Septoplasty Visual Feedback

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Variables

- int **FRAME_RATE** = 15
- int **LINE_OF_CUT_REFRESH_RATE_MS** = 20
- int **SCISSOR_REFRESH_RATE_MS** = 20
- int **READ_DATA_REFRESH_RATE_MS** = 1
- int **UPDATE_TIMER_MS** = 50
- list **RED** = [255,0,0]
- list **GREEN** = [0,255,0]
- int **LINE_OF_CUT_LINE_WIDTH** = 1
- int **TRAINING_LINE_WIDTH** = 1
- float **SCISSOR_OPACITY** = 0.5
- float **PLANE_OF_CUT_EPSILON** = 0.1
- int **DROP_PACKETS_OLDER_THAN_SEC** = .20
- **TRAINING_LINE_COLOR** = GREEN
- **LINE_OF_CUT_COLOR** = RED
- list **SEPTUM_COLOR** = [240, 200, 201]

- list **PLANE_OF_CUT_COLOR** = [255, 0, 0]
- dictionary **PACKET_PREFIXES**
- tuple **DIRECTORY** = os.path.dirname(__file__)
- list **threads** = [ ]
- list **exceptions** = [ ]
- **debug** = True
- **EXIT_APPLICATION** = False

4.1.1 Detailed Description

```
Visualization of Septum Line of Cut, Surgical Scissors, and Septum.

Uses VTK to visualize line of cut, pipes data from ./feedback
```

4.1.2 Function Documentation

4.1.2.1 def animation.create_cube_actor (*points, epsilon*)

```
Creates a VTK actor from points and an epsilon (see get_points_for_cube_from_plane)

Arguments
---------
points : list of four 3-tuples
    precondition : len(points) == 4
epsilon : float
    distance between the two longest faces of the cube that will be
    constructed

Returns
cube_actor : vtk.vtkActor
    cube that approximates the plane specified by points with width epsilon
```

4.1.2.2 def animation.create_training_line (*start, end*)

```
Creates a training line and returns a vtk.vtkActor representing the training line.  The color of the training

Arguments
---------
start : 3-tuple of float
    The starting point of the training line
end : 3-tuple of float
    The ending point of the training line

Returns
-------
training_line_actor : vtk.vtkActor
    an actor specifying a training line from the points start to end
```

4.1.2.3 def animation.draw_convex_hull (*convex_hull*)

```
Given a list of points on a convex hull, use vtk.vtkDelaunay2D to draw the convex hull and return a vtk Actor

Arguments
---------
convex_hull : list of 3-tuples of float
    points on a convex hull

Returns
    convex_hull_actor : vtk.vtkActor
        VTK Actor modeling a convex_hull
```

4.1.2.4 def animation.get_points_for_cube_from_plane (*points, epsilon*)

```
Give a square representing a plane, construct a cube whose points differ by
epsilon.

This allows for the construction of a plane with minimal width for
visualization of the plane-of-cut.

Arguments
---------
points : list of four 3-tuples
    precondition : len(points) == 4
epsilon : float
    distance between the two longest faces of the cube that will be
    constructed

Returns
-------
cube : list of eight 3-tuples
    postcondition : len(cube) == 8
    A cube constructed with two points that have two faces of the same
    dimension as points, and four faces with width of epsilon.
```

4.1.2.5 def animation.load_data ( )

```
Deprecated : was formally used to read data from data/Aurora.txt and read the packets in sequentially.
```

4.1.2.6 def animation.main ( )

```
Initializes scissor model, line of cut actor, septum plane actor, the camera, the render window, and the line
```

4.1.2.7 def animation.mkVtkIdList (*it*)

```
Creates a VTK ID list from the iterable it.  This is used for generating
planes.
```

4.1.2.8 def animation.process_line (*line*)

```
Reads a packet (defined in the Packet Routing document) from a string
    and draws or updates VTK actors with the data
```

4.1.2.9 def animation.process_stdin (*on_line* = process_line)

```
This generates and returns a function that handles reading data from stdin
and applies the function on_line to each newline-ending line.  The function
returned by process_stdin can be used as a VTKTimerCallback function.

Arguments
---------
on_line : callable
    function will be called on each line of stdin
```

4.1.3 Variable Documentation

4.1.3.1 dictionary animation.PACKET_PREFIXES

Initial value:

```
1 = {
2 #The Packet Prefixes are the first byte in packets received from the Platform
3 #and prediction modules.
4     'SEPTUM_SURFACE_POINTS': '3', #triangles/vertices
5     'SEPTUM_SURFACE_VERTEX_POINTS': '4',
6     'LINE_OF_CUT': '5',
7     'SEPTUM_SURFACE': '6',
8     'TRAINING_LINE': '7',
9     'REMOVE_TRAINING_LINE': '8',
10     'PLANE_OF_CUT': '9',
11     'TRAINING_PLANE': 'A',
12 }
```

4.2 bufferedreader Namespace Reference

Classes

- class NonBlockingNewlineBufferedReader
- class TestNonBlockingNewlineBufferedReader

4.2.1 Detailed Description

```
Author: Michael Norris
Reader for buffering non-blocking reads from stdout that can read multiple lines
from stdin and drop all but the newest line. Unit Tests are provided.
```

4.3 feedback Namespace Reference

Classes

- class Properties

4.3.1 Detailed Description

Properties class that reads project properties from properties.xml

Chapter 5

Class Documentation

5.1 coordinate Struct Reference

`#include <scissorTraining.h>`

Public Member Functions

- **coordinate** (const Eigen::Vector3d &input)
- Eigen::Vector3d **toEigen3d** () const

Public Attributes

- double **xyz** [3]

5.1.1 Detailed Description

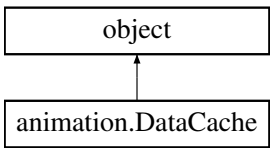
Convenience class for saving training data from Eigen::Vector3d

