

# Kinova Mico2 Windows Cartesian Controller

## 1.1.0

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# Chapter 1

## Introduction

This project is a C++ implementation of a Cartesian controller that provides basic human-machine interface modules for real-time end-effector Cartesian position/velocity control of the Kinova Mico2 robot arm using the built-in velocity controllers in the Kinova API. The project is written in C++ and is intended to be run on Windows 8.1/10 with Visual Studio 2017 (v15). The code is distributed under the MIT license for maximum flexibility of use. By using this software, you are agreeing to the license. Please read the license prior to using this project.

This introduction is broken down into the following sections.

- [Software License](#)
- [Installation Notes](#)

A note on units: All units in the library, unless specified, are in SI (international standard), i.e.: radians, meters, kilograms, etc...



## Chapter 2

# Software License

MIT License

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## Chapter 3

# Installation Notes

This project was built in Visual Studio 2017 (Community Edition) and the solution file is provided for reference. Additional dependencies need to be installed before building this project with the source and library files from the dependencies correctly linked to the project. Instructions for setting up the project and building it are presented below.

### 3.1 Install Dependencies

The following are the list of dependencies that are used in this project:

- [Kinova Mico2 SDK](#) [to control the Kinova Mico-2 robot arm]
- [Kinect SDK v1.8](#) [to use the Microsoft Kinect sensor for skeleton tracking]
- [CHAI3D \(version 3.2.0\)](#) [to use the Novint Falcon Haptics controller]

#### 3.1.1 Kinova Mico2 SDK

1. Download the SDK from the [Kinova website](#) and follow the instructions in the documentation to install the 32-bit version of the API.
2. Set the System Environment Variable KINOVASDK\_DIR to the installation directory.

#### 3.1.2 Kinect SDK v1.8

1. Download and install the Kinect v1.8 SDK from the [Microsoft website](#) and follow the instructions in the documentation to install the 32-bit version of the API.
2. Check whether the system environment variable KINECTSDK10\_DIR is set to the correct installation directory.

#### 3.1.3 CHAI3D (version 3.2.0)

1. Download the multiplatform version of the CHAI3D SDK (currently tested with version 3.2.0) from the [CHAI3D website](#)
2. Install the dependencies (HDF5 and ZLIB) and build the appropriate Visual Studio Solution that matches the available edition.
3. Set the system environment variable CHAI3D\_DIR to the installation directory





## **Chapter 4**

### **Overview**



## **Chapter 5**

### **Getting Started**



## **Chapter 6**

## **References**



## Chapter 7

# Class Index

### 7.1 Class List

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

<a href="#">CSocketInConnection</a>	??
<a href="#">CSocketOutConnection</a>	??
<a href="#">CXBOXController</a>	??
<a href="#">Experiment</a>	??
<a href="#">FIRFilter</a>	??
<a href="#">kinectSkelTrack::KinectInfo</a>	??
<a href="#">kinectSkelTrack</a>	??
<a href="#">KinovaAPIFunctions</a>	??
<a href="#">NovintFalconHapticsDevice</a>	??
<a href="#">Timer</a>	??





## Chapter 8

# File Index

### 8.1 File List

Here is a list of all files with brief descriptions:

<a href="#">angularCommandControl.cpp</a>	??
<a href="#">CartesianControl.h</a>	??
<a href="#">expt_HoloLensCartesianTeleop.cpp</a>	??
<a href="#">firFilter.cpp</a>	??
<a href="#">HMIfunctions.cpp</a>	??
<a href="#">KinovaHMICartesianControl.cpp</a>	??
<a href="#">lutLinearInterp.cpp</a>	??
<a href="#">socketInConnection.cpp</a>	??
<a href="#">socketInConnection.h</a>	??
<a href="#">socketOutConnection.h</a>	??
<a href="#">stdafx.cpp</a>	??
<a href="#">stdafx.h</a>	??
<a href="#">targetver.h</a>	??



## Chapter 9

# Class Documentation

### 9.1 CSocketInConnection Class Reference

```
#include <socketInConnection.h>
```

#### Public Member Functions

- [CSocketInConnection](#) (int theConnectionPort, unsigned short maxPacketSize=250, char headerID1=59, char headerID2=57)
- virtual [~CSocketInConnection](#) ()
- bool [connectToClient](#) ()
- char \* [receiveData](#) (int &dataSize)
- bool [replyToReceivedData](#) (char \*data, int dataSize)
- std::string [getConnectedMachineIP](#) ()

