNone ()
- void setFilterMedian (int kernelRadius, bool masked)
- void setFilterMedian3D (bool masked)
- void setFilterGaussian (int kernelRadius, double sigma, int borderType)
- void setFilterBilateral (int kernelSize, double sigmaColor, double sigmaSpace, int borderType)
- void setFilterMorphological (int kernelType, int kernelRadius, bool masked, int borderType)
- boost::shared_ptr< SlipDetector > getSlipDetector (uint matrixID)
- void enableSlipDetection (uint matrixID)
- void disableSlipDetection (uint matrixID)
- bool getSlipDetectionState ()
- bool getSlipDetectionState (uint matrixID)
- void setSlipThresholdReference (double thresh)
- void setSlipThresholdConsecutive (double thresh)
- bool setSlipReferenceFrameLive (uint matrixID)
- slipResult computeSlipLive (uint matrixID)
- std::vector< boost::optional< slipResult > > getSlipLive ()
- bool getSlipLiveBinary ()
- void slipResultProducer ()
- std::vector< boost::optional< slipResult > > slipResultConsumer ()
- bool setSlipReferenceFrame (uint matrixID, uint frameID)
- slipResult computeSlip (uint matrixID, uint frameID)
- const std::string & getProfileName ()
- void loadFrames (const std::string &filename)
- void storeFrames (const std::string &filename)
- void print_tree (const boost::property_tree::ptree &pt, int level)
- void print_tree (const boost::property_tree::ptree &pt)
- float hex2float (std::string &s)
- std::string float2hex (float f)
- void decodeTSFrame (const std::string &hexdata, std::vector< float > &decoded_-frame)
- void encodeTSFrame (const std::vector< float > &cells, std::string &hexdata)
- void loadProfile (const std::string &filename)
- void storeProfile (const std::string &filename)
- void storeProfileSelection (const string &filename, uint fromIdxTS, uint toIdxTS)
- void printJointAngleFrame (JointAngleFrame &jointAngleFrame)
- void printTemperatureFrame (TemperatureFrame &temperatureFrame)
- void printTSMatrix (uint frameID, uint m)
- void printTSMatrices (uint frameID)

### 6.17.1 Detailed Description

The heart of this project.

**Note**

A word on copy constructors: Since boost::mutex and boost::condition_variable are not copyable simply delete the copy constructor. Alternative: write a copy constructor that copies the data but constructs a new mutex, i.e. FrameManager(const FrameManager&) = delete;

### 6.17.2 Constructor & Destructor Documentation

#### 6.17.2.1 FrameManager::FrameManager ( )

Constructor. Calls resetOffline().

### 6.17.3 Member Function Documentation

#### 6.17.3.1 void FrameManager::addTSFrame ( )

Adds the current frame to the record

**Returns**

void

#### 6.17.3.2 TSFrame & FrameManager::allocateTSFrame ( )

Allocates space for new tactile sensor frame on the queue and returns reference.

**Returns**

Reference to the allocated tactile sensor frame.

#### 6.17.3.3 slipResult FrameManager::computeSlip ( uint *matrixID*, uint *frameID* )

Performs both translational and rotational slip-detection (offline version).

**Parameters**

| | |
|---|---|
| *matrixID* | The matrix ID. |
| *frameID* | The frame ID. |

**Returns**

The combined results of the rotational and translational slip-detection.

#### 6.17.3.4 slipResult FrameManager::computeSlipLive ( uint *matrixID* )

Performs both translational and rotational slip-detection (live version).

**Parameters**

| | |
|---|---|
| *matrixID* | The matrix ID. |

**Returns**

The combined results of the rotational and translational slip-detection.

#### 6.17.3.5 void FrameManager::convertCellIndex ( uint *cellID,* uint & *m,* uint & *x,* uint & *y* ) [inline]

Convert cellID of entire frame to (matrixID, x, y)

**Parameters**

| | |
|---|---|
| *cellID* | The cell ID in range [0, 486] |
| *m* | The matrix ID. |
| *x,y* | The Taxel coordinates. |

**Returns**

void

#### 6.17.3.6 uint FrameManager::convertCellIndex ( uint *m,* uint *x,* uint *y* ) [inline]

Convert (matrixID, x, y) to cellID of entire frame

**Parameters**

| | |
|---|---|
| *m* | The matrix ID. |
| *x,y* | The Taxel coordinates. |

**Returns**

The cellID

#### 6.17.3.7 void FrameManager::createJointAngleMapping ( )

Creates a mapping between tactile sensor frame and associated joint angles.

**Returns**

void

#### 6.17.3.8 std::vector< int > FrameManager::createSelectedCellsIdx ( )

Creates a list of indices of selected taxels.

**Returns**

The vector containing cell IDs of selected taxels.

#### 6.17.3.9 void FrameManager::createTemperatureMapping ( )

Creates a mapping between tactile sensor frame and associated temperature.

**Returns**

void

#### 6.17.3.10 void FrameManager::cropToFrames ( uint64_t *timestamp_from,* uint64_t *timestamp_to* )

Trim frames (tactile sensor, temperature, joint angles) to selection [from to] including borders.

**Parameters**

| | |
|---|---|
| *timestamp_-from* | From. |
| *timestamp_-to* | To. |

**Returns**

void

#### 6.17.3.11 void FrameManager::decodeTSFrame ( const std::string & *hexdata,* std::vector< float > & *decoded_frame* )

Decode "Enhanced RLE" compressed sensor frame

Only zero-valued matrix elements are run length encoded. Each token t consists of a single precision floating point value (IEEE-754). t $<$ 0 indicates $|t|$ consecutive zeros. t $>$ 0: The value of t represents a single observation.

**Note**

Tested with Little-Endian byte order only.

**Parameters**

| | |
|---|---|
| *hexdata* | Encoded hexadecimal string. |
| *decoded_-frame* | The resulting decoded vector of taxel values. |

**Returns**

void

#### 6.17.3.12 void FrameManager::deleteTSFrame ( uint *frameID* )

Deletes a single TSFrame without deleting corresponding temperatures/angles Use deleteTSFrames(from, to) to remove multiple frames.

**Note**

Operation might be expensive due to the used queue data structure.

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |

**Returns**

void

#### 6.17.3.13 void FrameManager::disableSlipDetection ( uint *matrixID* )

Disables slip-detection on specified sensor matrix.

**Parameters**

| | |
|---|---|
| *matrixID* | The matrix ID. |

#### 6.17.3.14 void FrameManager::enableSlipDetection ( uint *matrixID* )

Enables slip-detection on specified sensor matrix.

**Parameters**

| | |
|---|---|
| *matrixID* | The matrix ID. |

#### 6.17.3.15 void FrameManager::encodeTSFrame ( const std::vector< float > & *cells,* std::string & *hexdata* )

Frames are encoded using an "Enhanced RLE Compression"

Meaning only zero-valued matrix elements are run length encoded. Each token t consists of a single precision floating point value (IEEE-754). $t < 0$ indicates $|t|$ consecutive zeros. $t > 0$: The value of t represents a single observation.

**Note**

Tested with Little-Endian byte order only.

**Parameters**

| | |
|---|---|
| *cells* | A vector of taxel values. |
| *hexdata* | The hexadecimal representation. |

**Returns**

void

#### 6.17.3.16 string FrameManager::float2hex ( float *f* )

Converts a float to a hex string.

**Parameters**

| | |
|---|---|
| *f* | The converted float. |

**Returns**

The hex string.

#### 6.17.3.17 JointAngleFrame ∗ FrameManager::getCorrespondingJointAngle ( uint *frameID* )

Given a tactile sensor frame, returns the associated joint angle frame.

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |

**Returns**

Pointer to the recorded joint angle frame.

#### 6.17.3.18 TemperatureFrame ∗ FrameManager::getCorrespondingTemperature ( uint *frameID* )

Given a tactile sensor frame, returns the associated temperature frame.

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |

**Returns**

Pointer to the recorded temperature frame.

#### 6.17.3.19 TSFrame ∗ FrameManager::getCurrentFilteredFrame ( )

Get current frame of recorded frame history (specified filter is applied).

**Returns**

Pointer to the tactile sensor frame.

#### 6.17.3.20 TSFrame ∗ FrameManager::getCurrentFrame ( )

Get current frame of recorded frame history.

**Returns**

Pointer to the tactile sensor frame.

#### 6.17.3.21 uint FrameManager::getCurrentFrameID ( )

Returns the current frame ID.

**Returns**

The current frame ID.

#### 6.17.3.22 JointAngleFrame ∗ FrameManager::getCurrentJointAngleFrame ( )

Returns current joint angle frame.

**Returns**

Pointer to the joint angle frame.

#### 6.17.3.23 bool FrameManager::getDynamicMask ( uint *m*, uint *x*, uint *y* )

Gets dynamic mask of specified taxel.

**Parameters**

| | |
|---|---|
| *m* | The matrix ID. |
| *x,y* | The taxel coordinates. |

**Returns**

The masking state.

#### 6.17.3.24 TSFrame ∗ FrameManager::getFilteredFrame ( uint *frameID* )

Get specified frame of recorded frame history (specified filter is applied).

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |

**Returns**

Pointer to the tactile sensor frame.

#### 6.17.3.25 float FrameManager::getFilteredTexel ( uint *frameID,* uint *cellID* )

Returns filtered taxel value of specified frame and cell ID.

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |
| *cellID* | The cell ID in Range [0, 486] |

**Returns**

The taxel value.

#### 6.17.3.26 float FrameManager::getFilteredTexel ( uint *frameID,* uint *m,* uint *x,* uint *y* )

Returns filtered taxel value of specified frame, matrix and coordinate.

**Parameters**

| | |
|---|---|
| *frameID* | |
| *m* | The matrix ID. |
| *x,y* | Taxel coordinates. |

**Returns**

The taxel value.

#### 6.17.3.27 TSFrame ∗ FrameManager::getFrame ( uint *frameID* )

Get specified frame of recorded frame history.

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |

**Returns**

Pointer to the tactile sensor frame.

#### 6.17.3.28 uint FrameManager::getFrameCountJointAngles ( )

Returns the number of recorded joint angle readings.

**Returns**

The joint angle frame count.

#### 6.17.3.29 uint FrameManager::getFrameCountTemperature ( )

Returns the number of recorded temperature readings.

**Returns**

The temperature frame count.

#### 6.17.3.30 uint FrameManager::getFrameCountTS ( )

Returns the number of recorded tactile sensor frames.

**Returns**

The tactile sensor frame count.

#### 6.17.3.31 FrameProcessor ∗ FrameManager::getFrameProcessor ( )

Gets the frame processor.

**Returns**

The frame processor.

#### 6.17.3.32 JointAngleFrame ∗ FrameManager::getJointAngleFrame ( uint *angleID* )

Returns specified joint angle frame.

**Parameters**

| | |
|---|---|
| *angleID* | The joint angle frame ID. |

**Returns**

Pointer to the joint angle frame.

#### 6.17.3.33 bool FrameManager::getJointAngleFrameAvailable ( )

Checks if a joint angle frame is available.

