
Mindstorms EV3 Toolbox Documentation

Release v0.4-rc.10

LfB - RWTH Aachen

May 09, 2017

CONTENTS

1	Contents	3
1.1	General	3
1.2	Examples	3
1.3	EV3	3
1.4	Motor	7
1.5	Sensor	10
1.6	hidapi	14
1.7	usbBrickIO	18
1.8	btBrickIO	19
	MATLAB Module Index	21
	Index	23

This MATLAB toolbox was designed to abstract and simplify controlling Lego Mindstorms EV3 robots. Via Bluetooth or USB you can read sensor values or control your robots' motors in an intuitive way. On a low level (the Communication layer) you are able to send various commands directly to the brick, while on a high level, several classes abstract this behaviour for you. If you want to easily access your EV3 robot, these are the classes you will mostly use.

To get started, take a look at the [installation instructions](#) and [examples](#).

This toolbox is being developed at the RWTH Aachen, Germany, as part of the students' lab 'MATLAB meets Mindstorms'. It is the follow-up of the [MATLAB NXT Toolbox](#).

CONTENTS

Setting up the toolbox

1.1 General

1.1.1 Installation

1.1.2 Contribution

1.1.3 Licenses

1.2 Examples

```
% This example expects a motor at port A and a (random) sensor at port 1
b = EV3();
b.connect('usb');
ma = b.motorA;
ma.setProperties('power', 50, 'limitValue', 720);
ma.start();
% fun
ma.waitFor();
disp(b.sensor1.value);
b.beep();
b.delete();
```

Toolbox documentation

1.3 EV3

class `source.EV3` (*varargin*)

List of methods:

- `connect()`
- `disconnect()`
- `stopAllMotors()`
- `beep()`

- `playTone()`
- `stopTone()`
- `tonePlayed()`
- `setProperties()`

High-level class to work with physical bricks.

This is the ‘central’ class (from user’s view) when working with this toolbox. It delivers a convenient interface for creating a connection to the brick and sending commands to it. An EV3-object creates 4 Motor- and 4 Sensor-objects, one for each port.

Notes

- Creating multiple EV3 objects and connecting them to different physical bricks has not been thoroughly tested yet, but seems to work on a first glance.
- When an input argument of a method is marked as optional, the argument needs to be ‘announced’ by a preceding 2nd argument, which is a string containing the name of the argument. For example, `Motor.setProperties` may be given a power-parameter. The syntax would be as follows: *brickObject.motorA.setProperties('power', 50);*

motorA

Motor – Motor-object interfacing port A. See also *Motor*.

motorB

Motor – Motor-object interfacing port B. See also *Motor*.

motorC

Motor – Motor-object interfacing port C. See also *Motor*.

motorD

Motor – Motor-object interfacing port D. See also *Motor*.

sensor1

Sensor – Motor-object interfacing port 1. See also *Sensor*.

sensor2

Sensor – Motor-object interfacing port 2. See also *Sensor*.

sensor3

Sensor – Motor-object interfacing port 3. See also *Sensor*.

sensor4

Sensor – Motor-object interfacing port 4. See also *Sensor*.

debug

numeric in {0,1,2} – Debug mode. [WRITABLE]

- 0: Debug turned off
- 1: Debug turned on for EV3-object -> enables feedback in the console about what firmware-commands have been called when using a method
- 2: Low-level-Debug turned on -> each packet sent and received is printed to the console

batteryMode

string in {'Percentage', 'Voltage'} – Mode for reading battery charge. See also *batteryValue*. [WRITABLE]

batteryValue

numeric – Current battery charge. Depending on batteryMode, the reading is either in percentage or voltage. See also batteryMode. *[READ-ONLY]*

isConnected

bool – True if virtual brick-object is connected to physical one. *[READ-ONLY]*

Example

```
% This example expects a motor at port A and a (random) sensor at port 1
b = EV3(); % b.connect('usb'); %
ma = b.motorA; % ma.setProperties('power', 50, 'limitValue', 720); % ma.start(); % % fun ma.waitFor(); %
disp(b.sensor1.value); % b.beep(); % delete b; %
```

beep (*ev3*)

Plays a 'beep'-tone on brick.

Notes

- This equals playTone(10, 1000, 100).

Example

```
b = EV3(); % b.connect('bt', 'serPort', '/dev/rfcomm0'); % b.beep(); %
```

connect (*ev3*, *varargin*)

Connects EV3-object and its Motors and Sensors to physical brick.