#### Protected Member Functions

- bool [\\_sendSimplePacket](#) (char \*packet, int packetLength, unsigned short packetsLeft)
- int [\\_receiveSimplePacket](#) (std::vector< char > &packet)
- unsigned int [\\_getTimeInMs](#) ()
- unsigned int [\\_getTimeDiffInMs](#) (unsigned int lastTime)

#### Protected Attributes

- SOCKET [\\_socketServer](#)
- SOCKET [\\_socketClient](#)
- struct sockaddr\_in [\\_socketLocal](#)
- fd\_set [\\_socketTheSet](#)
- int [\\_socketConnectionPort](#)
- bool [\\_socketConnectWasOk](#)
- std::string [\\_socketConnectedMachineIP](#)
- char [\\_headerByte1](#)
- char [\\_headerByte2](#)
- unsigned short [\\_maxPacketSize](#)

### 9.1.1 Constructor & Destructor Documentation

9.1.1.1 **CSocketInConnection::CSocketInConnection** ( *int theConnectionPort*, unsigned short *maxPacketSize* = 250, char *headerID1* = 59, char *headerID2* = 57 )

9.1.1.2 **CSocketInConnection::~~CSocketInConnection** ( ) [virtual]

### 9.1.2 Member Function Documentation

9.1.2.1 unsigned int **CSocketInConnection::\_getTimeDiffInMs** ( unsigned int *lastTime* ) [protected]

9.1.2.2 unsigned int **CSocketInConnection::\_getTimeInMs** ( ) [protected]

9.1.2.3 int **CSocketInConnection::\_receiveSimplePacket** ( std::vector< char > & *packet* ) [protected]

9.1.2.4 bool **CSocketInConnection::\_sendSimplePacket** ( char \* *packet*, int *packetLength*, unsigned short *packetsLeft* ) [protected]

9.1.2.5 bool **CSocketInConnection::connectToClient** ( )

9.1.2.6 std::string **CSocketInConnection::getConnectedMachineIP** ( )

9.1.2.7 char \* **CSocketInConnection::receiveData** ( int & *dataSize* )

9.1.2.8 bool **CSocketInConnection::replyToReceivedData** ( char \* *data*, int *dataSize* )

### 9.1.3 Member Data Documentation

9.1.3.1 char **CSocketInConnection::\_headerByte1** [protected]

9.1.3.2 char **CSocketInConnection::\_headerByte2** [protected]

9.1.3.3 unsigned short **CSocketInConnection::\_maxPacketSize** [protected]

9.1.3.4 SOCKET **CSocketInConnection::\_socketClient** [protected]

9.1.3.5 std::string **CSocketInConnection::\_socketConnectedMachineIP** [protected]

9.1.3.6 int **CSocketInConnection::\_socketConnectionPort** [protected]

9.1.3.7 bool **CSocketInConnection::\_socketConnectWasOk** [protected]

9.1.3.8 struct sockaddr\_in **CSocketInConnection::\_socketLocal** [protected]

9.1.3.9 SOCKET **CSocketInConnection::\_socketServer** [protected]

9.1.3.10 fd\_set **CSocketInConnection::\_socketTheSet** [protected]

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

- [socketInConnection.h](#)
- [socketInConnection.cpp](#)

## 9.2 CSocketOutConnection Class Reference

```
#include <socketOutConnection.h>
```

### Public Member Functions

- [CSocketOutConnection](#) (const char \*theConnectionAddress, int theConnectionPort, unsigned short maxPacketSize=250, char headerID1=59, char headerID2=57)
- virtual [~CSocketOutConnection](#) ()
- int [connectToServer](#) ()
- bool [sendData](#) (char \*data, int dataSize)
- char \* [receiveReplyData](#) (int &dataSize)

### Protected Member Functions

- bool [\\_sendSimplePacket](#) (char \*packet, int packetLength, unsigned short packetsLeft)
- int [\\_receiveSimplePacket](#) (std::vector< char > &packet)
- int [\\_getTimeInMs](#) ()
- int [\\_getTimeDiffInMs](#) (int lastTime)

### Protected Attributes

- std::string [\\_socketConnectionAddress](#)
- int [\\_socketConnectionPort](#)
- SOCKET [\\_socketConn](#)
- struct sockaddr\_in [\\_socketServer](#)
- char [\\_headerByte1](#)
- char [\\_headerByte2](#)
- unsigned short [\\_maxPacketSize](#)

### 9.2.1 Constructor & Destructor Documentation

9.2.1.1 [CSocketOutConnection::CSocketOutConnection](#) ( const char \* *theConnectionAddress*, int *theConnectionPort*, unsigned short *maxPacketSize* = 250, char *headerID1* = 59, char *headerID2* = 57 )