**Returns**

The state.

#### 6.17.3.34 matrixInfo& FrameManager::getMatrixInfo ( uint *i* ) [inline]

Gets the queried matrix info.

**Parameters**

| | |
|---|---|
| *i* | The matrix. |

**Returns**

Reference to matrixInfo.

#### 6.17.3.35 uint FrameManager::getNumCells ( ) [inline]

Returns the number of taxels.

**Returns**

The number of taxels.

#### 6.17.3.36 uint FrameManager::getNumMatrices ( ) [inline]

Returns the number of matrices.

**Returns**

The number of matrices.

#### 6.17.3.37 int FrameManager::getNumSelectedCells ( )

Returns the number of selected taxels.

**Returns**

The number of selected taxels.

#### 6.17.3.38 const string & FrameManager::getProfileName ( )

Gets the pressure profile's file name.

**Returns**

The file name.

#### 6.17.3.39 std::vector< bool > & FrameManager::getSelection ( )

Returns a mask of selected taxels.

**Returns**

Reference to mask.

#### 6.17.3.40 sensorInfo& FrameManager::getSensorInfo ( ) [inline]

Gets the queried sensor info.

**Returns**

Reference to sensorInfo.

#### 6.17.3.41 bool FrameManager::getSlipDetectionState ( )

Checks the combined slip-state.

**Returns**

The slip-state.

#### 6.17.3.42 bool FrameManager::getSlipDetectionState ( uint *matrixID* )

Checks the slip-state on specified sensor matrix.

**Parameters**

| | |
|---|---|
| *matrixID* | The matrix ID. |

**Returns**

The slip-state.

#### 6.17.3.43 boost::shared_ptr< SlipDetector > FrameManager::getSlipDetector ( uint *matrixID* )

Returns the slip-detector of specified matrix.

**Parameters**

|  |  |
|---|---|
| *matrixID* | The matrix ID. |

**Returns**

The slip-detector.

#### 6.17.3.44 std::vector< boost::optional< slipResult > > FrameManager::getSlipLive ( )

Returns the results of the last slip computation (live version).

**Note**

Note: Might lead to a deadlock in combination with getSlipLiveBinary()

**Returns**

The combined results.

#### 6.17.3.45 bool FrameManager::getSlipLiveBinary ( )

Computes a binary slip indicator from the slip results and the given thresholds

**Note**

Note: Might lead to a deadlock in combination with getSlipLive()

**Returns**

The combined slip state.

#### 6.17.3.46 bool FrameManager::getStaticMask ( uint *m*, uint *x*, uint *y* )

Gets static mask of specified taxel.

**Parameters**

|  |  |
|---|---|
| *m* | The matrix ID. |
| *x,y* | The taxel coordinates. |

**Returns**

The masking state.

#### 6.17.3.47 TemperatureFrame ∗ FrameManager::getTemperatureFrame ( uint *tempID* )

Returns specified temperature frame.

**Parameters**

| | |
|---|---|
| *tempID* | The temperature frame ID. |

**Returns**

Pointer to the temperature frame.

#### 6.17.3.48 float FrameManager::getTexel ( uint *frameID,* uint *m,* uint *x,* uint *y* )

Returns taxel value of specified frame, matrix and coordinate.

**Parameters**

| | |
|---|---|
| *frameID* | |
| *m* | The matrix ID. |
| *x,y* | Taxel coordinates. |

**Returns**

The taxel value.

#### 6.17.3.49 float FrameManager::getTexel ( uint *frameID,* uint *cellID* )

Returns taxel value of specified frame and cell ID.

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |
| *cellID* | The cell ID in range [0, 486] |

**Returns**

The taxel value.

#### 6.17.3.50 bool FrameManager::getTSFrameAvailable ( )

Checks if a tactile sensor frame is available.

**Returns**

The state.

#### 6.17.3.51 float FrameManager::hex2float ( std::string & *s* )

Converts a hex string to a float using stringstream.

**Parameters**

|   |   |
|---|---|
| *s* | The hex string. |

**Returns**

The converted float.

#### 6.17.3.52 bool FrameManager::isConnectedDSA ( )

Checks if the DSA-controller is connected.

**Returns**

The state.

#### 6.17.3.53 bool FrameManager::isConnectedSDH ( )

Checks if the hand is connected.

**Returns**

The state.

#### 6.17.3.54 bool FrameManager::isSelected ( int *cellID* )

Checks if the specified taxel is selected.

**Parameters**

|   |   |
|---|---|
| *cellID* | The cell ID. |

**Returns**

The selection state.

#### 6.17.3.55 void FrameManager::loadFrames ( const std::string & *filename* )

Load pressure profile from file.

**Parameters**

|   |   |
|---|---|
| *filename* | The ∗.dsa file. |

**Returns**

void

#### 6.17.3.56 void FrameManager::loadProfile ( const std::string & *filename* )

Loads a SDH-2 pressure profile stored in ∗.dsa files

The file format is xml based and inspired by Weiss's dsa3 format. By removing the additional temperature and joint angle readings from the xml tree the profiles can be opened in the DSA Explorer by Weiss.

**Parameters**

| | |
|---|---|
| *filename* | The filename. |

**Returns**

void

#### 6.17.3.57 void FrameManager::print_tree ( const boost::property_tree::ptree & *pt* )

Pretty-prints an entire property tree

**Parameters**

| | |
|---|---|
| *pt* | The property tree. |

**Returns**

void

#### 6.17.3.58 void FrameManager::print_tree ( const boost::property_tree::ptree & *pt,* int *level* )

Pretty-prints property tree from a certain level onwards.

**Parameters**

| | |
|---|---|
| *pt* | The property tree. |
| *level* | The tree level. |

**Returns**

void

#### 6.17.3.59 void FrameManager::printJointAngleFrame ( JointAngleFrame & *jointAngleFrame* )

Pretty-printing of joint angle readings.

**Parameters**

| | |
|---|---|
| *jointAngle-Frame* | The joint angle frame. |

**Returns**

void

#### 6.17.3.60 void FrameManager::printTemperatureFrame ( TemperatureFrame & *temperatureFrame* )

Pretty-printing of temperature readings.

**Parameters**

| | |
|---|---|
| *temperature-Frame* | The temperature frame. |

**Returns**

void

#### 6.17.3.61 void FrameManager::printTSMatrices ( uint *frameID* )

Pretty-printing of all tactile sensor matrices.

**Parameters**

| | |
|---|---|
| *frameID* | |

**Returns**

void

#### 6.17.3.62 void FrameManager::printTSMatrix ( uint *frameID,* uint *m* )

Pretty-printing of a single tactile sensor matrix.

**Parameters**

| | |
|---|---|
| *frameID* | The temperature frame. |
| *m* | The matrix ID. |

**Returns**

void

#### 6.17.3.63 void FrameManager::queryDSAInfo ( )

Queries sensor controller and matrix info.

**Returns**

void

#### 6.17.3.64 void FrameManager::requestJointAngleFrame ( bool *record* )

Requests a joint angle frame from the connected SDH-2.

0 : common base axis of finger 0 and 2 1 : proximal axis of finger 0 2 : distal axis of finger 0 3 : proximal axis of finger 1 4 : distal axis of finger 1 5 : proximal axis of finger 2 6 : distal axis of finger 2

**Parameters**

| | |
|---|---|
| *record* | Should the frame be stored? |

#### 6.17.3.65 void FrameManager::requestTemperatureFrame ( bool *record* )

Requests a temperature frame from the connected SDH-2.

Temperatures 0-6: close to axes motors, Temperature 7: FPGA, Temperature 8: Printed circuit board.

**Parameters**

| | |
|---|---|
| *record* | Should the frame be stored? |

#### 6.17.3.66 void FrameManager::resetOffline ( )

Resets frame manager (offline state).

**Returns**

void

#### 6.17.3.67 void FrameManager::resetOnline ( )

Resets frame manager (online state).

**Returns**

void

#### 6.17.3.68 void FrameManager::selectCell ( uint *cellID,* bool *value* )

Select specified taxel.

see convertCellIndex().

**Parameters**

| | |
|---|---|
| *cellID* | |
| *value* | |

**Returns**

void.

#### 6.17.3.69 void FrameManager::setCurrentFrameID ( uint *frameID* )

Sets the current frame ID.

**Parameters**

| | |
|---|---|
| *frameID* | The current frame ID. |

**Returns**

void

#### 6.17.3.70 void FrameManager::setDSA ( cDSA $*$ *dsa* )

Sets the DSA-controller. Calls queryDSAInfo() and initializes frame manager accordingly.

**Parameters**

| | |
|---|---|
| *dsa* | The DSA instance. |

**Returns**

void

#### 6.17.3.71 void FrameManager::setDynamicMask ( std::vector$<$ bool $>$ & *bitmask* )

Sets dynamic bitmask of selected taxels.

**Parameters**

| | |
|---|---|
| *bitmask* | Bitmask of active taxels. |

#### 6.17.3.72 void FrameManager::setFilterBilateral ( int *kernelSize,* double *sigmaColor,* double *sigmaSpace,* int *borderType* )

Enables the Bilateral filter. Just a wrapper around frame processor.

**Parameters**

| | |
|---|---|
| *kernelRadius* | The filtering kernel' radius. |
| *sigmaColor* | The color standard deviation parameter. |
| *sigmaSpace* | The spatial standard deviation parameter. |
| *borderType* | OpenCV border type. |

**Returns**

void

#### 6.17.3.73 void FrameManager::setFilterGaussian ( int *kernelRadius,* double *sigma,* int *borderType* )

Enables the Gaussian filter. Just a wrapper around frame processor.

**Parameters**

| | |
|---|---|
| *kernelRadius* | The filtering kernel' radius. |
| *sigma* | The standard deviation. |
| *borderType* | OpenCV border type. |

**Returns**

void

#### 6.17.3.74 void FrameManager::setFilterMedian ( int *kernelRadius,* bool *masked* )

Enables the 2D Median filter. Just a wrapper around frame processor.

**Parameters**

| | |
|---|---|
| *kernelRadius* | The filtering kernel' radius. |
| *masked* | Taxels that survived the filtering process retain their original values. |

**Returns**

void

#### 6.17.3.75 void FrameManager::setFilterMedian3D ( bool *masked* )

Enables the spatio-temporal 3x3x3 Median filter. Just a wrapper around frame processor.

**Parameters**

| | |
|---|---|
| *masked* | Taxels that survived the filtering process retain their original values. |

**Returns**

void

#### 6.17.3.76 void FrameManager::setFilterMorphological ( int *kernelType,* int *kernelRadius,* bool *masked,* int *borderType* )

Enables the opening operation. Just a wrapper around frame processor.

**Parameters**

| | |
|---|---|
| *kernelType* | OpenCV kernel type. |
| *kernelRa-dius* | The filtering kernel' radius. |
| *masked* | Taxels that survived the filtering process retain their original values. |
| *borderType* | OpenCV border type. |

**Returns**

void

#### 6.17.3.77 void FrameManager::setFilterNone ( )

Disable filtering.