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

- include/scissorTraining.h

5.2 animation.DataCache Class Reference

Inheritance diagram for animation.DataCache:



Static Public Attributes

- tuple **lock** = threading.Lock()
- dictionary **cache** = {}

5.2.1 Detailed Description

```
Provides a global view of the data contained in the system, received from
packets from the lineOfCutGenerator and septumSurfaceGenerator
```

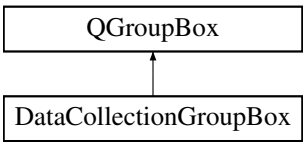
The documentation for this class was generated from the following file:

- vis/animation.py

5.3 DataCollectionGroupBox Class Reference

```
#include <gui.h>
```

Inheritance diagram for DataCollectionGroupBox:



Public Member Functions

- DataCollectionGroupBox (QString s)
- void addRadioButton (QAbstractButton ∗obj)
- void addControlButton (QWidget ∗obj)
- QAbstractButton ∗ checkedButton ()

5.3.1 Detailed Description

This provides a QWidget that stores radio button for various modes, and a controlButton (DataRecordGroupBox) that will do things with the selected button (DataCollectionGroupBox::checkedButton) when toggled.

The DataRecordGroupBox's actions for the Record button and optional Calculation button are mapped by taking the state of the DataRecordButton and the DataCollectionGroupBox::checkedButton(), and passing them to the ModeHandler, which do things in the Platform class with sensor data.

5.3.2 Constructor & Destructor Documentation

5.3.2.1 DataCollectionGroupBox::DataCollectionGroupBox (QString *s*)

Initialize with QString s as the border title.

5.3.3 Member Function Documentation

5.3.3.1 void DataCollectionGroupBox::addControlButton (QWidget ∗ *obj*)

Adds the control button to the rightmost layout

5.3.3.2 void DataCollectionGroupBox::addRadioButton (QAbstractButton ∗ *obj*)

Add the radio button to the radioButtonLayout and buttonGroup

5.3.3.3 QAbstractButton * DataCollectionGroupBox::checkedButton ( )

Returns the button that is currently checked.

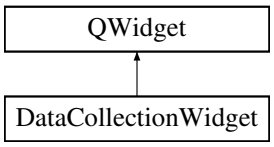
The documentation for this class was generated from the following files:

- include/gui.h
- src/gui.cpp

5.4 DataCollectionWidget Class Reference

`#include <gui.h>`

Inheritance diagram for DataCollectionWidget:



Public Slots

- void releaseOperationalCalculationButton ()
- void releaseCalibrationCalculationButton ()
- void releaseOperationalDataRecordGroupBox ()
- void clickOperationalDataRecordGroupBox (std::string buttonPressed, bool toggle)
- void releaseCalibrationDataRecordGroupBox ()
- void clickCalibrationDataRecordGroupBox (std::string buttonPressed, bool toggle)

Public Member Functions

- void setModeHandler (ModeHandler *modeHandler)

5.4.1 Detailed Description

The DataCollectionWidget contains the Calibration DataRecordGroupBox and the Operational DataRecordGroup↩ Box. It stacks them on top of each other using a vertical layout. This class also connects a ModeHandler to the Record and Calculation buttons.

5.4.2 Member Function Documentation

5.4.2.1 void DataCollectionWidget::clickCalibrationDataRecordGroupBox (std::string *buttonPressed,* bool *toggle*) [inline], [slot]

calls ModeHandler::handleModeChange

5.4.2.2 void DataCollectionWidget::clickOperationalDataRecordGroupBox (std::string *buttonPressed,* bool *toggle*) [inline], [slot]

calls ModeHandler::handleModeChange

5.4.2.3 void DataCollectionWidget::releaseCalibrationCalculationButton ( ) [inline], [slot]

Calls ModeHandler::handleCalibrationCalculation

5.4.2.4 void DataCollectionWidget::releaseCalibrationDataRecordGroupBox ( ) [inline], [slot]

calls DataCollectionWidget::clickCalibrationDataRecordGroupBox

5.4.2.5 void DataCollectionWidget::releaseOperationalCalculationButton ( ) [inline], [slot]

Calls ModeHandler::handleOperationalCalculation

5.4.2.6 void DataCollectionWidget::releaseOperationalDataRecordGroupBox ( ) [inline], [slot]

calls DataCollectionWidget::clickOperationalDataRecordGroupBox

5.4.2.7 void DataCollectionWidget::setModeHandler (ModeHandler * *modeHandler*)

Sets the ModeHandler (should be set before the widget is set visible)

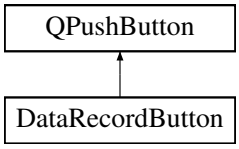
The documentation for this class was generated from the following files:

- include/gui.h
- src/gui.cpp

5.5 DataRecordButton Class Reference

`#include <gui.h>`

Inheritance diagram for DataRecordButton:



Public Member Functions

- **DataRecordButton** (const QString &text, QWidget *parent=0)

5.5.1 Detailed Description

The DataRecordButton is a button with a title, with the property QPushButton::setCheckable(true) set. This allows the button's state to stay toggled.

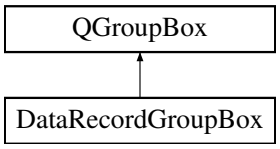
The documentation for this class was generated from the following files:

- include/gui.h
- src/gui.cpp

5.6 DataRecordGroupBox Class Reference

`#include <gui.h>`

Inheritance diagram for DataRecordGroupBox:



Public Member Functions

- DataRecordGroupBox (QString s, bool haveCalculateButton=true)
- const DataRecordButton * getStartStopRecordButton ()
- const QPushButton * getCalculationButton ()

5.6.1 Detailed Description

The DataRecordGroupBox contains a startStop button (That starts and stops a recording based on if the button is pushed or not), and an option calculation button.