9.2.1.2 virtual [CSocketOutConnection::~~CSocketOutConnection](#) ( ) [virtual]

### 9.2.2 Member Function Documentation

9.2.2.1 int [CSocketOutConnection::\\_getTimeDiffInMs](#) ( int *lastTime* ) [protected]

9.2.2.2 int [CSocketOutConnection::\\_getTimeInMs](#) ( ) [protected]

9.2.2.3 int [CSocketOutConnection::\\_receiveSimplePacket](#) ( std::vector< char > & *packet* ) [protected]

9.2.2.4 `bool CSocketOutConnection::_sendSimplePacket ( char * packet, int packetLength, unsigned short packetsLeft )`  
[protected]

9.2.2.5 `int CSocketOutConnection::connectToServer ( )`

9.2.2.6 `char* CSocketOutConnection::receiveReplyData ( int & dataSize )`

9.2.2.7 `bool CSocketOutConnection::sendData ( char * data, int dataSize )`

### 9.2.3 Member Data Documentation

9.2.3.1 `char CSocketOutConnection::_headerByte1` [protected]

9.2.3.2 `char CSocketOutConnection::_headerByte2` [protected]

9.2.3.3 `unsigned short CSocketOutConnection::_maxPacketSize` [protected]

9.2.3.4 `SOCKET CSocketOutConnection::_socketConn` [protected]

9.2.3.5 `std::string CSocketOutConnection::_socketConnectionAddress` [protected]

9.2.3.6 `int CSocketOutConnection::_socketConnectionPort` [protected]

9.2.3.7 `struct sockaddr_in CSocketOutConnection::_socketServer` [protected]

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

- [socketOutConnection.h](#)

## 9.3 CXBOXController Class Reference

```
#include <CartesianControl.h>
```

### Public Member Functions

- [CXBOXController](#) (int *playerNumber*)
- `XINPUT_STATE` [GetState](#) ()
- `bool` [IsConnected](#) ()
- `void` [Vibrate](#) (int *leftVal*=0, int *rightVal*=0)

### 9.3.1 Constructor & Destructor Documentation

9.3.1.1 `CXBOXController::CXBOXController ( int playerNumber )`

### 9.3.2 Member Function Documentation

9.3.2.1 `XINPUT_STATE CXBOXController::GetState ( )`

9.3.2.2 `bool CXBOXController::IsConnected ( )`

9.3.2.3 `void CXBOXController::Vibrate ( int leftVal = 0, int rightVal = 0 )`

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

- [CartesianControl.h](#)

## 9.4 Experiment Class Reference

```
#include <CartesianControl.h>
```

### Public Member Functions

- void [HoloLensCartesianTeleop](#) (char \*argv[], [KinovaAPIFunctions](#) kinova)
- double [interp\\_lut](#) (double t, double \*y\_lut, int L\_lut, double Tp\_lut, double fs\_lut)
- void [MovetoStartPos](#) ([KinovaAPIFunctions](#) kinova)
- void [MoveEndEffectorPos](#) ([KinovaAPIFunctions](#) kinova, float xe, float ze)
- bool [load\\_LUT1D](#) (char \*filename, char delim)

### Public Attributes

- double [T](#) = 10.0
- double [T\\_calib](#) = 10.0
- double [T\\_TF](#) = 10.0
- double [Ts](#) = 1.0 / 125.0
- const double [fs\\_qd\\_lut](#) = 3000.0
- const double [fs\\_uc\\_lut](#) = 3000.0
- double [scale\\_LUT](#) = 1
- double \* [LUT](#)
- int [len\\_LUT](#)
- const float [Kp](#) = 2.0f

### 9.4.1 Member Function Documentation

9.4.1.1 `void Experiment::HoloLensCartesianTeleop ( char * argv[], KinovaAPIFunctions kinova )`

9.4.1.2 `double Experiment::interp_lut ( double t, double * y_lut, int L_lut, double Tp_lut, double fs_lut )`

This function linearly interpolates the values in the Lookup table for a given input time instant.