**Returns**

void

#### 6.17.3.78 void FrameManager::setFrameGrabberDSA ( FrameGrabberDSA ∗ *fgDSA* )

Sets the DSA frame grabber.

**Parameters**

| | |
|---|---|
| *fgDSA* | The DSA frame grabber. |

**Returns**

void

#### 6.17.3.79 void FrameManager::setFrameGrabberSDH ( FrameGrabberSDH ∗ *fgSDH* )

Sets the SDH-2 frame grabber.

**Parameters**

| | |
|---|---|
| *fgSDH* | The SDH frame grabber. |

**Returns**

void

#### 6.17.3.80 void FrameManager::setJointAngleFrameAvailable ( bool *value* )

Sets the availability of the joint angle frames.

**Parameters**

| | |
|---|---|
| *The* | state. |

**Returns**

void

#### 6.17.3.81 void FrameManager::setLiveFrame ( )

Creates a copy of the current frame, the live frame. Access to live frame has to be synchronized.

**Returns**

void

#### 6.17.3.82 void FrameManager::setSDH ( cSDH ∗ *sdh* )

Sets the SDH-2

**Parameters**

| | |
|---|---|
| *sdh* | The hand instance. |

**Returns**

void

#### 6.17.3.83 void FrameManager::setSensitivity ( uint *matrixID,* float *sensitivity* )

Sets the sensitivity of the specified matrix.

**Parameters**

| | |
|---|---|
| *matrixID* | The matrix ID. |
| *sensitivity* | The matrix sensitivity threshold in range [0.0, 1.0]. |

**Returns**

void

#### 6.17.3.84 bool FrameManager::setSlipReferenceFrame ( uint *matrixID,* uint *frameID* )

(Re)sets the reference frame for both translational and rotational slip-detection (offline version).

**Parameters**

| | |
|---|---|
| *matrixID* | THe matrix ID. |
| *frameID* | The frame ID. |

**Returns**

Success.

#### 6.17.3.85 bool FrameManager::setSlipReferenceFrameLive ( uint *matrixID* )

(Re)sets the reference frame for both translational and rotational slip-detection (live version).

**Parameters**

| | |
|---|---|
| *matrixID* | The matrix ID. |

**Returns**

Success.

#### 6.17.3.86 void FrameManager::setSlipThresholdConsecutive ( double *thresh* )

Sets the threshold for comparison with previous sensor matrix.

**Parameters**

| | |
|---|---|
| *thresh* | The theshold. |

**Returns**

void

#### 6.17.3.87 void FrameManager::setSlipThresholdReference ( double *thresh* )

Sets the threshold for comparison with reference sensor matrix.

**Parameters**

| | |
|---|---|
| *thresh* | The theshold. |

**Returns**

void

#### 6.17.3.88 void FrameManager::setThreshold ( uint *matrixID,* float *threshold* )

Sets the sensor value threshold.

**Note**

Program might crash if the connection is choking due to the failing run length encoding in case of noise. This problem is hidden somewhere in the SDH-2's black-box.

**Parameters**

| | |
|---|---|
| *matrixID* | The matrix ID. |
| *threshold* | The matrix threshold. |

**Returns**

void

#### 6.17.3.89 void FrameManager::setTSFrameAvailable ( bool *value* )

Sets the availability of a tactile sensor frame.

**Parameters**

| | |
|---|---|
| *The* | state. |

**Returns**

void

#### 6.17.3.90 std::vector< boost::optional< slipResult > > FrameManager::slipResultConsumer ( )

Removes slip detection results from queue. (producer-consumer pattern)

**Returns**

The last slip-detection result.

#### 6.17.3.91 void FrameManager::slipResultProducer ( )

Computes slip detection results and pushes them on queue. (producer-consumer pattern)

**Returns**

void

#### 6.17.3.92 void FrameManager::storeFrames ( const std::string & *filename* )

Store pressure profile.

**Parameters**

| | |
|---|---|
| *filename* | The ∗.dsa file. |

**Returns**

void

#### 6.17.3.93 void FrameManager::storeProfile ( const std::string & *filename* )

Store SDH-2 pressure profile in ∗.dsa file

The file format is xml based and inspired by Weiss's dsa3 format. By removing the additional temperature and joint angle readings from the xml tree the profiles can be opened in the DSA Explorer by Weiss.

**Parameters**

| | |
|---|---|
| *filename* | The filename. |

**Returns**

void

#### 6.17.3.94 void FrameManager::storeProfileSelection ( const string & *filename,* uint *fromIdxTS,* uint *toIdxTS* )

Only stores a selection of tactile sensor frames and corresponding temperature and joint angles (including both limits). See storeProfile() for comparison.

**Parameters**

| | |
|---|---|
| *filename* | The filename. |
| *fromIdxTS* | Frame ID from. |
| *toIdxTS* | Frame ID to. |

**Returns**

void

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

- framemanager.h
- framemanager.cpp

## 6.18 FrameManagerWrapper Class Reference

Defines Boost.Python wrappers around the FrameManage class. See Python examples for usage.

### Public Member Functions

- **FrameManagerWrapper** (std::string filename)
- FrameManager & **get_framemanager** ()
- void **load_profile** (std::string filename)
- uint **get_tsframe_count** ()
- uint64_t **get_tsframe_timestamp** (int frameID)
- np::ndarray **get_tsframe_timestamp_list** ()
- np::ndarray **get_tsframe** (int frameID, int matrixID)
- bp::list **get_tsframe_list** (int frameID)
- void **set_filter_none** ()
- void **set_filter_median** (int kernel_radius, bool masked)
- void **set_filter_gaussian** (int kernel_radius, double sigma)
- void **set_filter_bilateral** (int kernel_radius, double sigma_color, double sigma_-space)
- void **set_filter_morphological** (int kernel_type, int kernel_radius, bool masked)
- np::ndarray **get_filtered_tsframe** (uint frameID, int matrixID)
- bp::list **get_filtered_tsframe_list** (int frameID)
- double **get_texel** (uint frameID, uint matrixID, uint x, uint y)
- np::ndarray **get_texel_list** (uint matrixID, uint x, uint y)
- double **get_average_frame** (uint frameID)
- np::ndarray **get_average_frame_list** ()
- double **get_average_matrix** (uint frameID, uint matrixID)
- np::ndarray **get_average_matrix_list** (uint matrixID)
- double **get_min_frame** (uint frameID)
- np::ndarray **get_min_frame_list** ()
- double **get_min_matrix** (uint frameID, uint matrixID)
- np::ndarray **get_min_matrix_list** (uint matrixID)
- double **get_max_frame** (uint frameID)
- np::ndarray **get_max_frame_list** ()
- double **get_max_matrix** (uint frameID, uint matrixID)

- np::ndarray **get_max_matrix_list** (uint matrixID)
- int **get_num_active_cells_frame** (uint frameID)
- int **get_num_active_cells_matrix** (uint frameID, uint matrixID)
- int **get_jointangle_frame_count** ()
- np::ndarray **get_jointangle_frame** (int angleID)
- np::ndarray **get_jointangle_frame_list** ()
- uint64_t **get_jointangle_frame_timestamp** (int angleID)
- np::ndarray **get_jointangle_frame_timestamp_list** ()
- int **get_temperature_frame_count** ()
- np::ndarray **get_temperature_frame** (int tempID)
- np::ndarray **get_temperature_frame_list** ()
- uint64_t **get_temperature_frame_timestamp** (int tempID)
- np::ndarray **get_temperature_frame_timestamp_list** ()
- np::ndarray **get_corresponding_jointangles** (int tsframeID)
- np::ndarray **get_corresponding_jointangles_list** ()
- np::ndarray **get_corresponding_temperatures** (int tsframeID)
- np::ndarray **get_corresponding_temperatures_list** ()

### 6.18.1 Detailed Description

Defines Boost.Python wrappers around the FrameManage class. See Python examples for usage.

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

- framemanager_python.cpp

## 6.19 FrameProcessor Class Reference

Manages temporal, spatial and spatio-temporal filtering.

`#include <frameprocessor.h>`

### Public Member Functions

- FrameProcessor ()
- void setFrameManager (FrameManager *fm)
- int getNumActiveCells (uint frameID)
- int getMatrixNumActiveCells (uint frameID, uint matrixID)
- void calcCharacteristics (uint frameID)
- double getAverage (uint frameID)
- double getMatrixAverage (uint frameID, uint matrixID)
- double getMin (uint frameID)
- double getMatrixMin (uint frameID, uint matrixID)
- double getMax (uint frameID)

- double getMatrixMax (uint frameID, uint matrixID)
- void setFilterNone ()
- void setFilterMedian (int kernelRadius, bool masked)
- void setFilterMedian3D (bool masked)
- void setFilterGaussian (int kernelRadius, double sigma, int borderType)
- void setFilterBilateral (int kernelRadius, double sigmaColor, double sigmaSpace, int borderType)
- void setFilterOpening (int kernelType, int kernelRadius, bool masked, int border-Type)
- FilterType getFilterType ()
- double **calcGaussianSigma** (int kernelRadius)
- void applyFilter (TSFrame ∗tsFrame, int frameID)

### 6.19.1 Detailed Description

Manages temporal, spatial and spatio-temporal filtering.

### 6.19.2 Constructor & Destructor Documentation

#### 6.19.2.1 FrameProcessor::FrameProcessor ( )

Constructor.

### 6.19.3 Member Function Documentation

#### 6.19.3.1 void FrameProcessor::applyFilter ( TSFrame ∗ *tsFrame,* int *frameID* )

Performs the actual filtering based on the current filter settings.

**Parameters**

| | |
|---|---|
| *tsFrame* | Pointer to the tactile sensor frame. |
| *frameID* | The frame ID. |

**Returns**

void

#### 6.19.3.2 void FrameProcessor::calcCharacteristics ( uint *frameID* )

Calculates all characteristic values at once in a single iteration. Characteristic values are: Per matrix as well as per frame averages, minimum and maximum values

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |

**Returns**

void

#### 6.19.3.3 double FrameProcessor::getAverage ( uint *frameID* )

Returns frame average. See calcCharacteristics().

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |

**Returns**

void

#### 6.19.3.4 FilterType FrameProcessor::getFilterType ( )

Getter: filter type.

**Returns**

The filter type.

#### 6.19.3.5 double FrameProcessor::getMatrixAverage ( uint *frameID,* uint *matrixID* )

Returns the matrix average. See calcCharacteristics().

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |
| *matrixID* | The matrix ID. |

**Returns**

void

#### 6.19.3.6 double FrameProcessor::getMatrixMax ( uint *frameID,* uint *matrixID* )

Returns the matrix maximum value. See calcCharacteristics().

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |
| *matrixID* | The matrix ID. |

**Returns**

void

#### 6.19.3.7 double FrameProcessor::getMatrixMin ( uint *frameID*, uint *matrixID* )

Returns the matrix minimum value. See calcCharacteristics().