Parameters

- **connectionType** (*string in {'bt', 'usb'}*) – Connection type
- **serPort** (*string in {'/dev/rfcomm1', '/dev/rfcomm2', ...}*) – Path to serial port (necessary if connectionType is 'bt'). *[OPTIONAL]*
- **beep** (*bool*) – If true, EV3 beeps if connection has been established. *[OPTIONAL]*

Example

```
% Setup bluetooth connection via com-port 0
b = EV3(); % b.connect('bt', 'serPort', '/dev/rfcomm0');
% % Setup usb connection, beep when connection has been established
b = EV3(); % b.connect('usb', 'beep', 'on', ); %
```

See also ISCONNECTED / isConnected

disconnect (*ev3*)

Disconnects EV3-object and its Motors and Sensors from physical brick.

Notes

- Gets called automatically when EV3-object is destroyed.

Example

```
b = EV3(); % b.connect('bt', 'serPort', '/dev/rfcomm0'); % % do stuff b.disconnect(); %  
playTone (ev3, volume, frequency, duration)  
Plays tone on brick.
```

Parameters

- **volume** (*numeric in [0, 100]*) – in percent
- **frequency** (*numeric in [250, 10000]*) – in Hertz
- **duration** (*numeric > 0*) – in milliseconds

Example

```
b = EV3(); % b.connect('bt', 'serPort', '/dev/rfcomm0'); % b.playTone(40, 5000, 1000); % Plays tone  
with 40% volume and 5000Hz for 1 second.  
  
setPropertyies (ev3, varargin)  
Set multiple EV3 properties at once using MATLAB's inputParser.
```

Parameters

- **debug** (*numeric in {0, 1, 2}*) – see EV3.debug [OPTIONAL]
- **batteryMode** (*string in {'Voltage'/'Percentage'}*) – see EV3.batteryMode [OPTIONAL]

Example

```
b = EV3(); % b.connect('bt', 'serPort', '/dev/rfcomm0'); % b.setPropertyies('debug', 'on', 'batteryMode',  
'Voltage'); % % Instead of: b.debug = 'on'; b.batteryMode = 'Voltage'; %  
  
See also EV3.DEBUG, EV3.BATTERYMODE / debug, batteryMode  
  
stopAllMotors (ev3)  
Sends a stop-command to all motor-ports.  
  
stopTone (ev3)  
Stops tone currently played.
```

Example

```
b = EV3(); % b.connect('bt', 'serPort', '/dev/rfcomm0'); % b.playTone(10,100,1000000000); % Acciden-  
tally given wrong tone duration :) b.stopTone(); % Stops tone immediately.  
  
tonePlayed (ev3)  
Tests if tone is currently played.  
  
Returns status – True if a tone is being played  
  
Return type bool
```

```
Example b = EV3(); % b.connect('bt', 'serPort', '/dev/rfcomm0'); % b.playTone(10, 100, 1000); %  
pause(0.5); % Small pause is necessary as tone does not start instantaneously b.tonePlayed(); % -  
> Outputs 1 to console.
```

1.4 Motor

`class source.Motor (varargin)`

List of methods:

- `start()`
- `stop()`
- `syncedStart()`
- `syncedStop()`
- `waitFor()`
- `internalReset()`
- `resetTachoCount()`
- `setBrake()`
- `setProperties()`

High-level class to work with motors.

This class is supposed to ease the use of the brick's motors. It is possible to set all kinds of parameters, request the current status of the motor ports and of course send commands to the brick to be executed on the respective port.

Notes

- You don't need to create instances of this class. The EV3-class automatically creates instances for each motor port, and you can work with them via the EV3-object.
- The Motor-class represents motor ports, not individual motors!
- If you start a motor with `power=0`, the internal state will still be set to 'isRunning'
- When an input argument of a method is marked as optional, the argument needs to be 'announced' by a preceding 2nd argument, which is a string containing the name of the argument. For example, `Motor.setProperties` may be given a power-parameter. The syntax would be as follows: `brickObject.motorA.setProperties('power', 50);`

power

numeric in [-100, 100] – Power level of motor in percent. [WRITABLE]

speedRegulation

bool – Speed regulation turned on or off. When turned on, motor will try to 'hold' its speed at given power level, whatever the load. In this mode, the highest possible speed depends on the load and mostly goes up to around 70-80 (at this point, the Brick internally inputs 100% power). When turned off, motor will constantly input the same power into the motor. The resulting speed will be somewhat lower, depending on the load. [WRITABLE]