5.6.2 Constructor & Destructor Documentation

5.6.2.1 DataRecordGroupBox::DataRecordGroupBox (QString *s,* bool *haveCalculateButton* = `true`)

Initialize a DataRecordGroupBox with a Record button and Calculation button.

5.6.3 Member Function Documentation

5.6.3.1 const QPushButton * DataRecordGroupBox::getCalculationButton ( )

Returns the getCalculationButton if it is present.

5.6.3.2 const DataRecordButton * DataRecordGroupBox::getStartStopRecordButton ( )

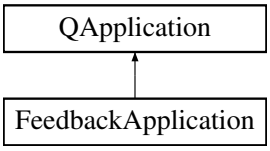
Returns the Record Button

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

- include/gui.h
- src/gui.cpp

5.7 FeedbackApplication Class Reference

Inheritance diagram for FeedbackApplication:



Public Member Functions

- FeedbackApplication (int argc, char **argv)

5.7.1 Constructor & Destructor Documentation

5.7.1.1 FeedbackApplication::FeedbackApplication (int *argc,* char ** *argv*) [inline]

Initialize the Feedback Application, and starts a boost thread that starts Platform::mainloop, which processes data from the SeptoServer application.

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

- include/gui.h

5.8 lineCoordinate Struct Reference

`#include <typedef.h>`

Public Member Functions

- void print ()

Public Attributes

- double scissorPinchPoint [3]
- double eulerXYZ [3]
- double startPoint [3]
- double endPoint [3]
- bool valid
- long timestamp

5.8.1 Detailed Description

Predicted Line of Cut of the scissors. lineCoordinate::print will print the Line of Cut packet to be sent to the visualization module.

5.8.2 Member Function Documentation

5.8.2.1 void lineCoordinate::print ( ) [inline]

Print the line of cut to stdout

5.8.3 Member Data Documentation

5.8.3.1 double lineCoordinate::endPoint[3]

the farthest point coordinate where the cut would end on the septum plane coordinate

5.8.3.2 double lineCoordinate::eulerXYZ[3]

Euler Angles

5.8.3.3 double lineCoordinate::scissorPinchPoint[3]

scissor pinch point position relative to the septum plane coordinate

5.8.3.4 double lineCoordinate::startPoint[3]

the point coordinate where the cut would happened on the septum plane coordinate

5.8.3.5 long lineCoordinate::timestamp

unix timestamp in milliseconds of when the SensorData packet was collected.

5.8.3.6 bool lineCoordinate::valid

whether the line coordinate is valid or not. False when the scissor will not cut the septum plane

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

- include/typedef.h

5.9 lineOfCutGenerator Class Reference

`#include <lineOfCutGenerator.h>`

Public Member Functions

- **lineOfCutGenerator** (const septumSurface &surfaceInput, const scissorModel &scissorInput)
- void **setDebugMode** (bool mode)
- void **setEMdata** (const transformComponent2< double > &scissor, const transformComponent2< double > &faceEM)
- void **setEMdata** (const transformComponent< double > &scissor, const transformComponent< double > &faceEM)
- void **setSeptumSurface** (const septumSurface &input)
- void **setScissorModel** (const scissorModel &input)
- bool **findIntersection** (const Eigen::Vector4d &planeA, const Eigen::Vector4d &planeB, Eigen::Vector3d &pointInPlane, Eigen::Vector3d &intersectionVector)
- Eigen::Vector3d **pointToLineProjection** (const Eigen::Vector3d &pointA, const Eigen::Vector3d &pointInLineB, const Eigen::Vector3d &vectorB)
- Eigen::Vector3d **findLineEndPoint** (const Eigen::Vector3d &pointA, const double &length, const Eigen::Vector3d &vectorB)
- lineCoordinate **callbackLineOfCut** ()

5.9.1 Detailed Description

Takes the pose from the scissor and the face sensors and calculates the line of cut.

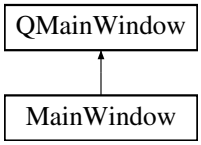
The documentation for this class was generated from the following files:

- include/lineOfCutGenerator.h
- src/lineOfCutGenerator.cpp

5.10 MainWindow Class Reference

`#include <gui.h>`

Inheritance diagram for MainWindow:



Public Member Functions

- **MainWindow** (Platform ∗platform)

Public Attributes

- QVBoxLayout ∗ **layout**

5.10.1 Detailed Description

The Main Window of the application. Contains a DataCollectionWidget and a menu for loading/saving/clearing training data.

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

- include/gui.h
- src/gui.cpp

5.11 ModeHandler Class Reference

Public Member Functions

- ModeHandler (DataCollectionWidget ∗dcw, Platform ∗platform)
- void handleModeChange (std::string mode, bool toggle)
- void handleCalibrationCalculation ()
- void handleOperationalCalculation ()

5.11.1 Constructor & Destructor Documentation

5.11.1.1 ModeHandler::ModeHandler (DataCollectionWidget * *dcw,* Platform * *platform*)

Initialize the ModeHandler.

ModeHandler handles the mode changes from the gui to the Platform. The gui will create a Mode Handler with a Platform reference, and the mode handler will handle any callback functions to the Platform.

It should be noted that the Platform object function calls in this class should be run in a thread, to prevent hanging up the GUI if they take a long time to finish.

5.11.2 Member Function Documentation

5.11.2.1 void ModeHandler::handleCalibrationCalculation ( )

Tells the Calibration Module to calculate the scissor model based on the recorded data.

5.11.2.2 void ModeHandler::handleModeChange (std::string *mode,* bool *toggle*)

Callback from DataCollectionWidget, when the Record button is pressed on or off.

Dispatches calls in the Platform based on the button that was pressed and whether the Record button was released on or released off.