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |
| *matrixID* | The matrix ID. |

**Returns**

void

#### 6.19.3.8 int FrameProcessor::getMatrixNumActiveCells ( uint *frameID*, uint *matrixID* )

Returns the number of active taxels of the specified matrix.

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |
| *matrixID* | The matrix ID. |

**Returns**

The number of active taxels.

#### 6.19.3.9 double FrameProcessor::getMax ( uint *frameID* )

Returns frame maximum value. See calcCharacteristics().

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |

**Returns**

void

#### 6.19.3.10 double FrameProcessor::getMin ( uint *frameID* )

Returns frame minimum value. See calcCharacteristics().

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |

**Returns**

void

#### 6.19.3.11 int FrameProcessor::getNumActiveCells ( uint *frameID* )

Returns the number of active taxels of the entire frame

**Parameters**

| | |
|---|---|
| *frameID* | The frame ID. |

**Returns**

The number of active taxels.

#### 6.19.3.12 void FrameProcessor::setFilterBilateral ( int *kernelRadius,* double *sigmaColor,* double *sigmaSpace,* int *borderType* )

Enables the Bilateral filter.

**Parameters**

| | |
|---|---|
| *kernelRadius* | The filtering kernel' radius. |
| *sigmaColor* | The color standard deviation parameter. |
| *sigmaSpace* | The spatial standard deviation parameter. |
| *borderType* | OpenCV border type. |

**Returns**

void

#### 6.19.3.13 void FrameProcessor::setFilterGaussian ( int *kernelRadius,* double *sigma,* int *borderType* )

Enables the Gaussian filter.

**Parameters**

| | |
|---|---|
| *kernelRadius* | The filtering kernel' radius. |
| *sigma* | The standard deviation. |
| *borderType* | OpenCV border type. |

**Returns**

void

#### 6.19.3.14 void FrameProcessor::setFilterMedian ( int *kernelRadius,* bool *masked* )

Enables the 2D Median filter.

**Parameters**

| | |
|---|---|
| *kernelRadius* | The filtering kernel' radius. |
| *masked* | Taxels that survived the filtering process retain their original values. |

**Returns**

void

#### 6.19.3.15 void FrameProcessor::setFilterMedian3D ( bool *masked* )

Enables the spatio-temporal 3x3x3 Median filter.

**Parameters**

| | |
|---|---|
| *masked* | Taxels that survived the filtering process retain their original values. |

**Returns**

void

#### 6.19.3.16 void FrameProcessor::setFilterNone ( )

Disables filtering.

#### 6.19.3.17 void FrameProcessor::setFilterOpening ( int *kernelType,* int *kernelRadius,* bool *masked,* int *borderType* )

Enables the opening operation.

**Parameters**

| | |
|---|---|
| *kernelType* | OpenCV kernel type. |
| *kernelRadius* | The filtering kernel' radius. |
| *masked* | Taxels that survived the filtering process retain their original values. |
| *borderType* | OpenCV border type. |

**Returns**

void

#### 6.19.3.18 void FrameProcessor::setFrameManager ( **FrameManager** ∗ *fm* )

Sets the frame manager.

**Parameters**

| | |
|---|---|
| *fm* | The frame manager. |

**Returns**

void

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

- frameprocessor.h
- frameprocessor.cpp

## 6.20 guiChart Class Reference

The chart containing the the zoom, crop and export buttons as well as the graph. Manages the dataset before it is displayed in the graph.

```
#include <guiChart.h>
```

### Public Member Functions

- **guiChart** (Controller ∗c, guiMain ∗gui)
- void initDataset ()
- void updateDataset ()
- void **setMarkerPosition** (int frameID)
- bool **getActiveSelection** ()
- uint **getSelectionFrom** ()
- uint **getSelectionTo** ()

### Protected Member Functions

- void **on_button_zoom_in_clicked** ()
- void **on_button_zoom_out_clicked** ()
- bool **on_slider_value_changed** (Gtk::ScrollType type, double value)
- void **on_button_crop_clicked** ()
- void **on_button_export_clicked** ()
- void **on_checkbutton_selection_clicked** ()

### 6.20.1 Detailed Description

The chart containing the the zoom, crop and export buttons as well as the graph. Manages the dataset before it is displayed in the graph.

### 6.20.2 Member Function Documentation

#### 6.20.2.1 void guiChart::initDataset ( )

Init chart

#### 6.20.2.2 void guiChart::updateDataset ( )

Only collect/copy missing data series

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

- guiChart.h
- guiChart.cpp

## 6.21 guiController Class Reference

GUI to control the SDH-2.

`#include <guiController.h>`

### Public Member Functions

- **guiController** (Controller ∗c)
- void **connectSDH** ()
- void **disconnectSDH** ()
- void **connectDSA** ()
- void **disconnectDSA** ()

### Protected Member Functions

- void **worker_grasp** (int graspID, double closeRatio, double velocity)
- void **on_worker_grasp_done** ()
- void **worker_grasp_reactive** (int graspID, double velocity, double limit)
- void **on_worker_grasp_reactive_done** ()
- void **worker_grasp_slip** (int graspID, double velocity, double limitLow, double limitHigh, double stepSize)
- void **on_worker_grasp_slip_done** ()
- void **on_button_pause_SDH_clicked** ()
- void **on_button_stop_SDH_clicked** ()
- void **on_button_record_SDH_clicked** ()
- void **on_checkbutton_temperature_clicked** ()
- void **on_checkbutton_joint_angles_clicked** ()
- void **on_button_pause_DSA_clicked** ()
- void **on_button_stop_DSA_clicked** ()

- void **on_button_record_DSA_clicked** ()
- void **on_combo_grasp_changed** ()
- void **on_button_grasp_clicked** ()
- void **on_button_grasp_reactive_clicked** ()
- void **on_button_grasp_slip_clicked** ()
- void **on_button_relax_clicked** ()
- bool **on_slider_close_clicked** (GdkEventButton ∗event)
- bool **on_slider_close_released** (GdkEventButton ∗event)
- bool **on_slider_close_value_changed** (Gtk::ScrollType type, double value)
- bool **on_slider_velocity_clicked** (GdkEventButton ∗event)
- bool **on_slider_velocity_released** (GdkEventButton ∗event)
- bool **on_slider_velocity_value_changed** (Gtk::ScrollType type, double value)
- bool **on_slider_reactive_clicked** (GdkEventButton ∗event)
- bool **on_slider_reactive_released** (GdkEventButton ∗event)
- bool **on_slider_reactive_value_changed** (Gtk::ScrollType type, double value)
- bool **on_slider_sensitivity_clicked** (GdkEventButton ∗event)
- bool **on_slider_sensitivity_released** (GdkEventButton ∗event)
- bool **on_slider_sensitivity_value_changed** (Gtk::ScrollType type, double value)

- bool **on_slider_threshold_clicked** (GdkEventButton ∗event)
- bool **on_slider_threshold_released** (GdkEventButton ∗event)
- bool **on_slider_threshold_value_changed** (Gtk::ScrollType type, double value)

- void on_button_threshold_clicked ()
- void **on_button_threshold_reset_clicked** ()

## Protected Attributes

- Controller ∗ **controller**
- FrameManager ∗ **frameManager**
- FrameProcessor ∗ **frameProcessor**
- FrameGrabberDSA ∗ **frameGrabberDSA**
- FrameGrabberSDH ∗ **frameGrabberSDH**
- Gtk::Image **m_Image_Play_SDH**
- Gtk::Image **m_Image_Pause_SDH**
- Gtk::Image **m_Image_Stop_SDH**
- Gtk::Image **m_Image_Record_SDH**
- Gtk::Image **m_Image_Play_DSA**
- Gtk::Image **m_Image_Pause_DSA**
- Gtk::Image **m_Image_Stop_DSA**
- Gtk::Image **m_Image_Record_DSA**
- Gtk::VBox **m_VBox_Left_Sidebar**
- Gtk::Frame **m_Frame_SDH**
- Gtk::Frame **m_Frame_DSA**
- Gtk::VBox **m_VBox_SDH**
- Gtk::VBox **m_VBox_DSA**

- Gtk::Frame **m_Frame_Recorder_SDH**
- Gtk::Frame **m_Frame_Recorder_DSA**
- Gtk::VBox **m_VBox_Recorder_SDH**
- Gtk::VBox **m_VBox_Recorder_DSA**
- Gtk::HButtonBox **m_ButtonBox_Recording_SDH**
- Gtk::Button **m_Button_Pause_SDH**
- Gtk::Button **m_Button_Stop_SDH**
- Gtk::Button **m_Button_Record_SDH**
- bool **recorder_paused_SDH**
- bool **recorder_recording_SDH**
- Gtk::CheckButton **m_CheckButton_Temperature**
- Gtk::CheckButton **m_CheckButton_JointAngles**
- Gtk::HButtonBox **m_ButtonBox_Recording_DSA**
- Gtk::Button **m_Button_Pause_DSA**
- Gtk::Button **m_Button_Stop_DSA**
- Gtk::Button **m_Button_Record_DSA**
- bool **recorder_paused_DSA**
- bool **recorder_recording_DSA**
- Gtk::Frame **m_Frame_Grasp**
- Gtk::VBox **m_VBox_Grasp**
- Gtk::HBox **m_HBox_Grasp**
- Gtk::ComboBoxText **m_Combo_Grasp**
- Gtk::Button **m_Button_Grasp**
- Gtk::Button **m_Button_Grasp_Reactive**
- bool **m_ToggleButton_Grasp_Slip_Failed**
- Gtk::ToggleButton **m_ToggleButton_Grasp_Slip**
- Gtk::Button **m_Button_Relax**
- Glib::Thread ∗ **m_Thread_Grasp**
- Glib::Dispatcher **m_Thread_Grasp_Dispatcher**
- Glib::Thread ∗ **m_Thread_Grasp_Reactive**
- Glib::Dispatcher **m_Thread_Grasp_Reactive_Dispatcher**
- bool **m_stop_thread_grasp_slip**
- Glib::Mutex **m_mutex_thread_grasp_slip**
- Glib::Thread ∗ **m_Thread_Grasp_Slip**
- Glib::Dispatcher **m_Thread_Grasp_Slip_Dispatcher**
- Gtk::Frame **m_Frame_Close**
- Gtk::Adjustment **m_Adjustment_Close**
- Gtk::HScale **m_Slider_Close**
- Gtk::Frame **m_Frame_Velocity**
- Gtk::Adjustment **m_Adjustment_Velocity**
- Gtk::HScale **m_Slider_Velocity**
- Gtk::Frame **m_Frame_Reactive**
- Gtk::Adjustment **m_Adjustment_Reactive**
- Gtk::HScale **m_Slider_Reactive**
- Gtk::Frame **m_Frame_Sensitivity**
- Gtk::Adjustment **m_Adjustment_Sensitivity**

- Gtk::HScale **m_Slider_Sensitivity**
- Gtk::Label **m_Label_Sensitivity**
- float **m_sensitivity**
- Gtk::Frame **m_Frame_Threshold**
- Gtk::VBox **m_VBox_Threshold**
- Gtk::Adjustment **m_Adjustment_Threshold**
- Gtk::HScale **m_Slider_Threshold**
- Gtk::Label **m_Label_Threshold**
- UInt16 **m_threshold**
- Gtk::HButtonBox **m_ButtonBox_Threshold**
- Gtk::Button **m_Button_Threshold**
- Gtk::Button **m_Button_Threshold_Reset**

### 6.21.1 Detailed Description

GUI to control the SDH-2.

