

# *USER MANUAL*

Microsoft Kinect based HMI for tower cranes

**ENGLISH**



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## SETTING UP THE ENVIRONMENT

### Operation System

The interface was designed and tested on **Windows 7 x86 (32 bit)** and **Windows 7 x64 (64 bit)** systems. Versions below Windows 7 are not supported. Operation on Windows 8 and above is possible, but not guaranteed.

### Microsoft .NET Framework

The interface requires an installation of **Microsoft .NET Framework version 4.5.50938.18408** and above. To download the latest version, please visit: <http://www.microsoft.com/net/downloads>

### Kinect for Windows Runtime

The interface requires an installation of **Kinect for Windows Runtime version 1.7** or higher. To download version 1.7, please visit: <http://www.microsoft.com/en-us/download/details.aspx?id=36997> or [www.microsoft.com/en-us/download/default.aspx](http://www.microsoft.com/en-us/download/default.aspx) to find a newer version.

Alternatively, if you are planning to use the developer functions of Kinect, you can use an installation of **Microsoft Kinect for Windows SDK version 1.7** or higher. To download the latest version, please visit: <http://www.microsoft.com/en-us/kinectforwindowsdev/Downloads.aspx>

### MATLAB

- The interface was designed and tested with **MATLAB version R2012b**. Other versions are not officially supported, but should work without major issues.
- Usage of **MATLAB** software is not required.

## COM PORT CONFIGURATION

### Connection settings

| Setting name              | Setting state        |
|---------------------------|----------------------|
| Communication mode        | synchronous          |
| Baud rate                 | CBR_115200           |
| Byte size                 | 8                    |
| Binary mode               | true                 |
| Parity                    | NOPARITY             |
| Stop bits                 | 1                    |
| XON/XOFF out flow control | disabled             |
| XON/XOFF in flow control  | disabled             |
| Error char                | disabled             |
| Message end char          | \r [carriage return] |

## Microsoft Windows 7 desktop PCs

### WARNING!

Some users running Windows 7 on a desktop PC may have a COM1 port listed in their device manager. This port most likely will not be physical and thus should not be used. Please check your motherboard specification to ensure that you have a physical port.