Inputs:

1. (double) t : current time instant (s)
2. (double\*) ylut : Lookup Table
3. (int) L\_lut : Length of the Lookup table
4. (double) Tp\_lut : Time period of Lookup table (s)
5. (double) fs\_lut : Sampling frequency of Lookupt table (Hz)

Output:

1. (double) : output of interpolation

9.4.1.3 `bool Experiment::load_LUT1D ( char * filename, char delim )`

Load Lookup table from CSV file

Inputs:

1. (char\*) filename: Filename of CSV file
2. (char) delim : Delimiter for CSV file

Output:

1. (bool) : Status of LUT load operation



9.4.1.4 void Experiment::MoveEndEffectorPos ( KinovaAPIFunctions *kinova*, float *xe*, float *ze* )

9.4.1.5 void Experiment::MovetoStartPos ( KinovaAPIFunctions *kinova* )

## 9.4.2 Member Data Documentation

9.4.2.1 const double Experiment::fs\_qd\_lut = 3000.0

9.4.2.2 const double Experiment::fs\_uc\_lut = 3000.0

9.4.2.3 const float Experiment::Kp = 2.0f

9.4.2.4 int Experiment::len\_LUT

9.4.2.5 double\* Experiment::LUT

9.4.2.6 double Experiment::scale\_LUT = 1

9.4.2.7 double Experiment::T = 10.0

9.4.2.8 double Experiment::T\_calib = 10.0

9.4.2.9 double Experiment::T\_TF = 10.0

9.4.2.10 double Experiment::Ts = 1.0 / 125.0

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

- [CartesianControl.h](#)
- [angularCommandControl.cpp](#)
- [expt\\_HoloLensCartesianTeleop.cpp](#)
- [lutLinearInterp.cpp](#)

## 9.5 FIRFilter Class Reference

```
#include <CartesianControl.h>
```

### Public Member Functions

- bool [firFloatInit](#) ()  
*Function to initialize the FIR Filter.*
- double \* [firFloat](#) (double \*input, int [length](#))  
*Function to compute the output of the FIR Filter.*

## Public Attributes

- `const char * filename = "./lowpass.mat"`  
*Filename of FIR Filter weights.*
- `int length = 1`
- `double * output = new double[length]`
- `double insamp [BUFFER_LEN]`  
*buffer array to hold input samples*
- `double * coeffs`  
*FIR Filter weights.*
- `double cutoff_freq_hz = 0.2`  
*Cutoff frequency of the FIR Filter in Hz.*

## 9.5.1 Member Function Documentation

### 9.5.1.1 `double * FIRFilter::firFloat ( double * input, int length )`

Function to compute the output of the FIR Filter.

#### FIR Filter Computation

This function computes the output of the FIR Filter for the given content of the input buffer in three steps:

- 1) Put new input at the high end of the buffer
- 2) Apply the filter to each input sample
- 3) Shift input samples back in time for next time instant

### 9.5.1.2 `bool FIRFilter::firFloatInit ( )`

Function to initialize the FIR Filter.

#### FIR Filter Initialization

This function initializes the FIR filter by searching for a CSV file formatted as

```
num_weights
w1
w2
.
.
.
wn
which is read into the coeffs variable.
```

## 9.5.2 Member Data Documentation

### 9.5.2.1 `double* FIRFilter::coeffs`

FIR Filter weights.

9.5.2.2 `double FIRFilter::cutoff_freq_hz = 0.2`

Cutoff frequency of the FIR Filter in Hz.

9.5.2.3 `const char* FIRFilter::filename = "/lowpass.mat"`

Filename of FIR Filter weights.

9.5.2.4 `double FIRFilter::insamp[BUFFER_LEN]`

buffer array to hold input samples

9.5.2.5 `int FIRFilter::length = 1`

9.5.2.6 `double* FIRFilter::output = new double[length]`

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

- [CartesianControl.h](#)
- [firFilter.cpp](#)

## 9.6 kinectSkelTrack::KinectInfo Struct Reference

```
#include <CartesianControl.h>
```

### Public Attributes

- `bool startSignal = false`
- `bool userFound = false`
- `double handPosition = 0`

### 9.6.1 Member Data Documentation

9.6.1.1 `double kinectSkelTrack::KinectInfo::handPosition = 0`

9.6.1.2 `bool kinectSkelTrack::KinectInfo::startSignal = false`

9.6.1.3 `bool kinectSkelTrack::KinectInfo::userFound = false`

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

- [CartesianControl.h](#)

## 9.7 kinectSkelTrack Class Reference

```
#include <CartesianControl.h>
```

### Classes

- struct [KinectInfo](#)

### Public Member Functions

- bool [initKinect](#) ()
- void [getSkeletalData](#) ()
- [KinectInfo](#) [getKinectData](#) ()

### Public Attributes

- int [width](#) = 640
- int [height](#) = 480
- HANDLE [depthStream](#)
- INuiSensor \* [sensor](#)
- Vector4 [skeletonPosition](#) [NUI\_SKELETON\_POSITION\_COUNT]

#### 9.7.1 Member Function Documentation

##### 9.7.1.1 kinectSkelTrack::KinectInfo kinectSkelTrack::getKinectData ( )

Auxiliary function if multithreading the Kinect sensor

##### 9.7.1.2 void kinectSkelTrack::getSkeletalData ( )

Get the skeletal data from the current frame

##### 9.7.1.3 bool kinectSkelTrack::initKinect ( )

Initialize the Kinect sensor for skeleton tracking of the user closest to the sensor.