### 6.21.2 Member Function Documentation

#### 6.21.2.1 void guiController::on_button_threshold_clicked ( ) `[protected]`

Measure current temperature and set sensor threshold to individually calibrated values The sensitivity of all matrices is subsequently set to 1.0 In order to get rid of ghosting have a look at setFilterOpening() of the frame processor

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

- guiController.h
- guiController.cpp

## 6.22 guiGraph Class Reference

The graph.

`#include <guiGraph.h>`

### Public Member Functions

- **guiGraph** (Controller ∗c, guiMain ∗gui, Timeseries &collection)
- void **updateSamples** (const Timeseries &inSample)
- void **setZoom** (int zoom)
- void setMarkerPosition (int frameID)
- void **setActiveSelection** (bool active)
- bool **getActiveSelection** ()
- void **moveLeftBoundary** (int pos)

- int **getLeftBoundary** ()
- double **getStepSize** ()
- int **getSampleRange** ()
- int **getSelectionFrom** ()
- int **getSelectionTo** ()

### Protected Member Functions

- virtual bool **on_expose_event** (GdkEventExpose ∗event)
- virtual bool on_button_press_event (GdkEventButton ∗event)
- virtual bool on_button_release_event (GdkEventButton ∗event)
- virtual bool on_motion_notify_event (GdkEventMotion ∗event)

## 6.22.1 Detailed Description

The graph.

The drawing is rather complex and adopts to the number of samples per pixel. In the overview mode, lines between samples are drawn individually. Otherwise a pyramidal linear subsampling scheme is applied to draw the time series.

## 6.22.2 Member Function Documentation

### 6.22.2.1 bool guiGraph::on_button_press_event ( GdkEventButton ∗ *event* ) `[protected, virtual]`

Mouse button pressed

### 6.22.2.2 bool guiGraph::on_button_release_event ( GdkEventButton ∗ *event* ) `[protected, virtual]`

Mouse button released

### 6.22.2.3 bool guiGraph::on_motion_notify_event ( GdkEventMotion ∗ *event* ) `[protected, virtual]`

Moving the mouse with pressed buttons

### 6.22.2.4 void guiGraph::setMarkerPosition ( int *frameID* )

Map marker from sample- to pixel space

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

- guiGraph.h
- guiGraph.cpp

## 6.23 guiMain Class Reference

The main window. Inherits from Gtk::Window.

`#include <guiMain.h>`

### Public Member Functions

- **guiMain** (Controller ∗controller)
- void **resetGUIOnline** ()
- void resetGUIOffline ()
- void updateGUIOffline ()
- void **setCurrentFrame** (int frameID)
- void **updateDataset** ()
- bool **getActiveSelection** ()
- uint **getSelectionFrom** ()
- uint **getSelectionTo** ()
- void **setCharacteristics** (std::vector< std::vector< int > > c)
- std::vector< std::vector< int > > **getCharacteristics** ()
- void **saveCurrentFramePDF** ()

### Protected Member Functions

- void **on_menu_take_screenshot_2D_clicked** ()
- void **on_menu_take_screenshot_3D_clicked** ()
- void **on_screenshot_delete_clicked** ()
- void **on_menu_connect_SDH** ()
- void **on_menu_connect_DSA** ()
- void on_menu_new_profile ()
- void on_menu_load_profile ()
- void **on_menu_save_profile_as** ()
- void **on_menu_file_quit** ()
- void **on_menu_show_tools** ()
- void **on_menu_show_slip_detection** ()
- void **on_menu_show_sensor_view** ()
- void **on_menu_show_chart_view** ()
- void **on_menu_show_tree_view** ()
- void embedPython ()
- void **on_menu_classify** ()
- void **on_notebook_switch_page** (GtkNotebookPage ∗page, guint page_num)
- void **on_vpaned_size_allocate** (Gtk::Allocation &allocation)
- void **on_vpaned_realize** ()
- void **on_resize_notify** (GdkEventConfigure ∗event)
- bool **on_tools_delete_clicked** (GdkEventAny ∗event)
- bool **on_slip_detection_delete_clicked** (GdkEventAny ∗event)
- virtual bool **on_key_press_event** (GdkEventKey ∗event)
- virtual bool **on_key_release_event** (GdkEventKey ∗event)

## Protected Attributes

- Controller ∗ **m_controller**
- FrameManager ∗ **m_frameManager**
- FrameProcessor ∗ **m_frameProcessor**
- FeatureExtraction **m_featureExtractor**
- uint **current_frame**
- Gtk::VBox **m_VBox_Main**
- Gtk::MenuBar **m_Menubar**
- Gtk::Toolbar **m_Toolbar**
- Gtk::ToggleToolButton **m_ToggleToolButton_Connect_SDH**
- Gtk::ToggleToolButton **m_ToggleToolButton_Connect_DSA**
- bool **m_ToggleToolButton_Connect_SDH_pressed**
- bool **m_ToggleToolButton_Connect_DSA_pressed**
- Gtk::ToggleToolButton **m_ToggleToolButton_Tools**
- Gtk::ToggleToolButton **m_ToggleToolButton_Slip_Detection**
- Gtk::ToggleToolButton **m_ToggleToolButton_Sensor_View**
- Gtk::ToggleToolButton **m_ToggleToolButton_Chart_View**
- Gtk::ToggleToolButton **m_ToggleToolButton_Tree_View**
- Gtk::HBox **m_HBox_Main**
- Gtk::VBox **m_VBox_Right_Sidebar**
- Gtk::VBox **m_VBox_Renderer**
- guiController ∗ **m_Frame_Controller**
- bool **showSensorView**
- bool **showChartView**
- bool **showTreeView**
- bool **m_pythonEmbedded**
- bp::object **m_main**
- bp::object **m_global**
- Renderer **renderer**
- Gtk::VPaned **m_VPaned_Views**
- int **m_VPaned_Views_Divider_Pos**
- double **m_VPaned_Views_Ratio**
- bool **m_resized**
- Gtk::Notebook **m_Notebook_Renderer**
- Gtk::Frame **m_Frame_Renderer2D**
- guiRenderer2D ∗ **m_guiRenderer2D**
- Gtk::Frame **m_Frame_Renderer3D**
- guiRenderer3D ∗ **m_guiRenderer3D**
- guiSeekbar ∗ **m_guiSeekbar**
- guiChart ∗ **m_guiChart**
- guiTreeView ∗ **m_guiTreeView**
- guiTools ∗ **m_guiTools**
- guiSlipDetection ∗ **m_guiSlipDetection**
- guiScreenshot ∗ **m_guiScreenshot**
- std::vector< std::vector< int > > **characteristics**

### 6.23.1 Detailed Description

The main window. Inherits from Gtk::Window.

### 6.23.2 Member Function Documentation

#### 6.23.2.1 void guiMain::embedPython ( ) [protected]

Embed python interpreter, load trained state of SVM and classify feature vector

#### 6.23.2.2 void guiMain::on_menu_load_profile ( ) [protected]

File chooser for ∗.dsa pressure profile file

#### 6.23.2.3 void guiMain::on_menu_new_profile ( ) [protected]

Reset FrameManager

#### 6.23.2.4 void guiMain::resetGUIOffline ( )

Reset to initial state (no frames available)

#### 6.23.2.5 void guiMain::updateGUIOffline ( )

Update state (frames available)

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

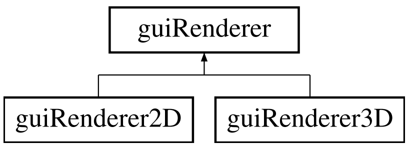
- guiMain.h
- guiMain.cpp

## 6.24 guiRenderer Class Reference

Base class for guiRenderer2D and guiRenderer3D.

`#include <guiRenderer.h>`

Inheritance diagram for guiRenderer:



### Public Member Functions

- **guiRenderer** (FrameManager ∗fm)
- **guiRenderer** (FrameManager ∗fm, guiMain ∗gui)
- void **startRendering** (bool live)
- void **stopRendering** ()
- virtual void **invalidate** ()
- virtual void **update** ()
- virtual void **renderFrame** ()
- virtual void **renderFrame** (uint frameID)
- RGB **determineColor** (float value)
- virtual bool **on_key_press_event** (GdkEventKey ∗event)
- virtual bool **on_key_release_event** (GdkEventKey ∗event)

### Public Attributes

- FrameManager ∗ **m_frameManager**
- FrameProcessor ∗ **m_frameProcessor**
- guiMain ∗ **m_mainGUI**
- Colormap **m_colormap**
- bool **m_liveMode**
- bool **m_isRendering**

### Protected Member Functions

- virtual bool **on_idle** ()
- virtual bool **on_map_event** (GdkEventAny ∗event)
- virtual bool **on_unmap_event** (GdkEventAny ∗event)
- virtual bool **on_visibility_notify_event** (GdkEventVisibility ∗event)

### Protected Attributes

- sigc::connection **m_ConnectionIdle**

### 6.24.1 Detailed Description

Base class for guiRenderer2D and guiRenderer3D.

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

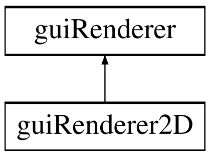
- guiRenderer.h
- guiRenderer.cpp

## 6.25 guiRenderer2D Class Reference

Renders visualization of tactile sensor profiles with the help of Cairo, a vector graphics library.

`#include <guiRenderer2D.h>`

Inheritance diagram for guiRenderer2D:



### Public Member Functions

- **guiRenderer2D** (FrameManager ∗fm)
- **guiRenderer2D** (FrameManager ∗fm, guiMain ∗gui)
- virtual void **renderFrame** ()
- virtual void **renderFrame** (uint frameID)
- void **drawMatrices** (const Cairo::RefPtr< Cairo::Context > &cr, int width, int height, bool screenshot)
- void **takeScreenshot** (const string &filename)
- void **init** ()

### Protected Member Functions

- virtual void **invalidate** ()
- virtual void **update** ()
- virtual bool **on_expose_event** (GdkEventExpose ∗event)
- virtual bool **on_button_press_event** (GdkEventButton ∗event)
- virtual bool **on_button_release_event** (GdkEventButton ∗event)
- virtual bool **on_motion_notify_event** (GdkEventMotion ∗event)

### 6.25.1 Detailed Description

Renders visualization of tactile sensor profiles with the help of Cairo, a vector graphics library.

Not very suitable for real-time rendering, but great for rendering PDFs.

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

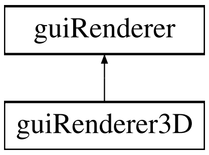
- guiRenderer2D.h
- guiRenderer2D.cpp

## 6.26 guiRenderer3D Class Reference

Renders visualization of tactile sensor profiles in OpenGL.