5.11.2.3 void ModeHandler::handleOperationalCalculation ( )

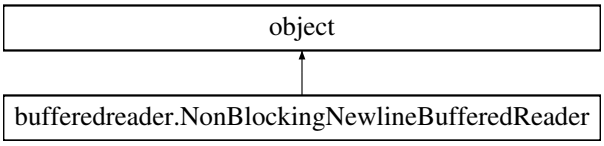
Unused method since there's no calculation that happens in the Operation mode.

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

- include/ModeHandler.h
- src/ModeHandler.cpp

5.12 bufferedreader.NonBlockingNewlineBufferedReader Class Reference

Inheritance diagram for bufferedreader.NonBlockingNewlineBufferedReader:



Public Member Functions

- def **__init__**
- def **read** (self, file_like)

Public Attributes

- **last_read**
- **lines**

- **read_limit**
- **lock**
- **drop_packet_prefixes**

5.12.1 Detailed Description

```
Reader that reads up to read_limit characters and will store parts of
previous lines.
This will allow you to do non-blocking reads and find lines between
reads.

This object reads stdin, and either buffers a piece of the most recent
line (if less than 1 line is present in the read + what's in the buffer from
the last read), return a line if there is only one line in stdin, or will
return the oldest line that was read from stdin (if multiple lines were read
at once) that's not also allowed to be dropped.

if more than one line is read, anything after the last newline character
will be buffered for the next read.

Useage:
reader = NonBlockingBufferedReader(read_limit=100)
out = reader.read(sys.stdin)

if out:
    #do stuff
    pass
```

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

- vis/bufferedreader.py

5.13 planeFromLineCoordinate Struct Reference

```
#include <typedef.h>
```

Public Member Functions

- planeFromLineCoordinate (const lineCoordinate &input)
- void print ()

Public Attributes

- lineCoordinate **line**
- double cornerPoints [4][3]
- bool corner_defined

5.13.1 Detailed Description

This is a planar representation of the lineCoordinate.

5.13.2 Constructor & Destructor Documentation

5.13.2.1 planeFromLineCoordinate::planeFromLineCoordinate (const lineCoordinate & *input*) [inline]

Initialize the plane of cut with a line of cut.

5.13.3 Member Function Documentation

5.13.3.1 void planeFromLineCoordinate::print ( ) [inline]

Prints the plane of cut.

5.13.4 Member Data Documentation

5.13.4.1 bool planeFromLineCoordinate::corner_defined

Whether the corners have been specified. If not, then plane's four corners are all the same, lineCoordinate.scissor↩PinchPoint

5.13.4.2 double planeFromLineCoordinate::cornerPoints[4][3]

Corners of the plane

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

- include/typedef.h

5.14 Platform Class Reference

`#include <Platform.h>`

Public Types

- enum DataReceiveMode {
  PHANTOM_TRACE, **SEPTUM_TRACE**, **NASAL_BRIDGE_TRACE**, **CUT**,
  LINE, **POINT_TRACE**, **TRACE_SCISSORS**, **VALIDATE_SCISSORS** }

Public Member Functions

- void receiveMessage (std::istream &stream_)
- void mainloop (int argc, char **argv)
- void clearCache ()
- void call_scissorTrain_add_line ()
- void call_scissorTrain_add_initial_cloud ()
- void call_scissorTrain_add_cut_training_data ()
- void call_scissorTrain_add_scissor_normal_trace_data ()
- void call_scissorTrain_training_solve (int bladeLength=40, int n_blade_points=1)
- void call_septumEstimate_add_nasal_points ()
- void call_septumEstimate_add_septum_points ()
- void call_septumEstimate_generate_plane ()
- void call_phantom_add_points ()
- void setLineOfCutMode ()
- void setScissorValidateMode ()
- void setToolCutValidationMode ()
- void callScissorIncrementActualCutIndex ()
- void setCacheMode ()
- void clearMode ()

- bool isDataValidForReceiveMode (transformComponent2< double > scissorSensor, bool haveScissor, transformComponent2< double > faceSensor, bool haveFace, transformComponent2< double > pointer↩ Sensor, bool havePointer)
- void setDataReceiveMode (DataReceiveMode dpm)
- void saveScissorModel (scissorModel &scissors)
- void loadScissorTrainingData (std::string)
- void saveScissorTrainingData (std::string)
- void openScissorModel ()

Public Attributes

- DataReceiveMode dataReceiveMode
- feedback::Properties * **properties**
- lineOfCutGenerator * **generator**

5.14.1 Detailed Description

This class handles incoming messages from an istream, creates the septum surface from calibration, creates the line of cut, and sends outgoing messages to the visualizer.

5.14.2 Member Enumeration Documentation

5.14.2.1 enum Platform::DataReceiveMode

In Platform::ProcessingMode.CACHE_MODE for calibration and Septum Tracing, there are 5 algorithms that can be run. This keeps track of which algorithm will be run when the recording stops.

5.14.3 Member Function Documentation

5.14.3.1 void Platform::call_phantom_add_points ( )

Add point cloud from tracing the phantom to the septumSurfaceGenerator Model. calls SeptumSurfaceGenerator↩ ::addSeptumPoints, then SeptumSurfaceGenerator::generatePhantomPlane, then scissorTrainingModel.set↩ PlaneNormals

5.14.3.2 void Platform::call_scissorTrain_add_cut_training_data ( )

Adds a single scissor cut to the scissorTrainingModel

5.14.3.3 void Platform::call_scissorTrain_add_initial_cloud ( )

Adds a point cloud to the scissorTrainingModel

5.14.3.4 void Platform::call_scissorTrain_add_line ( )

Adds a line to the scissorTrainingModel

5.14.3.5 void Platform::call_scissorTrain_add_scissor_normal_trace_data ( )

Adds the scissor normal from a single trace of the scissors.