#### 9.7.2 Member Data Documentation

##### 9.7.2.1 HANDLE kinectSkelTrack::depthStream

##### 9.7.2.2 int kinectSkelTrack::height = 480

##### 9.7.2.3 INuiSensor\* kinectSkelTrack::sensor

##### 9.7.2.4 Vector4 kinectSkelTrack::skeletonPosition[NUI\_SKELETON\_POSITION\_COUNT]

##### 9.7.2.5 int kinectSkelTrack::width = 640

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

- [CartesianControl.h](#)
- [HMIfunctions.cpp](#)

## 9.8 KinovaAPIFunctions Class Reference

```
#include <CartesianControl.h>
```

### Public Attributes

- `int(* MyInitAPI )()`
- `int(* MyCloseAPI )()`
- `int(* MyStartControlAPI )()`
- `int(* MyStartForceControl )()`
- `int(* MyStopForceControl )()`
- `int(* MyGetClientConfigurations )(ClientConfigurations &config)`
- `int(* MySetClientConfigurations )(ClientConfigurations config)`
- `int(* MySendJoystickCommand )(JoystickCommand joystickCommand)`
- `int(* MyGetGlobalTrajectoryInfo )(TrajectoryFIFO &Response)`
- `int(* MyRunGravityZEstimationSequence )(ROBOT_TYPE type, double OptimalzParam[OPTIMAL_Z_PARAM_SIZE], double OptimalzParam[OPTIMAL_Z_PARAM_SIZE])`
- `int(* MySendBasicTrajectory )(TrajectoryPoint command)`
- `int(* MyGetActualTrajectoryInfo )(TrajectoryPoint &)`
- `int(* MyGetDevices )(KinovaDevice devices[MAX_KINOVA_DEVICE], int &result)`
- `int(* MySetActiveDevice )(KinovaDevice device)`
- `int(* MySetGravityOptimalZParam )(double optimalZParams[OPTIMAL_Z_PARAM_SIZE])`
- `int(* MySetGravityType )(GRAVITY_TYPE type)`
- `int(* MyMoveHome )()`
- `int(* MyInitFingers )()`
- `int(* MyGetCartesianCommand )(CartesianPosition &)`
- `int(* MyGetCartesianPosition )(CartesianPosition &)`
- `int(* MyGetAngularPosition )(AngularPosition &)`
- `int(* MySetActuatorPID )(unsigned int adress, float P, float I, float D)`
- `int(* MyGetGripperStatus )(Gripper &)`

### 9.8.1 Member Data Documentation

9.8.1.1 `int(* KinovaAPIFunctions::MyCloseAPI )()`

9.8.1.2 `int(* KinovaAPIFunctions::MyGetActualTrajectoryInfo )(TrajectoryPoint &)`

9.8.1.3 `int(* KinovaAPIFunctions::MyGetAngularPosition )(AngularPosition &)`

9.8.1.4 `int(* KinovaAPIFunctions::MyGetCartesianCommand )(CartesianPosition &)`

9.8.1.5 `int(* KinovaAPIFunctions::MyGetCartesianPosition )(CartesianPosition &)`

9.8.1.6 `int(* KinovaAPIFunctions::MyGetClientConfigurations )(ClientConfigurations &config)`

9.8.1.7 `int(* KinovaAPIFunctions::MyGetDevices )(KinovaDevice devices[MAX_KINOVA_DEVICE], int &result)`

9.8.1.8 `int(* KinovaAPIFunctions::MyGetGlobalTrajectoryInfo )(TrajectoryFIFO &Response)`