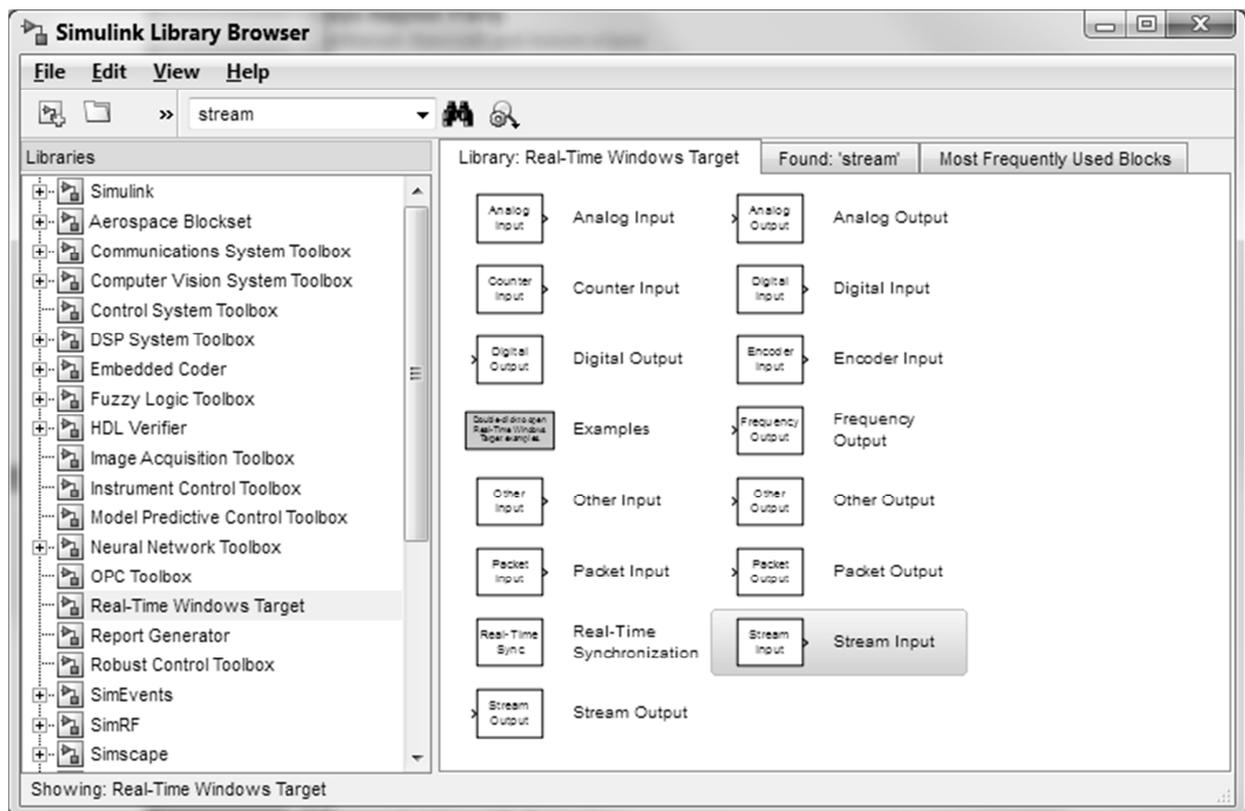
## Virtual COM port

- The program can use a virtual COM port for communication along with a physical device.
- While using a virtual device, baud rate can be either emulated or not emulated.
- For commercial solution, the suggested emulator is **Virtual Serial Ports Emulator**. To purchase and download the latest version, please visit: <http://www.eterlogic.com/Downloads.html>
- For open source solution, the suggested emulator is **com0com Project**. To download the latest version, please visit: <http://sourceforge.net/projects/com0com/>

## MATLAB CONFIGURATION

### Input and output

To receive a data in **Matlab Simulink** use “Stream Input” from “Real-Time Windows Target library”.

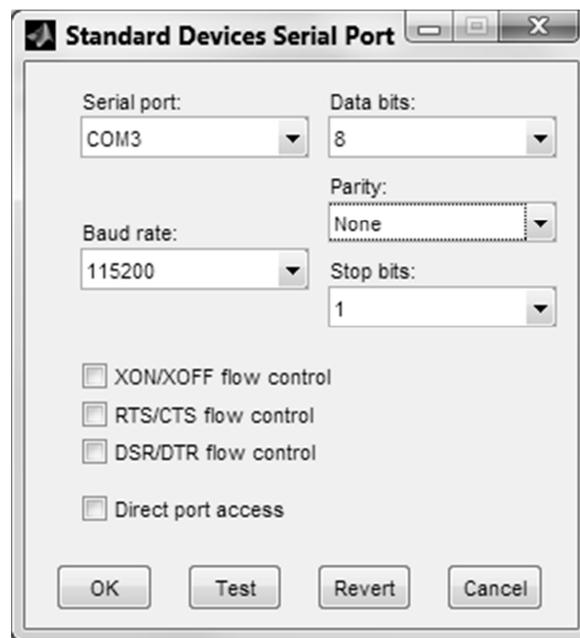


[Simulink Library Browser]

After placing the “Stream Input” block, double click on it. Parameters window will pop-up.

Click on **Install new board** button, a drop down menu will show up. From the **Standard devices** menu select **Serial port**. Select the newly created serial port device a click on the **Board setup** button. **Standard Devices Serial Port** settings windows will pop-up.

- As the **Serial port** select the input port of MATLAB.
- Set **Data bits** to 8.
- Set **Parity** to None.
- Set **Baud rate** to 115200.
- Set **Stop bits** to 1.
- Leave tick boxes as default.



[Standard Devices Serial Port]

To test the settings press the Test button. After finishing press OK.

- Set **Sample time** value to **0.01** or lower. Higher values could create lag and buffering.
- Leave **Maximum missed ticks** value as default.
- Leave **Show “Missed Ticks” port** and **Yield CPU when waiting** as default.
- You can set **Block output data types** to any decimal numerical type. But the recommended are float and double. To learn about formatting please read the official MATLAB help.
- Set **Format stream** variables as any decimal numerical type, while using the following format:

‘%\*,%\*,%\*;’

, where \* is a data type. To learn about data types please read the official MATLAB help.