5.14.3.6 void Platform::call_scissorTrain_training_solve (int *bladeLength* = 40, int *n_blade_points* = 1)

Solves for the scissorModel with the lines, point clouds, cut data, and scissor traces that have been added to the scissorTrainingModel, generates a scissorModel, and saves it to the default scissormodel xml file (scissormodel.xml)

5.14.3.7 void Platform::call_septumEstimate_add_nasal_points ( )

Add a point cloud from tracing the nasal bridge

5.14.3.8 void Platform::call_septumEstimate_add_septum_points ( )

Add a point cloud from tracing the septum surface

5.14.3.9 void Platform::call_septumEstimate_generate_plane ( )

Generate the septum plane.

5.14.3.10 void Platform::callScissorIncrementActualCutIndex ( )

Sets the ProcessingMode to CACHE_MODE (all other modes)

5.14.3.11 void Platform::clearCache ( )

arguments [filename default "data/Aurora.txt"] [-pipe] filename: file to read data from. defaults to data/Auora.txt if not present -pipe: will read data from stdin and ignore file argument. Must be first argument TODO: add slick argparse library

5.14.3.12 void Platform::clearMode ( )

Sets the ProcessingMode to NO_MODE (drops all packets)

5.14.3.13 bool Platform::isDataValidForReceiveMode (transformComponent2< double > *scissorSensor,* bool *haveScissor,* transformComponent2< double > *faceSensor,* bool *haveFace,* transformComponent2< double > *pointerSensor,* bool *havePointer*)

The calibration algorithms require vectors of readings from two sensors. Because we allow Platform to drop packets if the status is not OK, we need to ensure that the data that we have collected for the current frame is appropriate for the DataReceiveMode

5.14.3.14 void Platform::loadScissorTrainingData (std::string *file* = " ")

Loads the default scissor training data file specified in properties.xml, or loads a scissor model if it's passed as an argument

5.14.3.15 void Platform::mainloop (int *argc,* char ** *argv*)

Reads sensor data from one of 3 modes: pipe, http, readfile.

$ ./platform pipe This will receive sensor data from stdin and will execute the receiveMessage function with the std::cin istream until it is closed.

$ ./platform readfile $FILENAME This will read a recording file from FILENAME and run it through the system. Note that time is not simulated – all packets are thrown through the system in rapid succession.

$ ./platform http This mode is currently disabled.

5.14.3.16 void Platform::openScissorModel ( )

Attemps to open a ScissorModel from the default scissor model file (scissormodel.xml), and loads it if it exists. If the scissor model file does not exist, then one must be created from calibration before operation mode will run.

5.14.3.17 void Platform::receiveMessage (std::istream & *stream_*)

Receive a message from the SeptoServer. The format of the message is defined in the document "Packet Routing." In pipe mode, receiveMessage(std::cout) is called, in http mode, a stringstream is used, and to playback a recorded session, an iftream can be used.

As long as messages are separated by newlines, this can handle receiving multiple messages in a single call, and will continue until the filestream is closed.

Receives a stream of messages (for reading a file) or a single stream (string stream) from the web service and writes the packet to stdout. Head sensor –> port 1 Scissors –> port 2 pointer –> port 3

5.14.3.18 void Platform::saveScissorModel (scissorModel & *scissors*)

Saves the ScissorModel to an xml file

5.14.3.19 void Platform::saveScissorTrainingData (std::string *file* = " ")

Saves the scissor training data from the scissorTraining object to the xml file specified, or if it's not specified, then the default scissor training data file specified in properties.xml will be loaded

5.14.3.20 void Platform::setCacheMode ( )

Changes the ProcessingMode to CACHE_MODE

5.14.3.21 void Platform::setDataReceiveMode (DataReceiveMode *dpm*)

Sets the DataReceiveMode (when ProcessingMode == CACHE_MODE), which determines what happens to the cached data once the ProcessingMode ends.

5.14.3.22 void Platform::setLineOfCutMode ( )

Sets the ProcessingMode to LINE_OF_CUT_MODE (streaming)

5.14.3.23 void Platform::setScissorValidateMode ( )

Sets the ProcessingMode to SCISSOR_VALIDATE_MODE (streaming)

5.14.3.24 void Platform::setToolCutValidationMode ( )

Sets the ProcessingMode to TOOL_CUT_VALIDATION_MODE (streaming)

5.14.4 Member Data Documentation

5.14.4.1 DataReceiveMode Platform::dataReceiveMode

The current DataReceiveMode. Set by the ModeHandler.

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

- include/Platform.h
- src/Platform.cpp

5.15 feedback::Properties Class Reference

Public Member Functions

- Properties ()
- std::string getScissorModelFile ()
- std::string getSensorSerial (std::string sensor)
- std::string getTrainingDataFile ()

Public Attributes

- double **pivot_offset** [3]

5.15.1 Constructor & Destructor Documentation

5.15.1.1 feedback::Properties::Properties ( )

Properties class that reads project properties from properties.xml

5.15.2 Member Function Documentation

5.15.2.1 std::string feedback::Properties::getScissorModelFile ( )

Returns the name of the file that the scissor model should be saved to /loaded from (defaults to scissormodel.xml)

5.15.2.2 std::string feedback::Properties::getSensorSerial (std::string *sensor*)

Returns the serial number for the sensor that's in properties.xml, or the string "SENSOR_IS_NOT_DEFINED" if it's not specified.

Since this can return "", getSensorSerial("phantom").find(parsed_sensor_name) returns false, but the inverse will always return true since "" is contained in every string.

5.15.2.3 std::string feedback::Properties::getTrainingDataFile ( )

Returns the name of the file that the training data should be saved to / loaded from by default (defaults to trainingdata.xml)

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

- include/Properties.h
- src/Properties.cpp

5.16 scissorModel Struct Reference

`#include <typedef.h>`

Public Member Functions

- void print ()

Public Attributes

- double bladeLength
- int scissor_model_id
- int n_blade_points
- double normalVector [3]
- double sensorTranslationToPinchPoint [3]
- bool valid

5.16.1 Detailed Description

A model of the scissors, with the translation from the sensor to the scissor pinch point, and the normal of the blades.