`#include <guiRenderer3D.h>`

Inheritance diagram for guiRenderer3D:



### Public Member Functions

- EIGEN_MAKE_ALIGNED_OPERATOR_NEW **guiRenderer3D** (FrameManager ∗frameManager)
- **guiRenderer3D** (FrameManager ∗frameManager, guiMain ∗gui)
- virtual void **renderFrame** ()
- virtual void **renderFrame** (uint frameID)
- void **takeScreenshot** (std::string filename)
- void **takeScreenshot** (int width, int height, std::string filename)
- void **setOffscreenSize** (int width, int height)
- void **init** ()
- bool **on_key_press_event** (GdkEventKey ∗event)
- bool **on_key_release_event** (GdkEventKey ∗event)

### Protected Member Functions

- virtual void **invalidate** ()
- virtual void **update** ()
- virtual void on_realize ()
- virtual bool on_expose_event (GdkEventExpose ∗event)
- virtual bool on_configure_event (GdkEventConfigure ∗event)
- virtual bool on_button_press_event (GdkEventButton ∗event)
- virtual bool on_button_release_event (GdkEventButton ∗event)
- virtual bool on_motion_notify_event (GdkEventMotion ∗event)

### 6.26.1 Detailed Description

Renders visualization of tactile sensor profiles in OpenGL.

Uses the old OpenGL immediate mode. Given the (recorded) joint angles the computed miniball can be visualized.

### 6.26.2 Member Function Documentation

#### 6.26.2.1 bool guiRenderer3D::on_button_press_event ( GdkEventButton ∗ *event* ) [protected, virtual]

Mouse button pressed

#### 6.26.2.2 bool guiRenderer3D::on_button_release_event ( GdkEventButton ∗ *event* ) [protected, virtual]

Mouse button released

#### 6.26.2.3 bool guiRenderer3D::on_configure_event ( GdkEventConfigure ∗ *event* ) [protected, virtual]

Called when resizing

#### 6.26.2.4 bool guiRenderer3D::on_expose_event ( GdkEventExpose ∗ *event* ) [protected, virtual]

Draw scene

#### 6.26.2.5 bool guiRenderer3D::on_motion_notify_event ( GdkEventMotion ∗ *event* ) [protected, virtual]

Moving the mouse with pressed buttons

#### 6.26.2.6 void guiRenderer3D::on_realize ( ) [protected, virtual]

Initialization (called only once)

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

- guiRenderer3D.h
- guiRenderer3D.cpp

## 6.27 guiScreenshot Class Reference

Take screen shot GUI.

`#include <guiScreenshot.h>`

### Public Member Functions

- **guiScreenshot** (Controller ∗c, guiRenderer3D ∗renderer, uint from, uint to)

### Protected Member Functions

- void **on_button_render_clicked** ()
- void **on_button_close_clicked** ()

### Protected Attributes

- Gtk::Button **m_Button_Render**
- Gtk::Button **m_Button_Close**
- Gtk::Label **m_Label_Width**
- Gtk::Label **m_Label_Height**
- Gtk::Label **m_Label_From**
- Gtk::Label **m_Label_To**
- Gtk::Label **m_Label_From_Value**
- Gtk::Label **m_Label_To_Value**
- Gtk::Adjustment **m_Adjustment_Width**
- Gtk::SpinButton **m_SpinButton_Width**
- Gtk::Adjustment **m_Adjustment_Height**
- Gtk::SpinButton **m_SpinButton_Height**
- Gtk::Table **m_Table**
- Gtk::HButtonBox **m_ButtonBox_Dialog**
- Gtk::VBox **m_VBox_Dialog**

### 6.27.1 Detailed Description

Take screen shot GUI.

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

- guiScreenshot.h
- guiScreenshot.cpp

## 6.28 guiSeekbar Class Reference

The seekbar.

`#include <guiSeekbar.h>`

## Public Member Functions

- **guiSeekbar** (Controller ∗c, guiMain ∗gui)
- void **initSeekbar** ()
- void **resetSeekbar** ()
- void setSliderPosition (int frameID)

## Protected Member Functions

- bool **on_idle** ()
- bool on_signal_timeout ()
- void **on_button_play_clicked** ()
- void **on_button_next_clicked** ()
- void **on_button_prev_clicked** ()
- bool **on_slider_clicked** (GdkEventButton ∗event)
- bool **on_slider_released** (GdkEventButton ∗event)
- bool **on_slider_value_changed** (Gtk::ScrollType type, double value)

### 6.28.1 Detailed Description

The seekbar.

### 6.28.2 Member Function Documentation

#### 6.28.2.1 bool guiSeekbar::on_signal_timeout ( ) `[protected]`

this timer callback function is called every 1/fps seconds and updates the the current video frame (Gtk::Image) periodically

#### 6.28.2.2 void guiSeekbar::setSliderPosition ( int *frameID* )

Update navigation bar

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

- guiSeekbar.h
- guiSeekbar.cpp

## 6.29 guiSlipDetection Class Reference

The Slip-detection control GUI.

`#include <guiSlipDetection.h>`

### Public Member Functions

- **guiSlipDetection** (Controller ∗c, guiMain ∗gui)
- void **clearTrajectory** (uint m)
- void **setModeOnline** ()
- void **setModeOffline** ()
- bool **runSlipDetectionOnline** ()
- bool **drawTrajectoryOnline** (uint m)
- void **setCurrentFrameOffline** (uint frameID)
- void **runSlipDetectionOffline** (uint m, uint startFrame, uint stopFrame)
- bool **drawTrajectoryOffline** (uint m, uint currentFrameID)

### Protected Member Functions

- bool **on_slider_threshold_reference_value_changed** (Gtk::ScrollType type, double value)
- bool **on_slider_threshold_reference_clicked** (GdkEventButton ∗event)
- bool **on_slider_threshold_reference_released** (GdkEventButton ∗event)
- bool **on_slider_threshold_consecutive_value_changed** (Gtk::ScrollType type, double value)
- bool **on_slider_threshold_consecutive_clicked** (GdkEventButton ∗event)
- bool **on_slider_threshold_consecutive_released** (GdkEventButton ∗event)
- void **on_checkbutton_enable_clicked** (uint m)
- void **on_button_set_reference_clicked** (uint m)
- void **on_togglebutton_details_clicked** (uint m)
- bool **on_delete_detail_clicked** (GdkEventAny ∗event, uint m)

### 6.29.1 Detailed Description

The Slip-detection control GUI.

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

- guiSlipDetection.h
- guiSlipDetection.cpp

## 6.30 guiSlipDetectionMultiPlot Class Reference

Combines individual widgets.

```
#include <guiSlipDetectionMultiPlot.h>
```

### Public Member Functions

- void **drawTrajectory** (slipResult &slip, std::deque< slip_trajectory > &slipvectors, std::deque< double > &slipangles, uint currentFrameID)
- void **updateTrajectory** (slipResult &slip, std::deque< slip_trajectory > &slipvectors, std::deque< double > &slipangles, uint currentFrameID)
- void **drawTrajectoryReference** (slipResult &slip, std::deque< slip_trajectory > &slipvectors, std::deque< double > &slipangles, uint currentFrameID)
- void **reset** ()
- void **setAxisLimits** (int x_lower, int x_upper, int y_lower, int y_upper)

### Protected Attributes

- Gtk::VBox **m_VBox_Main**
- Gtk::HBox **m_HBox_Upper**
- Gtk::HBox **m_HBox_Lower**
- Gtk::HBox **m_HBox_UpperLeft**
- Gtk::HBox **m_HBox_UpperRight**
- Gtk::HBox **m_HBox_LowerLeft**
- Gtk::HBox **m_HBox_LowerRight**
- Gtk::AspectFrame **m_AspectFrame_UpperLeft**
- Gtk::AspectFrame **m_AspectFrame_UpperRight**
- Gtk::AspectFrame **m_AspectFrame_LowerLeft**
- Gtk::AspectFrame **m_AspectFrame_LowerRight**

### 6.30.1 Detailed Description

Combines individual widgets.

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

- guiSlipDetectionMultiPlot.h
- guiSlipDetectionMultiPlot.cpp

## 6.31 guiTools Class Reference

Dialog for OpenCV filters.

`#include <guiTools.h>`

### Public Member Functions

- **guiTools** (Controller ∗c, guiMain ∗gui)

### 6.31.1 Detailed Description

Dialog for OpenCV filters.

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

- guiTools.h
- guiTools.cpp

## 6.32 guiTreeView Class Reference

Tree view of matrix characteristics. Follows the MVC pattern.

`#include <guiTreeView.h>`

### Classes

- struct **ModelColumns**

### Public Member Functions

- **guiTreeView** (Controller ∗c, guiMain ∗gui)
- void **init** ()
- void **updateCharacteristics** ()

### Protected Member Functions

- void **on_cell_toggled** (const Glib::ustring &path_string)
- void **notifyMain** ()

### 6.32.1 Detailed Description

Tree view of matrix characteristics. Follows the MVC pattern.

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

- guiTreeView.h
- guiTreeView.cpp

## 6.33 HSL Class Reference

Simple HSL color management class. Hue, Saturation and Luminance are doubles in the range [0.0, 1.0].

`#include <colormap.h>`

### Public Member Functions

- HSL (double hue=0.0, double saturation=0.0, double luminance=0.0)

### Public Attributes

- union {
  double **data** [3]
  struct {
  double **h**
  double **s**
  double **l**
  }
  };

### 6.33.1 Detailed Description

Simple HSL color management class. Hue, Saturation and Luminance are doubles in the range [0.0, 1.0].

### 6.33.2 Constructor & Destructor Documentation

#### 6.33.2.1 HSL::HSL ( double *hue* = `0.0`, double *saturation* = `0.0`, double *luminance* = `0.0` ) `[inline]`

Constructor

**Parameters**

| | |
|---|---|
| *h,s,l* | Hue, saturation and luminance in the range [0.0, 1.0]. |

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

- colormap.h

## 6.34 JointAngleFrame Struct Reference

Joint angles in accordance with SDHLibrary.

```
#include <framemanager.h>
```

### Public Attributes

- std::vector< double > **angles**
- uint64_t **timestamp**

### 6.34.1 Detailed Description

Joint angles in accordance with SDHLibrary.