smoothStart

numeric s. t. smoothStart+smoothStop < limitValue – Degrees/Time indicating how far/long the motor should smoothly start. Depending on `limitMode`, the input is interpreted either in degrees or milliseconds. The first {smoothStart}-milliseconds/degrees of `limitValue` the motor will slowly accelerate until reaching its defined speed. See also `limitValue`, `limitMode`. [WRITABLE]

smoothStop

numeric s. t. smoothStart+smoothStop < limitValue – Degrees/Time indicating how far/long the motor should smoothly stop. Depending on limitMode, the input is interpreted either in degrees or milliseconds. The last [smoothStop]-milliseconds/degrees of limitValue the motor will slowly slow down until it has stopped. See also *limitValue*, *limitMode*. [WRITABLE]

limitValue

numeric>=0 – Degrees/Time indicating how far/long the motor should run. Depending on limitMode, the input is interpreted either in degrees or milliseconds. See also *limitMode*. [WRITABLE]

limitMode

'Tacho'|'Time' – Mode for motor limit. See also *limitValue*. [WRITABLE]

brakeMode

'Brake'|'Coast' – Action done when stopping. If 'Coast', the motor will (at tacholimit, if ~=0) coast to a stop. If 'Brake', the motor will stop immediately (at tacholimit, if ~=0) and hold the brake. [WRITABLE]

debug

bool – Debug turned on or off. In debug mode, everytime a command is passed to the sublayer ('communication layer'), there is feedback in the console about what command has been called. [WRITABLE]

isRunning

bool – True if motor is running. [READ-ONLY]

tachoCount

numeric – Current tacho count in degrees. [READ-ONLY]

currentSpeed

numeric – Current speed of motor. If speedRegulation=on this should equal power, otherwise it will probably be lower than that. See also *speedRegulation*. [READ-ONLY]

type

DeviceType – Type of connected device if any. [READ-ONLY]

internalReset (*motor*)

Resets internal tacho count. Use this if motor behaves weird (i.e. not starting at all, or not correctly running to limitValue).

The internal tacho count is used for positioning the motor. When the motor is running with a tacho limit, internally it uses another counter than the one read by tachoCount. This internal tacho count needs to be reset if you physically change the motor's position or it coasted into a stop. If the motor's brakemode is 'Coast', this function is called automatically.

Notes

- A better name would probably be resetPosition...
- Gets called automatically when starting the motor and the internal tacho count is > 0

See also MOTOR.RESETTACHOCOUNT / *resetTachoCount*

resetTachoCount (*motor*)

Resets tachocount.

See also MOTOR.TACHOCOUNT / *tachoCount*

setBrake (*motor*, *brake*)

Apply or release brake of motor.

Parameters **brake** (*bool*) – If true, brake will be pulled

Notes

- This method does not affect `Motor.brakeMode`. After the next run, the motor will again be stopped as specified in `Motor.brakeMode`.

See also `MOTOR.BRAKEMODE` / [*brakeMode*](#)

setProperties (*motor*, *varargin*)

Sets multiple Motor properties at once using MATLAB's `inputParser`.

Parameters

- **debug** (*bool*) – [OPTIONAL]
- **smoothStart** (*numeric in [0, limitValue]*) – [OPTIONAL]
- **smoothStop** (*numeric in [0, limitValue]*) – [OPTIONAL]
- **speedRegulation** (*bool*) – [OPTIONAL]
- **brakeMode** (*'Coast' | 'Brake'*) – [OPTIONAL]
- **limitMode** (*'Time' | 'Tacho'*) – [OPTIONAL]
- **limitValue** (*numeric > 0*) – [OPTIONAL]
- **power** (*numeric in [-100, 100]*) – [OPTIONAL]
- **batteryMode** (*'Voltage' | 'Percentage'*) – [OPTIONAL]

Example

```
b = EV3(); % b.connect('bt', 'serPort', '/dev/rfcomm0'); % b.motorA.setProperties('debug', 'on',
'power', 50, 'limitValue', 720, 'speedRegulation', 'on'); % % Instead of: b.motorA.debug = 'on'; %
b.motorA.power = 50; % b.motorA.limitValue = 720; % b.motorA.speedRegulation = 'on';
```

start (*motor*)

Starts the motor.

stop (*motor*)

Stops the motor.