5.16.2 Member Function Documentation

5.16.2.1 void scissorModel::print ( ) [inline]

Prints the scissor model to stderr

5.16.3 Member Data Documentation

5.16.3.1 double scissorModel::bladeLength

the distance from the pinch point to the tip of the blade

5.16.3.2 int scissorModel::n_blade_points

The number of blade points. Currently not utilized, but this can allow for scissors with curved blades.

5.16.3.3 double scissorModel::normalVector[3]

Normal of the blades

5.16.3.4 int scissorModel::scissor_model_id

Scissor ID (allows for different styles of scissors to have their own scissor model)

5.16.3.5 double scissorModel::sensorTranslationToPinchPoint[3]

Translation from sensor mounted on scissors to the pinch point of the scissors

5.16.3.6 bool scissorModel::valid

Whether the model is valid or not. The model needs plane normal, starting point, and line vector.

If valid then the scissorModel can produce cut data.

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

- include/typedef.h

5.17 scissorTraining Class Reference

`#include <scissorTraining.h>`

Public Member Functions

- scissorTraining ()
- void setTrainingData (const trainingData &input)
- void setPlaneNormals (const double plane_normal[4])
- void addLineData (const std::vector< transformComponent2< double > > &line_point_cloud, const std::vector< transformComponent2< double > > &plane_EM_pose)
- void addInitialCloudData (const std::vector< transformComponent2< double > > &plane_EM_pose_initial_clouds, const std::vector< transformComponent2< double > > &plane_EM_pose)
- void setDebugMode (bool mode)
- Eigen::Vector3d getLineDirection (const std::vector< Eigen::Vector3d > &line_point_cloud, const std::vector< transformComponent2< double > > &plane_EM_pose, const Eigen::Vector3d &starting_point)
- Eigen::Vector3d getAverageInitialPoint (const std::vector< Eigen::Vector3d > &pointer_initial_clouds)
- void setScissorNormal (const double scissorNormal[3])
- void addCutTrainingData (const std::vector< transformComponent2< double > > &scissor_EM_pose, const std::vector< transformComponent2< double > > &plane_EM_pose)
- scissorModel solveScissorParameters (const double &bladeLength, const int n_blade_points)
- void setScissorModelForValidation (const scissorModel &input)
- void validate (const transformComponent2< double > &pointerEM, const transformComponent2< double > &scissorEM, const transformComponent2< double > &planeEM)
- void validateWithActualCut (const lineCoordinate &input)
- void incrementActualCutIndex ()
- void printTrainingLineDataAtIndex (std::size_t index_to_process)
- void printNewTrainingLineData ()
- void pivotCalibratePinchPoint (const std::vector< transformComponent2< double > > &scissor_EM_pose, const std::vector< transformComponent2< double > > &plane_EM_pose)
- trainingData dumpTrainingData ()

5.17.1 Detailed Description

Contains data collected from the Training process. Provides functions for calibrating the scissors and verifying the results of the scissor calibration.

When all data is present, scissorModel solveScissorParameters(double, int) produces a scissorModel, which predicts the position of the scissor's pinch point from the EM Sensor positioned on the scissor

5.17.2 Constructor & Destructor Documentation

5.17.2.1 scissorTraining::scissorTraining ( ) [inline]

Initialize the scissorTraining object.

5.17.3 Member Function Documentation

5.17.3.1 void scissorTraining::addCutTrainingData (const std::vector< transformComponent2< double > > & *scissor_EM_pose,* const std::vector< transformComponent2< double > > & *plane_EM_pose*)

Adds a point cloud of the scissor sensor data while it's placed on one of the intitial points.

5.17.3.2 void scissorTraining::addInitialCloudData (const std::vector< transformComponent2< double > > & *plane_EM_pose_initial_clouds,* const std::vector< transformComponent2< double > > & *plane_EM_pose*)

Adds a line starting point (from placing the EM Pointer on the start of the line and holding it still) to the scissorTraining model by finding the center of mass of the point cloud.

5.17.3.3 void scissorTraining::addLineData (const std::vector< transformComponent2< double > > & *line_point_cloud,* const std::vector< transformComponent2< double > > & *plane_EM_pose*)

Adds line data (from tracing the EM Pointer on a line on the phantom) to the scissorTraining model.

5.17.3.4 trainingData scissorTraining::dumpTrainingData ( )

Turns the scissorTraining model into a trainingData object, used for writing the training model in the xml writer for saving trainingdata files.

5.17.3.5 Eigen::Vector3d scissorTraining::getAverageInitialPoint (const std::vector< Eigen::Vector3d > & *pointer_initial_clouds*)

convert one initial point clouds to a single point by averaging its value

5.17.3.6 Eigen::Vector3d scissorTraining::getLineDirection (const std::vector< Eigen::Vector3d > & *line_point_cloud,* const std::vector< transformComponent2< double > > & *plane_EM_pose,* const Eigen::Vector3d & *starting_point*)

convert one line_point_cloud to a single vector using PCA

5.17.3.7 void scissorTraining::incrementActualCutIndex ( )

Increments the index of the training line that we validate. This is called when the user selects the Tool Cut Validation mode in the GUI and toggles the Record button.

5.17.3.8 void scissorTraining::pivotCalibratePinchPoint (const std::vector< transformComponent2< double > > & *scissor_EM_pose,* const std::vector< transformComponent2< double > > & *plane_EM_pose*)

Performs a pivot calibration on the scissor pinch point.

5.17.3.9 void scissorTraining::printNewTrainingLineData ( )

calls printTrainingLineDataAtIndex on the newest cut_direction vector

5.17.3.10 void scissorTraining::printTrainingLineDataAtIndex (std::size_t *index_to_process*)

Outputs the training line data and training plane of cut for the index.