The documentation for this struct was generated from the following file:

- framemanager.h

## 6.35 matrixInfo Struct Reference

Individual sensor matrices (see dsa.h)

`#include <framemanager.h>`

### Public Attributes

- UInt8 **uid** [6]
- uint **hw_revision**
- uint **cells_x**
- uint **cells_y**
- float **texel_width**
- float **texel_height**
- float **matrix_center_x**
- float **matrix_center_y**
- float **matrix_center_z**
- float **matrix_theta_x**
- float **matrix_theta_y**
- float **matrix_theta_z**
- float **fullscale**
- std::vector< bool > **static_mask**
- std::vector< bool > **dynamic_mask**
- uint **num_cells**
- uint **texel_offset**

### 6.35.1 Detailed Description

Individual sensor matrices (see dsa.h)

The documentation for this struct was generated from the following file:

- framemanager.h

## 6.36 Miniball::Miniball< CoordAccessor > Class Template Reference

### Public Types

- typedef std::list< Pit >::const_iterator **SupportPointIterator**

### Public Member Functions

- **Miniball** (int d_, Pit begin, Pit end, CoordAccessor ca=CoordAccessor())
- const NT ∗ **center** () const
- NT **squared_radius** () const
- int **nr_support_points** () const
- SupportPointIterator **support_points_begin** () const
- SupportPointIterator **support_points_end** () const
- NT **relative_error** (NT &subopt) const
- bool **is_valid** (NT tol=NT(10)∗std::numeric_limits< NT >::epsilon()) const
- double **get_time** () const

#### template<typename CoordAccessor> class Miniball::Miniball< CoordAccessor >

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

- Miniball.hpp

## 6.37 NiceScale Class Reference

Pretty axis tick labels. Graphics Gems, Volume 1 by Andrew S. Glassner.

```
#include <guiSlipDetectionMultiPlot.h>
```

### Public Member Functions

- **NiceScale** (double min, double max, int maxTicks)
- void **computeScale** (double min, double max, int maxTicks)
- double **getNiceMin** ()
- double **getNiceMax** ()
- double **getTickSpacing** ()
- int **getNumTicks** ()

### 6.37.1 Detailed Description

Pretty axis tick labels. Graphics Gems, Volume 1 by Andrew S. Glassner.

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

- guiSlipDetectionMultiPlot.h
- guiSlipDetectionMultiPlot.cpp

## 6.38 NumPyArrayData< T > Class Template Reference

### Public Member Functions

- **NumPyArrayData** (const np::ndarray &arr)
- T ∗ **data** ()
- const Py_intptr_t ∗ **strides** ()
- T & **operator()** (int i)
- T & **operator()** (int i, int j)
- T & **operator()** (int i, int j, int k)
- T & **operator()** (int i, int j, int k, int l)

**template<typename T> class NumPyArrayData< T >**

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

- NumPyArrayData.h

## 6.39 Orientation Class Reference

Visualizes current orientation.

```
#include <guiSlipDetectionMultiPlot.h>
```

### Public Member Functions

- void **reset** ()
- void **drawAxes** (const Cairo::RefPtr< Cairo::Context > &cr, int width, int height)
- bool **drawOrientation** (bool success, double angle, double lambda1, double lambda2, double skew_x, double skew_y)

### Protected Member Functions

- virtual bool **on_expose_event** (GdkEventExpose ∗event)

### 6.39.1 Detailed Description

Visualizes current orientation.

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

- guiSlipDetectionMultiPlot.h
- guiSlipDetectionMultiPlot.cpp

## 6.40 OrientationTrajectory Class Reference

Visualizes rotation trajectory.

`#include <guiSlipDetectionMultiPlot.h>`

### Public Member Functions

- **OrientationTrajectory** (std::deque< double > &slipangles)
- void **reset** ()
- void **resetAxisLimits** (int x_lower, int x_upper, int y_lower, int y_upper)
- void **drawBackgroundSurface** ()
- void **drawAxes** (const Cairo::RefPtr< Cairo::Context > &cr, int width, int height)
- bool **drawTrajectory** (std::deque< double > &slipangles, uint currentFrameID)
- bool **updateTrajectory** (std::deque< double > &slipangles, uint currentFrameID)

### Protected Member Functions

- virtual bool **on_expose_event** (GdkEventExpose ∗event)

### 6.40.1 Detailed Description

Visualizes rotation trajectory.

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

- guiSlipDetectionMultiPlot.h
- guiSlipDetectionMultiPlot.cpp

## 6.41 RGB Class Reference

Simple RGB color management class. Red Green Blue are floats in the range [0.0, 1.0].

`#include <colormap.h>`

### Public Member Functions

- RGB (float red=0.0, float green=0.0, float blue=0.0)

### Public Attributes

```
• union {
    float color [3]
    struct {
      float r
      float g
      float b
    }
  };
```

### 6.41.1 Detailed Description

Simple RGB color management class. Red Green Blue are floats in the range [0.0, 1.0].

### 6.41.2 Constructor & Destructor Documentation

#### 6.41.2.1 RGB::RGB ( float *red* = `0.0`, float *green* = `0.0`, float *blue* = `0.0` ) `[inline]`

Constructor

**Parameters**

| | |
|---|---|
| *r,g,b* | Red, Green and Blue in the range [0.0, 1.0]. |

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

- colormap.h

## 6.42 Rotation Class Reference

Implements the rotational slip detection based on the principal axis method.

`#include <slipdetection.h>`

### Public Member Functions

- Rotation ()
- bool setReferenceFrame (cv::Mat &referenceFrame)
- shapeFeatures rotationFromMoments (cv::Mat &frame)
- rotationResult computeRotation (cv::Mat &currentFrame)

### 6.42.1 Detailed Description

Implements the rotational slip detection based on the principal axis method.

### 6.42.2 Constructor & Destructor Documentation

#### 6.42.2.1 Rotation::Rotation ( )

Constructor.

### 6.42.3 Member Function Documentation

#### 6.42.3.1 rotationResult Rotation::computeRotation ( cv::Mat & *currentFrame* )

Computes slip angles by evaluating the orientation using rotationFromMoments() and tracking the rotation.

**Parameters**

| | |
|---|---|
| *current-Frame* | The current tactile sensor matrix. |

**Returns**

A tuple containing shape features, orientation and slip angles.

#### 6.42.3.2 shapeFeatures Rotation::rotationFromMoments ( cv::Mat & *frame* )

Computes the shape's orientation using the principal axis method. Shape features such as eccentricity and compactness can be used for quality evaluation.

**Parameters**

| | |
|---|---|
| *frame* | The current tactile sensor matrix. |

**Returns**

A tuple containing shape features and orientation.

#### 6.42.3.3 bool Rotation::setReferenceFrame ( cv::Mat & *referenceFrame* )

Initialization / reseting of angle tracking

**Parameters**

| | |
|---|---|
| *reference-Frame* | The reference tactile sensor matrix. |

**Returns**

Success.

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

- slipdetection.h
- slipdetection.cpp

## 6.43 RowData Class Reference

### Public Member Functions

- **RowData** (Glib::ustring label, bool plot, Glib::ustring value)
- **RowData** (Glib::ustring label, const std::vector< RowData > &children)
- **RowData** (const RowData &src)
- RowData & **operator=** (const RowData &src)

### Public Attributes

- Glib::ustring **m_label**
- bool **m_plot**
- Glib::ustring **m_value**
- std::vector< RowData > **m_children**

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

- guiTreeView.h
- guiTreeView.cpp

## 6.44 Ext::sControllerInfo Struct Reference

A data structure describing the controller info about the remote DSACON32m controller.

```
#include <extension.h>
```

### Public Attributes

- UInt16 **error_code**
- UInt32 **serial_no**
- UInt8 **hw_version**
- UInt16 **sw_version**
- UInt8 **status_flags**
- UInt8 **feature_flags**

- UInt8 **senscon_type**
- UInt8 **active_interface**
- UInt32 **can_baudrate**
- UInt16 **can_id**

### 6.44.1 Detailed Description

A data structure describing the controller info about the remote DSACON32m controller.

The documentation for this struct was generated from the following file:

- extension.h

## 6.45 sensorInfo Struct Reference

Tactile sensor Controller info (see dsa.h)

`#include <framemanager.h>`

### Public Attributes

- uint **nb_matrices**
- uint **nb_cells**
- uint **generated_by**
- uint **hw_revision**
- uint **serial_no**
- uint **converter_resolution**

### 6.45.1 Detailed Description

Tactile sensor Controller info (see dsa.h)

The documentation for this struct was generated from the following file:

- framemanager.h

## 6.46 SlipDetector Class Reference

Combined Slip-Detection class (Translation + Rotation)

`#include <slipdetection.h>`

### Public Member Functions

- SlipDetector (uint cols, uint rows)
- void reset ()
- bool setReferenceFrame (cv::Mat &referenceFrame)
- bool setReferenceFrameTranslation (cv::Mat &referenceFrame)
- bool setReferenceFrameTranslation (cv::Mat &referenceFrame, int activeCells)
- bool setReferenceFrameRotation (cv::Mat &referenceFrame)
- bool setReferenceFrameRotation (cv::Mat &referenceFrame, int activeCells)
- slipResult computeSlip (cv::Mat &currentFrame)

## 6.46.1 Detailed Description

Combined Slip-Detection class (Translation + Rotation)

## 6.46.2 Constructor & Destructor Documentation

### 6.46.2.1 SlipDetector::SlipDetector ( uint *cols*, uint *rows* )

Constructor. It calls the translational and rotational slip-detection constructors.

**Parameters**

| | |
|---|---|
| *cols* | Tactile sensor width. |
| *rows* | Tactile sensor height. |

## 6.46.3 Member Function Documentation

### 6.46.3.1 slipResult SlipDetector::computeSlip ( cv::Mat & *currentFrame* )

Performs both translational and rotational slip-detection. It is not necessary to set the reference or previous tactile sensor matrix beforehand. In this case, the methods are initialized with the current frame and the actual slip vector/rotation angle is computed between the very same tactile image. The real slip-detection then starts with the next call to this function, assuming the tactile sensor matrix satisfies the constraints.

**Parameters**

| | |
|---|---|
| *current-Frame* | The current tactile sensor matrix. |

**Returns**

The combined results of the rotational and translational slip-detection.

#### 6.46.3.2 void SlipDetector::reset ( )

Invalidates the reference frame, the previous frame as well as the tracked angle.

**Returns**

void

#### 6.46.3.3 bool SlipDetector::setReferenceFrame ( cv::Mat & *referenceFrame* )

(Re)sets the reference frame for both translational and rotational slip-detection. Checks the number of active taxels

**Parameters**

| | |
|---|---|
| *reference-Frame* | The reference tactile sensor matrix. |

**Returns**

Success.

#### 6.46.3.4 bool SlipDetector::setReferenceFrameRotation ( cv::Mat & *referenceFrame* )

(Re)sets the reference frame for the rotational slip-detection. Counts the number of active taxels. Rotation fails if frame is empty and/or shape is circular.

**Parameters**

| | |
|---|---|
| *reference-Frame* | The reference tactile sensor matrix. |

**Returns**

Success.

#### 6.46.3.5 bool SlipDetector::setReferenceFrameRotation ( cv::Mat & *referenceFrame,* int *activeCells* )

(Re)sets the reference frame for the rotational slip-detection. Expects the number of active taxels. Rotation fails if frame is empty and/or shape is circular.

**Parameters**

| | |
|---|---|
| *reference-Frame* | The reference tactile sensor matrix. |

**Returns**

Success.

#### 6.46.3.6 bool SlipDetector::setReferenceFrameTranslation ( cv::Mat & *referenceFrame,* int *activeCells* )

(Re)sets the reference frame for the translational slip-detection. Expects the number of active taxels. Translation fails only if frames are empty.