- 9.8.1.9 `int(* KinovaAPIFunctions::MyGetGripperStatus) (Gripper &)`
- 9.8.1.10 `int(* KinovaAPIFunctions::MyInitAPI) ()`
- 9.8.1.11 `int(* KinovaAPIFunctions::MyInitFingers) ()`
- 9.8.1.12 `int(* KinovaAPIFunctions::MyMoveHome) ()`
- 9.8.1.13 `int(* KinovaAPIFunctions::MyRunGravityZEstimationSequence) (ROBOT_TYPE type, double OptimalzParam[OPTIMAL_Z_PARAM_SIZE])`
- 9.8.1.14 `int(* KinovaAPIFunctions::MySendBasicTrajectory) (TrajectoryPoint command)`
- 9.8.1.15 `int(* KinovaAPIFunctions::MySendJoystickCommand) (JoystickCommand joystickCommand)`
- 9.8.1.16 `int(* KinovaAPIFunctions::MySetActiveDevice) (KinovaDevice device)`
- 9.8.1.17 `int(* KinovaAPIFunctions::MySetActuatorPID) (unsigned int adress, float P, float I, float D)`
- 9.8.1.18 `int(* KinovaAPIFunctions::MySetClientConfigurations) (ClientConfigurations config)`
- 9.8.1.19 `int(* KinovaAPIFunctions::MySetGravityOptimalZParam) (double optimalZParams[OPTIMAL_Z_PARAM_SIZE])`
- 9.8.1.20 `int(* KinovaAPIFunctions::MySetGravityType) (GRAVITY_TYPE type)`
- 9.8.1.21 `int(* KinovaAPIFunctions::MyStartControlAPI) ()`
- 9.8.1.22 `int(* KinovaAPIFunctions::MyStartForceControl) ()`
- 9.8.1.23 `int(* KinovaAPIFunctions::MyStopForceControl) ()`

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

- [CartesianControl.h](#)

## 9.9 NovintFalconHapticsDevice Class Reference

```
#include <CartesianControl.h>
```

### Public Member Functions

- `bool InitializeHapticsDevice ()`
- `void UpdateHaptics (void)`
- `void ResetIC (void)`

## Public Attributes

- chai3d::cGenericHapticDevicePtr [hapticDevice](#)
- chai3d::cVector3d [hapticDevicePosition](#)
- chai3d::cThread \* [hapticsThread](#)
- chai3d::cHapticDeviceHandler \* [handler](#)
- double [maxforce](#) = 1
- chai3d::cVector3d [position](#)
- chai3d::cMatrix3d [rotation](#)
- chai3d::cVector3d [linearVelocity](#)
- chai3d::cVector3d [angularVelocity](#)
- chai3d::cVector3d [desiredPosition](#)
- chai3d::cMatrix3d [desiredRotation](#)
- bool [isRunning](#) = false
- bool [button0\\_state](#) = false
- bool [button2\\_state](#) = false
- bool [useDamping](#) = false
- bool [useForceField](#) = false

## 9.9.1 Member Function Documentation

### 9.9.1.1 bool NovintFalconHapticsDevice::InitializeHapticsDevice ( )

Initialize the Novint Falcon Haptics device

### 9.9.1.2 void NovintFalconHapticsDevice::ResetIC ( void )

Reset the Haptics Device and apply a feedback force towards the center of the joystick

### 9.9.1.3 void NovintFalconHapticsDevice::UpdateHaptics ( void )

Update the current position of the Haptics joystick

## 9.9.2 Member Data Documentation

### 9.9.2.1 chai3d::cVector3d NovintFalconHapticsDevice::angularVelocity

### 9.9.2.2 bool NovintFalconHapticsDevice::button0\_state = false

### 9.9.2.3 bool NovintFalconHapticsDevice::button2\_state = false

### 9.9.2.4 chai3d::cVector3d NovintFalconHapticsDevice::desiredPosition

### 9.9.2.5 chai3d::cMatrix3d NovintFalconHapticsDevice::desiredRotation

### 9.9.2.6 chai3d::cHapticDeviceHandler\* NovintFalconHapticsDevice::handler

9.9.2.7 `chai3d::cGenericHapticDevicePtr NovintFalconHapticsDevice::hapticDevice`

9.9.2.8 `chai3d::cVector3d NovintFalconHapticsDevice::hapticDevicePosition`

9.9.2.9 `chai3d::cThread* NovintFalconHapticsDevice::hapticsThread`

9.9.2.10 `bool NovintFalconHapticsDevice::isRunning = false`

9.9.2.11 `chai3d::cVector3d NovintFalconHapticsDevice::linearVelocity`

9.9.2.12 `double NovintFalconHapticsDevice::maxforce = 1`

9.9.2.13 `chai3d::cVector3d NovintFalconHapticsDevice::position`

9.9.2.14 `chai3d::cMatrix3d NovintFalconHapticsDevice::rotation`

9.9.2.15 `bool NovintFalconHapticsDevice::useDamping = false`

9.9.2.16 `bool NovintFalconHapticsDevice::useForceField = false`

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

- [CartesianControl.h](#)
- [HMIfunctions.cpp](#)

## 9.10 Timer Class Reference

```
#include <CartesianControl.h>
```

### Public Member Functions

- void [start](#) ()
- double [elapsedTime](#) ()
- bool [isTimeout](#) (unsigned long seconds)