- Set **Message termination** to {‘\r’,‘\n’}.
- Leave **Show “Data Ready” port** and **Show “Data Error” port** tick boxes as default.

**Block Parameters: Stream Input**

RTWin Stream Input (mask) (link)  
Real-Time Windows Target stream input.

Data acquisition board

Install new board    Delete current board

Standard Devices Serial Port [3h]    Board setup

Timing

Sample time:  
0.01

Maximum missed ticks:  
10

Show "Missed Ticks" port  
 Yield CPU when waiting

Input/Output

Block output data types:  
'3\*float'

Format string:  
'%f,%f,%f;'

Message termination:  
{'\r','\n'}

Show "Data Ready" port  
 Show "Data Error" port

OK    Cancel    Help    Apply

[Block Parameters: Stream Input]

# KINECT T-CRANE APPLICATION

## Graphical User Interface overview

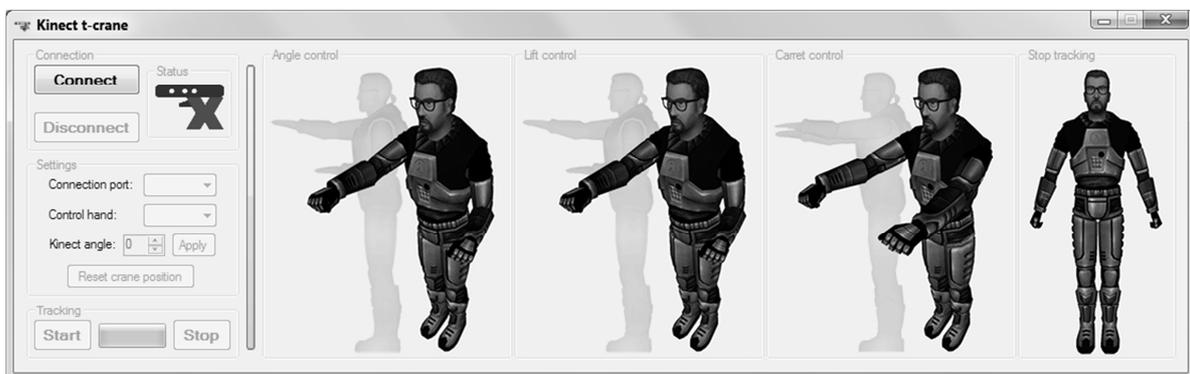


[Kinect t-crane connected]



[Kinect t-crane disconnected]

- Use **Connect** and **Disconnect** buttons to establish a connection with your Microsoft Kinect device.
- From the **Connection port** drop-down menu you can choose a COM port ranging from COM1 to COM9.
- From the **Control hand** drop-down menu you can choose your dominant hand, which will control the crane movements.
- You can set your Microsoft **Kinect angle** ranging from -27 to +27 degrees relative to the ground and Kinect stand.
- By clicking **Reset crane** position button, the GUI will send a string containing 0 0 0 coordinates.
- Use **Start** and **Stop** buttons to respectively start or stop tracking and sending your inputs.
- By pressing a **vertical bar/button** on the right side of application you can show or hide on-screen short control guide.



[Kinect t-crane on-onscreen help]

## Data/string handling and structure

The application designed in a way that it gathers gesture input around 30 frames per second while using smoothest Kinect preset available. Thus damping the jerkiness of movement, while sacrificing the speed of reaction and generating some input lag.

Kinect t-crane application gets joints coordinates from Kinect with a precision of 9 digits after the decimal point. Output data is Radians ranging from -1 to 1, with a precision of 3 digits after the decimal point.

The output string is formatted as follows:

```
'%1,%2,%3;\r'
```

,where:

- %1 is X coordinate/angle in radians
- %2 is Theta angle in radians
- %3 is Z coordinate/angle in radians
- \r is string termination character