**Parameters**

| | |
|---|---|
| *reference-Frame* | The reference tactile sensor matrix. |
| *activeCells* | Number of active taxels. |

**Returns**

Success.

#### 6.46.3.7 bool SlipDetector::setReferenceFrameTranslation ( cv::Mat & *referenceFrame* )

(Re)sets the reference frame for the translational slip-detection. Counts the number of active taxels. Translation fails only if frames are empty.

**Parameters**

| | |
|---|---|
| *reference-Frame* | The reference tactile sensor matrix. |

**Returns**

Success.

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

- slipdetection.h
- slipdetection.cpp

## 6.47 slipResult Struct Reference

Final return type struct: Boost tuples are limited to 10 elements, so this is why...

```
#include <slipdetection.h>
```

### Public Attributes

- bool **successTranslation**

- bool **successRotation**
- double **slipVector_x**
- double **slipVector_y**
- double **slipVectorReference_x**
- double **slipVectorReference_y**
- double **slipAngle**
- double **slipAngleReference**
- double **orientation**
- double **centroid_x**
- double **centroid_y**
- double **skew_x**
- double **skew_y**
- double **lambda1**
- double **lambda2**
- double **eccentricity**
- double **compactness**

### 6.47.1 Detailed Description

Final return type struct: Boost tuples are limited to 10 elements, so this is why...

The documentation for this struct was generated from the following file:

- slipdetection.h

## 6.48 SlipVectorLive Class Reference

Visualizes current slip vector.

`#include <guiSlipDetectionMultiPlot.h>`

### Public Member Functions

- void **reset** ()
- void **drawAxes** (const Cairo::RefPtr< Cairo::Context > &cr, int width, int height)
- bool **drawVector** (double x, double y)

### Protected Member Functions

- virtual bool **on_expose_event** (GdkEventExpose ∗event)

### 6.48.1 Detailed Description

Visualizes current slip vector.

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

- guiSlipDetectionMultiPlot.h
- guiSlipDetectionMultiPlot.cpp

## 6.49 SlipVectorTrajectory Class Reference

Visualizes slip vector trajectory.

```
#include <guiSlipDetectionMultiPlot.h>
```

### Public Member Functions

- **SlipVectorTrajectory** (std::deque< slip_trajectory > &slipvectors)
- void **reset** ()
- void **drawBackgroundSurface** ()
- void **drawAxes** (const Cairo::RefPtr< Cairo::Context > &cr, int width, int height)
- bool **drawTrajectory** (std::deque< slip_trajectory > &slipvectors, uint current-FrameID)
- bool **updateTrajectory** (std::deque< slip_trajectory > &slipvectors, uint current-FrameID)

### Protected Member Functions

- virtual bool **on_expose_event** (GdkEventExpose ∗event)

### 6.49.1 Detailed Description

Visualizes slip vector trajectory.

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

- guiSlipDetectionMultiPlot.h
- guiSlipDetectionMultiPlot.cpp

## 6.50 TemperatureFrame Struct Reference

Temperatures 0-6: close to axes motors, Temperature 7: FPGA, Temperature 8: Printed circuit board.

```
#include <framemanager.h>
```

### Public Attributes

- std::vector< double > **values**
- uint64_t **timestamp**

#### 6.50.1 Detailed Description

Temperatures 0-6: close to axes motors, Temperature 7: FPGA, Temperature 8: Printed circuit board.

The documentation for this struct was generated from the following file:

- framemanager.h

## 6.51 TemperatureNoise Struct Reference

A data structure containing the linear regression parameters as well as the RMS Error of the prediction band.

```
#include <calibration.h>
```

### Public Attributes

- double **slope**
- double **intercept**
- double **RMSE**

#### 6.51.1 Detailed Description

A data structure containing the linear regression parameters as well as the RMS Error of the prediction band.

The documentation for this struct was generated from the following file:

- calibration.h

## 6.52 TimeSeriesDataset Struct Reference

### Public Member Functions

- **TimeSeriesDataset** (std::string name, RGB rgb, uint size)

### Public Attributes

- std::string **description**
- RGB **color**
- std::vector< float > **rawData**
- std::vector< float > **sampleIntervalMin**
- std::vector< float > **sampleIntervalMax**
- std::vector< float > **filteredSamples**
- bool **calculateOverview**
- bool **calculateFiltering**

The documentation for this struct was generated from the following file:

- guiGraph.h

## 6.53 TimestampComparator< Frame > Struct Template Reference

Timestamp comparator functor.

```
#include <framemanager.h>
```

### Public Member Functions

- bool **operator()** (const Frame &frame1, const Frame &frame2) const
- bool **operator()** (const Frame &frame, uint64_t timestamp) const
- bool **operator()** (uint64_t timestamp, const Frame &frame) const

### 6.53.1 Detailed Description

**template<typename Frame>struct TimestampComparator< Frame >**

Timestamp comparator functor.

The documentation for this struct was generated from the following file:

- framemanager.h

## 6.54 Translation Class Reference

Implements the translational slip detection based on tracking the convolution matrix's center of gravity.

```
#include <slipdetection.h>
```

### Public Member Functions

- Translation (uint cols, uint rows)
- void init (uint cols, uint rows)
- void setReferenceFrame (cv::Mat &referenceFrame)
- cv::Point2d computeSlipReference (cv::Mat &currentFrame)
- cv::Point2d computeSlip (cv::Mat &currentFrame)

## 6.54.1 Detailed Description

Implements the translational slip detection based on tracking the convolution matrix's center of gravity.

## 6.54.2 Constructor & Destructor Documentation

### 6.54.2.1 Translation::Translation ( uint *cols,* uint *rows* )

Constructor. Calls init()

**Parameters**

| | |
|---|---|
| *cols* | Tactile sensor width. |
| *rows* | Tactile sensor height. |

## 6.54.3 Member Function Documentation

### 6.54.3.1 cv::Point2d Translation::computeSlip ( cv::Mat & *currentFrame* )

Computes the slip vector between the current and the previous tactile sensor matrix. (Normalized Cross Correlation) Use this method in conjunction with setReferenceFrame().

**Parameters**

| | |
|---|---|
| *current-Frame* | The current tactile sensor matrix. |

**Returns**

The corresponding slip vector.

### 6.54.3.2 cv::Point2d Translation::computeSlipReference ( cv::Mat & *currentFrame* )

Computes the slip vector between the current and the reference tactile sensor matrix. (Normalized Cross Correlation) Use this method in conjunction with setReferenceFrame().

**Parameters**

| | |
|---|---|
| *current-Frame* | The current tactile sensor matrix. |

**Returns**

The corresponding slip vector.

#### 6.54.3.3 void Translation::init ( uint *cols,* uint *rows* )

Creates index matrices of corresponding taxel positions in convolution matrix.

**Parameters**

| | |
|---|---|
| *cols* | Tactile sensor width. |
| *rows* | Tactile sensor height. |

#### 6.54.3.4 void Translation::setReferenceFrame ( cv::Mat & *referenceFrame* )

(Re)sets the reference tactile sensor matrix. Computes the reference frames's convolution with itself.

**Parameters**

| | |
|---|---|
| *reference-Frame* | The reference tactile sensor matrix. |

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

- slipdetection.h
- slipdetection.cpp

## 6.55 TSFrame Struct Reference

Tactile sensor frame.

```
#include <framemanager.h>
```

### Public Member Functions

- **TSFrame** (uint nb_cells)

### Public Attributes

- std::vector< float > **cells**
- uint64_t **timestamp**

### 6.55.1 Detailed Description

Tactile sensor frame.

The documentation for this struct was generated from the following file:

- framemanager.h

# Chapter 7

# File Documentation

## 7.1 sdhoptions.cpp File Reference

Implementation of a class to parse common SDH related command line options.

```
#include <getopt.h>
#include <assert.h>
#include <iostream>
#include <fstream>
#include "sdh/sdh.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/release.h"
#include "sdh/dsa.h"
#include "sdhoptions.h"
```

### Defines

- #define XSTRINGIFY(_x) STRINGIFY(_x)
- #define STRINGIFY(_s) #_s

    *helper macro for XSTRINGIFY, see there*

### 7.1.1 Detailed Description

Implementation of a class to parse common SDH related command line options.

**Author**

Dirk Osswald

**Date**

2008-05-05

### 7.1.2 Copyright

Copyright (c) 2008 SCHUNK GmbH & Co. KG

### 7.1.3 Define Documentation

#### 7.1.3.1 #define XSTRINGIFY( _x ) STRINGIFY(_x)

macro for stringification of *_x*

allows to stringify the **value** of a macro:

```
#define foo 4

STRINGIFY( foo ) // yields "foo"
XSTRINGIFY( foo ) // yields "4"
```

## 7.2 sdhoptions.h File Reference

Implementation of a class to parse common SDH related command line options.

```
#include <getopt.h>
#include <assert.h>
#include <iostream>
#include <string>
#include <sdh/sdh.h>
```

### Classes

- class cSDHOptions

  *class for command line option parsing holding option parsing results*

### Defines

- #define SDHUSAGE_DEFAULT "general sdhcom_serial sdhcom_common sdhcom_-esdcan sdhcom_peakcan sdhcom_cancommon sdhcom_tcp"
- #define **SDH_DEFAULT_TCP_ADR** "192.168.1.1"
- #define **SDH_DEFAULT_TCP_PORT** 23

### 7.2.1 Detailed Description

Implementation of a class to parse common SDH related command line options. Taken from SDHLibrary (modified version).

### 7.2.2 General file information

**Author**

Dirk Osswald

**Date**

2008-05-05

### 7.2.3 Copyright

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### 7.2.4 Define Documentation

#### 7.2.4.1 #define SDHUSAGE_DEFAULT "general sdhcom_serial sdhcom_common sdhcom_esdcan sdhcom_peakcan sdhcom_cancommon sdhcom_tcp"

string defining all the usage helptexts included by default

**Bug**

When compiled with VCC then the macros WITH_ESD_CAN / WITH_PEAK_CAN used above are not available since these are defined in the VCC project settings of the SDHLibrary VCC-Project. Therefore the value of SDHUSAGE_DEFAULT is incorrect and thus the cSDHOptions will display an incomplete usage string when called with -h/--help.
Workaround: use the online help contained in the doxygen documentation: `Online help of demonstration programs`

## 7.3 utils.h File Reference

```
#include <cmath>
#include <algorithm>
#include <limits>
#include <string>
#include <stdint.h>
```

## Functions

- uint64_t utils::getCurrentTimeMilliseconds ()
- bool utils::almostEqual (float x, float y, int ulp)
- template<typename T >
  std::string utils::numberToString (T number)
- template<typename T >
  T utils::stringToNumber (const std::string &text)
- void utils::splitFilename (const std::string &filename, std::string &basename, std::string &extension)
- double utils::degToRad (double d)

### 7.3.1 Detailed Description

Just a few utilities functions. Possibly copy-pasted from somewhere else...

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