#### 9.10.1 Member Function Documentation

9.10.1.1 `double Timer::elapsedTime ( ) [inline]`

9.10.1.2 `bool Timer::isTimeout ( unsigned long seconds ) [inline]`

9.10.1.3 `void Timer::start ( ) [inline]`

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

- [CartesianControl.h](#)

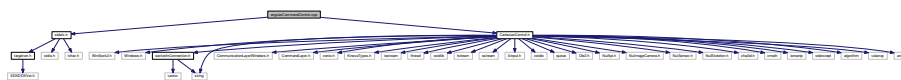


## Chapter 10

# File Documentation

### 10.1 angularCommandControl.cpp File Reference

```
#include "stdafx.h"
#include "CartesianControl.h"
Include dependency graph for angularCommandControl.cpp:
```



### Macros

- `#define _WINSOCK_DEPRECATED_NO_WARNINGS`
- `#define WIN32_LEAN_AND_MEAN`

#### 10.1.1 Macro Definition Documentation

10.1.1.1 `#define _WINSOCK_DEPRECATED_NO_WARNINGS`

10.1.1.2 `#define WIN32_LEAN_AND_MEAN`

### 10.2 CartesianControl.h File Reference

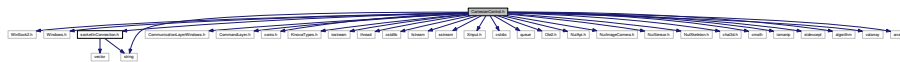
```
#include <WinSock2.h>
```

```

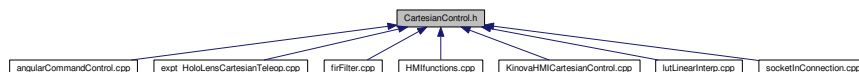
#include <Windows.h>
#include "socketInConnection.h"
#include "CommunicationLayerWindows.h"
#include "CommandLayer.h"
#include <conio.h>
#include "KinovaTypes.h"
#include <iostream>
#include <thread>
#include <cstdlib>
#include <fstream>
#include <string>
#include <sstream>
#include <Xinput.h>
#include <cstdio>
#include <queue>
#include <Ole2.h>
#include "NuiApi.h"
#include "NuiImageCamera.h"
#include "NuiSensor.h"
#include "NuiSkeleton.h"
#include "chai3d.h"
#include <cmath>
#include <iomanip>
#include <stdexcept>
#include <algorithm>
#include <valarray>
#include <array>

```

Include dependency graph for CartesianControl.h:



This graph shows which files directly or indirectly include this file:



## Classes

- class [CXBOXController](#)
- class [Timer](#)
- class [KinovaAPIFunctions](#)
- class [kinectSkelTrack](#)
- struct [kinectSkelTrack::KinectInfo](#)
- class [FIRFilter](#)
- class [Experiment](#)
- class [NovintFalconHapticsDevice](#)

## Macros

- `#define _WINSOCK_DEPRECATED_NO_WARNINGS`
- `#define WIN32_LEAN_AND_MEAN`
- `#define WIN32_LEAN_AND_MEAN`
- `#define USE_KINOVA true`
- `#define USE_KINECT false`
- `#define USE_TCP true`
- `#define USE_HAPTICS true`
- `#define GNUPLOT false`
- `#define _XBOX_CONTROLLER_H_`
- `#define WIN32_LEAN_AND_MEAN`
- `#define BUFFER_LEN 96`

*Buffer length to hold input samples of FIR Filter.*

### 10.2.1 Macro Definition Documentation

10.2.1.1 `#define _WINSOCK_DEPRECATED_NO_WARNINGS`

10.2.1.2 `#define _XBOX_CONTROLLER_H_`

10.2.1.3 `#define BUFFER_LEN 96`

Buffer length to hold input samples of FIR Filter.

10.2.1.4 `#define GNUPLOT false`

10.2.1.5 `#define USE_HAPTICS true`

10.2.1.6 `#define USE_KINECT false`

10.2.1.7 `#define USE_KINOVA true`

10.2.1.8 `#define USE_TCP true`

10.2.1.9 `#define WIN32_LEAN_AND_MEAN`

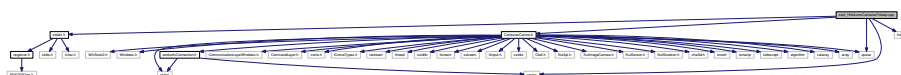
10.2.1.10 `#define WIN32_LEAN_AND_MEAN`

10.2.1.11 `#define WIN32_LEAN_AND_MEAN`

## 10.3 expt\_HoloLensCartesianTeleop.cpp File Reference

```
#include "stdafx.h"
#include "CartesianControl.h"
#include <vector>
#include <queue>
#include <future>
```