Notes

- If this motor has been started synced with another one (either as master or slave, using `Motor.syncedStart`), `syncedStop()` will be called, stopping both motors.

See also `MOTOR.START`, `MOTOR.SYNCEDEDSTOP` / [*start\(\)*](#), [*syncedStop\(\)*](#)

syncedStart (*motor*, *syncMotor*, *varargin*)

Starts this motor synchronized with another.

The motor, with which this method is called, acts as a *master*, meaning that the synchronized control is done with it and uses its parameters. When `syncedStart` is called, the master sets some of the slave's (`syncMotor`) properties to keep it consistent with the physical brick. So, for example, if the master has another power-value than the slave, the slave's power-value will be set to that of the master when `syncedStart()` is called. The following parameters will be affected on the slave: *power*, *brakeMode*, *limitValue*, *speedRegulation*

Parameters

- **syncMotor** (*Motor*) – The motor-object to sync with
- **turnRatio** (*numeric in [-200, 200]*) – Ratio between the two master's and the slave's motor speed. With values $\neq 0$ one motor will be slower than the other or even turn into the other direction. This can be used for turning car-like robots, for example. *[OPTIONAL]* (Read in Firmware-comments in `c_output.c`): -> 0 is moving straight forward -> Negative values turn to the left -> Positive values turn to the right -> Value -100 stops the left motor -> Value +100 stops the right motor -> Values less than -100 makes the left motor run the opposite direction of the right motor (Spin) -> Values greater than +100 makes the right motor run the opposite direction of the left motor (Spin)

Notes

- This is a pretty 'heavy' function, as it tests if both motors are connected AND aren't running, wasting four packets, keep that in mind.

Example

```
b = EV3(); % b.connect('usb'); % m = b.motorA; % slave = b.motorB; % m.power = 50; %  
m.syncedStart(slave); % % Do stuff m.stop(); %
```

See also MOTOR.STOP, MOTOR.SYNCEDSTOP / `stop()`, `syncedStop()`

syncedStop (*motor*)

Stops both motors previously started with `syncedStart`.

Notes

- This method is called automatically by `stop()`, if the motors have been started using `syncedStart`, and the regular `stop`-method has been called afterwards.

See also MOTOR.SYNCEDSTART, MOTOR.STOP / `syncedStart()`, `stop()`

waitFor (*motor*)

Stops execution of program as long as motor is running.

Notes

- This one's a bit tricky. The `opCode` which is supposed to be used here, `OutputReady`, makes the brick stop sending responses until the motor has stopped. For security reasons, in this toolbox there is an internal timeout for receiving messages from the brick. It raises an error if a reply takes too long, which would happen in this case. As a workaround, there is an infinite loop that catches errors from `outputReady` and continues then, until `outputReady` will actually finish without an error.
- Workaround: Poll `isRunning` until it is false (No need to check if motor is connected as speed correctly returns 0 if it's not)

1.5 Sensor

```
class source.Sensor (varargin)
```

List of methods:

- `reset()`
- `setProperties()`

High-level class to work with sensors.

The Sensor-class facilitates the communication with sensors. This mainly consists of reading the sensor's type and current value in a specified mode.

Notes

- You don't need to create instances of this class. The EV3-class automatically creates instances for each sensor port, and you can work with them via the EV3-object.
- The Sensor-class represents sensor ports, not individual sensors!
- When an input argument of a method is marked as optional, the argument needs to be 'announced' by a preceding 2nd argument, which is a string containing the name of the argument. For example, `Motor.setProperties` may be given a power-parameter. The syntax would be as follows: `brickObject.motorA.setProperties('power', 50);`

mode

DeviceMode.{Type} – Sensor mode in which the value will be read. By default, mode is set to *DeviceMode.Default.Undefined*. See also *type*. [WRITABLE] Once a physical sensor is connected to the port and the physical Brick is connected to the EV3-object, the allowed mode and the default mode for a Sensor-object are the following (depending on the sensor type):

•Touch-Sensor:

- `DeviceMode.Touch.Pushed` [Default]
- `DeviceMode.Touch.Bumps`

•Ultrasonic-Sensor:

- `DeviceMode.UltraSonic.DistCM` [Default]
- `DeviceMode.UltraSonic.DistIn`
- `DeviceMode.UltraSonic.Listen`

•Color-Sensor:

- `DeviceMode.Color.Reflect` [Default]
- `DeviceMode.Color.Ambient`
- `DeviceMode.Color.Col`