## HMI CONTROL GUIDELINES

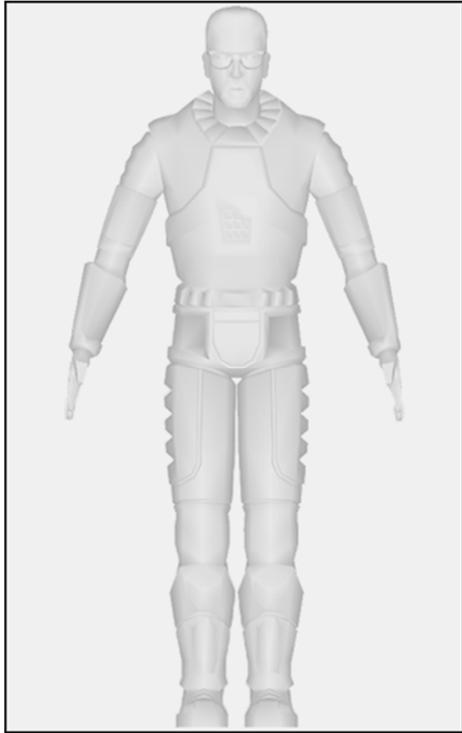
### Setting up

For all of the application settings please refer to Graphical User Interface overview part of this user manual.

1. Connect your Microsoft Kinect to the PC.
2. Start the Kinect t-crane application.
3. Press Connect.
4. Select your output port and dominant hand.
5. Press Start.

## General controls

### Stopping and pausing the tracking



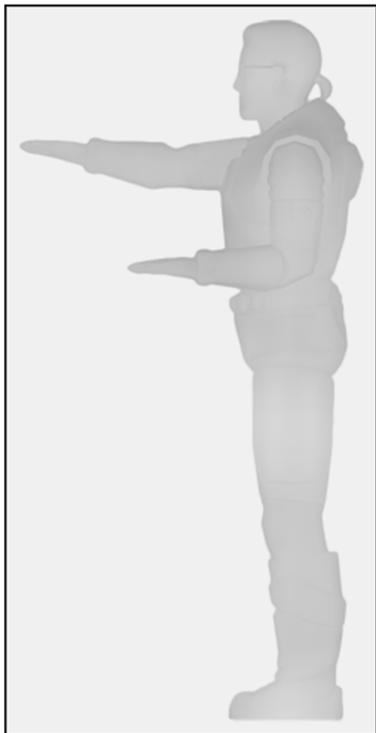
*[Stopping gesture]*

You can stop the tracking by pressing the Stop button in the Kinect t-crane application.

Alternatively you can assume position shown on the left. Generally you can be at any position as long as your both wrists are below your waist line.

Any time your non-dominant hand will assume position not described in this manual, the tracking will be paused.

### Crane arm rotation and cargo height



*[Rotation and height gesture]*

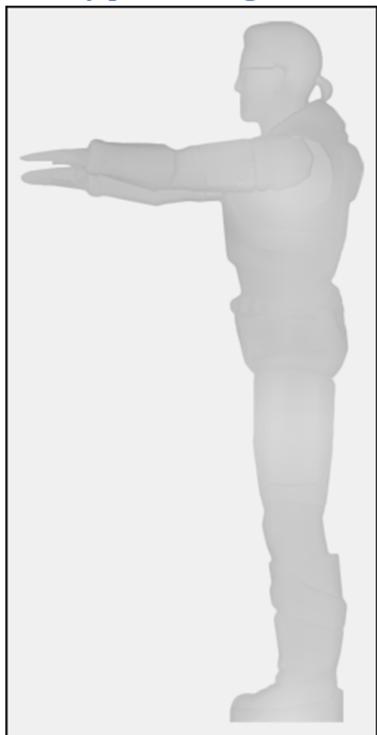
Vertical axis is considered Z and the cargo moves along it. The crane arm rotates by the angle Theta around Z axis.

To initiate crane arm rotation and to change the cargo height, assume position shown on the left. If your dominant hand is right, then your left wrist and elbow must be positioned around your waist line. If your dominant hand is left, then your right wrist and elbow must be positioned around your waist line.

To rotate the crane arm, move your dominant arm left or right.

To change the height of the cargo, move your dominant arm up or down.

## Trolley positioning



*[Trolley position gesture]*

Horizontal axis is considered X and the trolley moves along it.

To initiate trolley positioning, assume position shown on the left. If your dominant hand is right, then your left wrist and elbow must be positioned around your left shoulder line. If your dominant hand is left, then your right wrist and elbow must be positioned around your right shoulder line.

To move the trolley, move your dominant arm up or down.