5.17.3.11 void scissorTraining::setDebugMode (bool *mode*)

If true, it will print out a detailed summary of the scissor parameters in realtime while the training mode is activated

5.17.3.12 void scissorTraining::setPlaneNormals (const double *plane_normal[4]*)

Sets the plane normal for the phantom surface.

5.17.3.13 void scissorTraining::setScissorModelForValidation (const **scissorModel** & *input*)

In validation mode, set the scissorModel. Sets the pinch_point_result and scissor_normal_result of this scissor↩ Model from input

5.17.3.14 void scissorTraining::setScissorNormal (const double *scissorNormal[3]*)

Sets the normal vector of the scissor blade.

5.17.3.15 void scissorTraining::setTrainingData (const **trainingData** & *input*)

Set the trainingData (from loading a training data file), which sets the member variables cut_directions, starting_↩ points

5.17.3.16 **scissorModel** scissorTraining::solveScissorParameters (const double & *bladeLength,* const int *n_blade_points* = `1`)

Produces a scissorModel from the data stored in the scissorTraining model.

5.17.3.17 void scissorTraining::validate (const **transformComponent2**< double > & *pointerEM,* const **transformComponent2**< double > & *scissorEM,* const **transformComponent2**< double > & *planeEM*)

Prints the following data to cerr for each frame received from the sensor: if debugMode Pointer position in scissor coordinates Plane normal in scissor coordinates

always prints: Distance between pinch point and pointer (in mm) Angle between plane normal and scissor plane (in degrees)

5.17.3.18 void scissorTraining::validateWithActualCut (const **lineCoordinate** & *input*)

When Platform.procesingMode == Platform::TOOL_CUT_VALIDATION_MODE, this validates each traced line's calibration cut and initial point with the predicted line of cut.

When the user selects the Tool Cut Validation mode in the GUI, and pressed Record in the Calibration mode, the first traced line will be validated. As the Record button is toggled, scissorTraining::incrementActualCutIndex is called and the next line will be validated.

Prints the following data to cerr for each frame received from the sensor: if debugMode Current target cut initial point Current target cut vector

always prints: Estimated Line of cut vector Estimated scissor pinch point in plane Translation error Rotation error

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

- include/scissorTraining.h
- src/scissorTraining.cpp

5.18 septumSurface Struct Reference

`#include <typedef.h>`

Public Attributes

- std::vector< std::vector< double > > **convexHull**
- double **planeParameters** [4]
- bool **valid**

Friends

- std::ostream & **operator**<< (std::ostream &os, septumSurface const &septum)

5.18.1 Detailed Description

Contains convex hull and plane approximations of the septum surface.

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

- include/typedef.h

5.19 SeptumSurfaceGenerator Class Reference

Public Member Functions

- septumSurface generateSeptumPlane ()
- septumSurface generatePhantomPlane ()
- void setDistanceThreshold (double distanceThreshold)
- void generatePointCloudFromVector (const std::vector< Eigen::Vector3d > &input, pcl::PointCloud< pcl::↩ PointXYZ >::Ptr &output_cloud)
- void addNasalPoints (const std::vector< transformComponent2< double > > &pointer_pose, const std↩ ::vector< transformComponent2< double > > &plane_EM_pose)
- void addSeptumPoints (const std::vector< transformComponent2< double > > &pointer_pose, const std↩ ::vector< transformComponent2< double > > &plane_EM_pose)

Public Attributes

- bool haveNasalPoints
- bool **haveSeptumPoints**

5.19.1 Member Function Documentation

5.19.1.1 void SeptumSurfaceGenerator::addNasalPoints (const std::vector< transformComponent2< double > > & *pointer_pose,* const std::vector< transformComponent2< double > > & *plane_EM_pose*)

Add points that are traced from the outside of the nose on the nasal bridge

5.19.1.2 void SeptumSurfaceGenerator::addSeptumPoints (const std::vector< transformComponent2< double > > & *pointer_pose,* const std::vector< transformComponent2< double > > & *plane_EM_pose*)

Add points that are traced on the septum

5.19.1.3 septumSurface SeptumSurfaceGenerator::generatePhantomPlane ( )

Generates the phantom plane

5.19.1.4 void SeptumSurfaceGenerator::generatePointCloudFromVector (const std::vector< Eigen::Vector3d > & *input*, pcl::PointCloud< pcl::PointXYZ >::Ptr & *output_cloud*)

Turns a vector of Eigen points into a PCL point cloud.

5.19.1.5 septumSurface SeptumSurfaceGenerator::generateSeptumPlane ( )

Generates the septum plane if we have nasal points and septum points.

5.19.1.6 void SeptumSurfaceGenerator::setDistanceThreshold (double *distanceThreshold*)

distanceThreshold is the max distance from the scissor pinchpoint to the septum plane that we will calculate a valid line of cut.

5.19.2 Member Data Documentation

5.19.2.1 bool SeptumSurfaceGenerator::haveNasalPoints

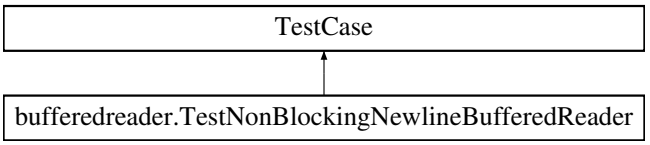
True if we have done the trace nasal bridge and trace septum plane steps in Operational Mode.