Include dependency graph for expt\_HoloLensCartesianTeleop.cpp:









## 10.8.1 Macro Definition Documentation

10.8.1.1 `#define _WINSOCK_DEPRECATED_NO_WARNINGS`

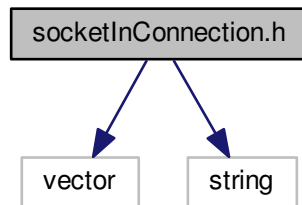
10.8.1.2 `#define HEADER_LENGTH 6`

## 10.9 socketInConnection.h File Reference

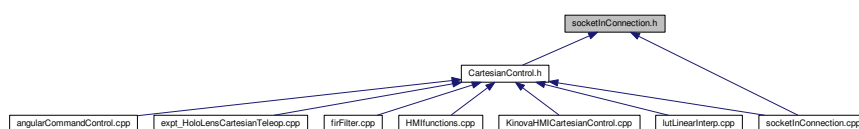
```
#include <vector>
```

```
#include <string>
```

Include dependency graph for socketInConnection.h:



This graph shows which files directly or indirectly include this file:



## Classes

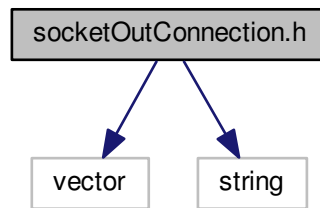
- class [CSocketInConnection](#)

## 10.10 socketOutConnection.h File Reference

```
#include <vector>
```

```
#include <string>
```

Include dependency graph for socketOutConnection.h:



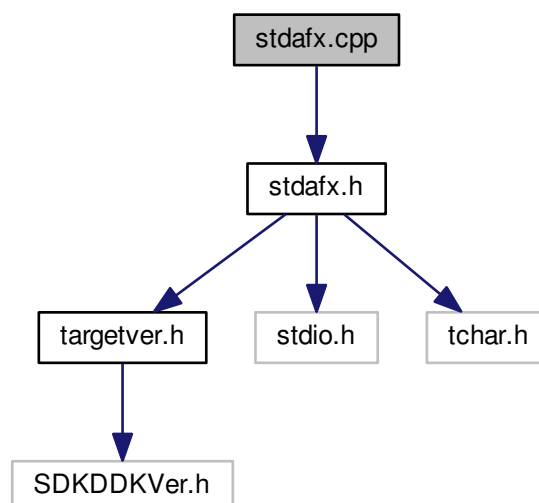
## Classes

- class [CSocketOutConnection](#)

## 10.11 stdafx.cpp File Reference

```
#include "stdafx.h"
```

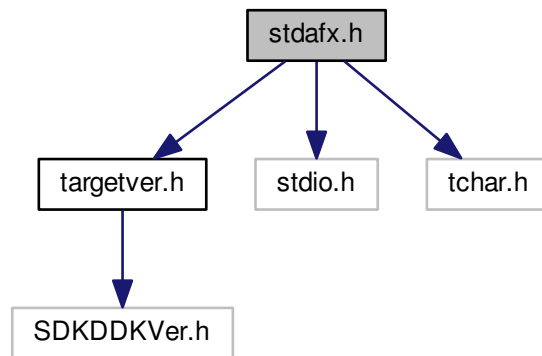
Include dependency graph for stdafx.cpp:



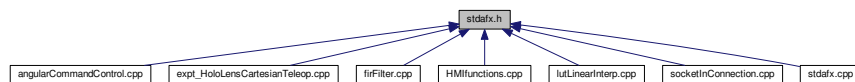


## 10.12 stdafx.h File Reference

```
#include "targetver.h"  
#include <stdio.h>  
#include <tchar.h>  
Include dependency graph for stdafx.h:
```

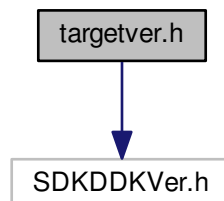


This graph shows which files directly or indirectly include this file:

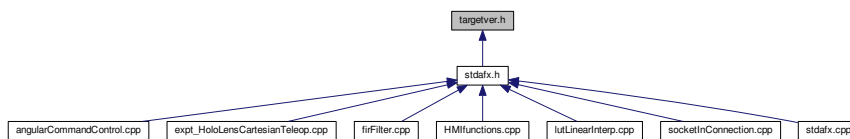


## 10.13 targetver.h File Reference

```
#include <SDKDDKVer.h>  
Include dependency graph for targetver.h:
```



This graph shows which files directly or indirectly include this file:



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