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

- include/SeptumSurfaceGenerator.h
- src/SeptumSurfaceGenerator.cpp

5.20 bufferedreader.TestNonBlockingNewlineBufferedReader Class Reference

Inheritance diagram for bufferedreader.TestNonBlockingNewlineBufferedReader:



Public Member Functions

- def **test_simple_read** (self)
- def **test_partial_read** (self)
- def **test_multiple_reads** (self)
- def **test_read_limit** (self)

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

- vis/bufferedreader.py

5.21 trainingData Struct Reference

`#include <scissorTraining.h>`

Public Attributes

- std::vector< coordinate > cut_directions
- std::vector< coordinate > starting_points
- coordinate plane_normal

5.21.1 Detailed Description

Contains all of the data from the Training process.

5.21.2 Member Data Documentation

5.21.2.1 std::vector<coordinate > trainingData::cut_directions

Contains n cut_directions corresponding to starting_points. Each cut_direction is estimated from tracing the EM Pointer.

5.21.2.2 coordinate trainingData::plane_normal

The plane_normal corresponds to the normal of the phantom plane, achieved by fitting a plane to a point cloud of data from tracing the EM Pointer on the phantom

5.21.2.3 std::vector<coordinate > trainingData::starting_points

Contains n starting_points corresponding to cut_direction. Each starting_point is estimated from averaging the EM Pointer's position while held at a starting point.

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

- include/scissorTraining.h

5.22 transformComponent< numericStandard > Struct Template Reference

`#include <typedef.h>`

Public Attributes

- numericStandard quaternion [4]
- numericStandard translation [3]
- long timestamp
- long frameNumber

5.22.1 Detailed Description

template<typename numericStandard>struct transformComponent< numericStandard >

Contains a Frame Transformation with a quaternion.

5.22.2 Member Data Documentation

5.22.2.1 template<typename numericStandard> long transformComponent< numericStandard >::frameNumber

The frame number of the sensor.

5.22.2.2 template<typename numericStandard> numericStandard transformComponent< numericStandard >::quaternion[4]

quaternion representation of the rotation matrix of the frame transformation

5.22.2.3 template<typename numericStandard> long transformComponent< numericStandard >::timestamp

unix timestamp in milliseconds

5.22.2.4 template<typename numericStandard> numericStandard transformComponent< numericStandard >::translation[3]

translation vector of the frame transformation

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

- include/typedef.h

5.23 transformComponent2< numericStandard > Struct Template Reference

`#include <typedef.h>`

Public Member Functions

- void setTransform (numericStandard x, numericStandard y, numericStandard z, numericStandard input_↩ rotation[3][3], long timestamp)
- void **setPivotOffset** (numericStandard offset[3])
- void **setPivotOffset** (numericStandard x_offset, numericStandard y_offset, numericStandard z_offset)

Public Attributes

- numericStandard rotation [3][3]
- numericStandard translation [3]
- long timestamp
- long frameNumber

5.23.1 Detailed Description

template<typename numericStandard>struct transformComponent2< numericStandard >

Contains a Frame Transformation with a 3x3 rotation matrix.

5.23.2 Member Function Documentation

5.23.2.1 template<typename numericStandard> void transformComponent2< numericStandard >::setTransform (numericStandard *x,* numericStandard *y,* numericStandard *z,* numericStandard *input_rotation[3][3],* long *timestamp*) [inline]

Initialize the frame transformation with the translation vector {x,y,z} and the rotation matrix input_rotation, and the timestamp.

5.23.3 Member Data Documentation

5.23.3.1 template<typename numericStandard> long transformComponent2< numericStandard >::frameNumber

The frame number of the sensor.

5.23.3.2 template<typename numericStandard> numericStandard transformComponent2< numericStandard >::rotation[3][3]

Rotation matrix of the frame transformation

5.23.3.3 template<typename numericStandard> long transformComponent2< numericStandard >::timestamp

unix timestamp in milliseconds

5.23.3.4 template<typename numericStandard> numericStandard transformComponent2< numericStandard >::translation[3]

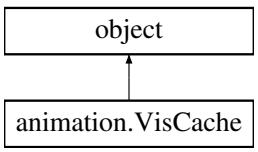
translation vector of the frame transformation

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

- include/typedef.h

5.24 animation.VisCache Class Reference

Inheritance diagram for animation.VisCache:



Static Public Attributes

- dictionary **cache** = {}

5.24.1 Detailed Description

Provides global references to VTK actors in the visualization.

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

- vis/animation.py

5.25 animation.vtkScissorCallback Class Reference

Public Member Functions

- def **__init__** (self, data_source, renderer)
- def execute (self, obj, event)

Public Attributes

- **timer_count**
- **data_source**
- **render_window**
- **renderer**

5.25.1 Detailed Description

```
VTK Timer Callback that modifies the Scissor Actor
```

5.25.2 Member Function Documentation

5.25.2.1 def animation.vtkScissorCallback.execute (*self, obj, event*)

```
if more than SCISSOR_REFRESH_RATE_MS milliseconds has elapsed since the
last scissor rendering (DataCache.cache['last_scissor_update']), and the
scissor pose has been updated (DataCache.cache['scissor_update']), then
the scissor's pose will be adjusted.
```

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

- vis/animation.py

5.26 animation.vtkTimerCallback Class Reference

Public Member Functions

- def __init__ (self, data_source, renderer)
- def execute (self, obj, event)

Public Attributes

- **timer_count**
- **data_source**
- **render_window**
- **renderer**

5.26.1 Detailed Description

```
General VTK Timer Callback function.
```

5.26.2 Constructor & Destructor Documentation

5.26.2.1 def animation.vtkTimerCallback.__init__ (*self, data_source, renderer*)

```
Arguments
---------
data_source : str
    enum : 'line_of_cut', 'plane_of_cut'
    specifies which callback this is
renderer : vtk.Renderer
```

5.26.3 Member Function Documentation

5.26.3.1 def animation.vtkTimerCallback.execute (*self, obj, event*)

```
VTK Timer Callback function

If the line_of_cut or plane_of_cut data has not been updated or the line_of_cut or plane_of_cut has been rende

If the VTK actors are modified, then render_window.Render() is called
```

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

- vis/animation.py

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