•Gyro-Sensor:

- `DeviceMode.Gyro.Angular` [Default]
- `DeviceMode.Gyro.Rate`

•Infrared-Sensor:

- `DeviceMode.InfraRed.Prox` [Default]
- `DeviceMode.InfraRed.Seek`
- `DeviceMode.InfraRed.Remote`

•**NXTCOLOR-Sensor:**

- DeviceMode.NXTCOLOR.Reflect *[Default]*
- DeviceMode.NXTCOLOR.Ambient
- DeviceMode.NXTCOLOR.Color
- DeviceMode.NXTCOLOR.Green
- DeviceMode.NXTCOLOR.Blue
- DeviceMode.NXTCOLOR.Raw

•**NXTLIGHT-Sensor:**

- DeviceMode.NXTLIGHT.Reflect *[Default]*
- DeviceMode.NXTLIGHT.Ambient

•**NXTSOUND-Sensor:**

- DeviceMode.NXTSOUND.DB *[Default]*
- DeviceMode.NXTSOUND.DBA

•**NXTTEMPERATURE-Sensor**

- DeviceMode.NXTTEMPERATURE.C *[Default]*
- DeviceMode.NXTTEMPERATURE.F

•**NXTTOUCH-Sensor:**

- DeviceMode.NXTTOUCH.Pushed *[Default]*
- DeviceMode.NXTTOUCH.Bumps

•**NXTULTRASONIC-Sensor:**

- DeviceMode.NXTULTRASONIC.CM *[Default]*
- DeviceMode.NXTULTRASONIC.IN

•**HTACCELEROMETER-Sensor:**

- DeviceMode.HTACCELEROMETER.Acceleration *[Default]*
- DeviceMode.HTACCELEROMETER.AccelerationAllAxes

•**HTCOMPASS-Sensor:**

- DeviceMode.HTCOMPASS.Degrees *[Default]*

•**HTCOLOR-Sensor:**

- DeviceMode.HTCOLOR.Col *[Default]*
- DeviceMode.HTCOLOR.Red
- DeviceMode.HTCOLOR.Green
- DeviceMode.HTCOLOR.Blue
- DeviceMode.HTCOLOR.White
- DeviceMode.HTCOLOR.Raw
- DeviceMode.HTCOLOR.Nr,
- DeviceMode.HTCOLOR.All

debug

bool – Debug turned on or off. In debug mode, everytime a command is passed to the sublayer (‘communication layer’), there is feedback in the console about what command has been called. *[WRITABLE]*

value

numeric – Value read from hysical sensor. What the value represents depends on *mode*. *[READ-ONLY]*

type

DeviceType – Type of physical sensor connected to the port. Possible types are: *[READ-ONLY]*

- *DeviceType.NXTTouch*
- *DeviceType.NXTLight*
- *DeviceType.NXTSound*
- *DeviceType.NXTColor*
- *DeviceType.NXTUltraSonic*
- *DeviceType.NXTTemperature*
- *DeviceType.LargeMotor*
- *DeviceType.MediumMotor*
- *DeviceType.Touch*
- *DeviceType.Color*
- *DeviceType.UltraSonic*
- *DeviceType.Gyro*
- *DeviceType.InfraRed*
- *DeviceType.HTColor*
- *DeviceType.HTCompass*
- *DeviceType.HTAccelerometer*
- *DeviceType.Unknown*
- *DeviceType.None*
- *DeviceType.Error*

reset (*sensor*)

Resets sensor value.

Notes

- This clears ALL the sensors right now, no other Op-Code available... :(

setProperties (*sensor*, *varargin*)

Sets multiple Sensor properties at once using MATLAB’s inputParser.

Parameters

- **debug** (*bool*) – *[OPTIONAL]*
- **mode** (*DeviceMode.Type*) – *[OPTIONAL]*

Example

```
b = EV3(); % b.connect('bt', 'serPort', '/dev/rfcomm0'); % b.sensor1.setProperties('debug', 'on', 'mode',  
DeviceMode.Color.Ambient); % % Instead of: b.sensor1.debug = 'on'; % b.sensor1.mode = Device-  
Mode.Color.Ambient;
```

Advanced

1.6 hidapi

class `source.hidapi` (*vendorID*, *productID*, *nReadBuffer*, *nWriteBuffer*)

List of methods:

- `open()`
- `close()`
- `read()`
- `read_timeout()`
- `write()`
- `getHIDInfoString()`
- `setNonBlocking()`
- `init()`
- `exit()`
- `error()`
- `enumerate()`
- `getManufacturersString()`
- `getProductString()`
- `getSerialNumberString()`

Interface to the hidapi library

Notes

- Developed from the hidapi available at <http://www.signal11.us/oss/hidapi/>.
- Windows: hidapi.dll needed.
- Mac: hidapi.dylib needed. In addition, Xcode has to be installed.
- Linux: hidapi has to be compiled on host-system.

handle

vendorID

numeric – Vendor-ID of the USB device.

productID

numeric – Product-ID of the USB device.

nReadBuffer

numeric – Read-buffer size in bytes.

nWriteBuffer

numeric – Write-buffer size in bytes. Needs to be 1 Byte bigger than actual packet.

slib

string – Name of shared library file (without file extension). Defaults to 'hidapi'.

sheader

string – Name of shared library header. Defaults to 'hidapi.h'.

Example

```
hidHandle = hidapi(1684,0005,1024,1025); %|brl
```

close (*hid*)

Close the connection to a hid device.

Throws: InvalidHandle: Handle to USB-device not valid

Notes

- Gets called automatically when deleting the hidapi instance.

2001.Check if pointer is (unexpectedly) already invalidated

enumerate (*hid*, *vendorID*, *productID*)

Enumerates the info about the hid device with the given vendorID and productID and returns a string with the returned hid information.

Parameters

- **vendorID** (*numeric*) – Vendor-ID of the USB device in decimal.
- **productID** (*numeric*) – Product-ID of the USB device in decimal.

Notes

- Using a vendorID and productID of (0,0) will enumerate all connected hid devices.
- MATLAB does not have the hid_device_infoPtr struct so some of the returned information will need to be resized and cast into uint8 or chars.

Enumerate the hid devices

error (*hid*)

Return the hid device error string if a function produced an error.

Throws: InvalidHandle: Handle to USB-device not valid

Notes

- This function must be called explicitly if you think an error was generated from the hid device.

2001. Check if pointer is (unexpectedly) already invalidated

exit (*hid*)

hidapi.exit Exit hidapi

hid.exit() exits the hidapi library.

Throws: CommError: Error during communication with device

Notes: - You should not have to call this function directly.

getHIDInfoString (*hid, info*)

Get the corresponding hid info from the hid device.

Throws: CommError: Error during communication with device InvalidHandle: Handle to USB-device not valid

Notes

- Info is the hid information string.

See also HIDAPI.GETMANUFACTURERSSTRING, HIDAPI.GETPRODUCTSTRING, HIDAPI.GETSERIALNUMBERSTRING.

Read buffer nReadBuffer length

getManufacturersString (*hid*)

Get manufacturers string from hid object using getHIDInfoString.

getProductString (*hid*)

Get product string from hid object using getProductString.

getSerialNumberString (*hid*)

Get serial number from hid object using getSerialNumberString.

init (*hid*)

Initiates the hidapi library.

Throws: CommError: Error during communication with device

Notes

- This is called automatically in the library itself with the open function. You should not have to call this function directly.

open (*hid*)

Open a connection with a hid device

Throws: CommError: Error during communication with device

Notes

- Gets called automatically when creating an hidapi-object.
- The pointer return value from this library call is always null so it is not possible to know if the open was successful.

- The final parameter to the open hidapi library call has different types depending on OS. On windows it is uint16, on linux/mac int32.

Create a null pointer for the hid_open function (depends on OS)

read (*hid*)

Read from a hid device and returns the read bytes.

Throws: CommError: Error during communication with device InvalidHandle: Handle to USB-device not valid

Notes

- Will print an error if no data was read.

Read buffer of nReadBuffer length

read_timeout (*hid, timeOut*)

Read from a hid device with a timeout and return the read bytes.

Parameters **timeOut** (*numeric* ≥ 0) – Milliseconds after which a timeout-error occurs if no packet could be read.

Throws: CommError: Error during communication with device InvalidHandle: Handle to USB-device not valid

Read buffer of nReadBuffer length

setNonBlocking (*hid, nonblock*)

Set the non blocking flag on the hid device connection.

Parameters **nonblock** (*numeric* in $\{0, 1\}$) – 0 disables nonblocking, 1 enables non-blocking

Throws: CommError: Error during communication with device InvalidHandle: Handle to USB-device not valid

2001.Check if pointer is (unexpectedly) already invalidated

write (*hid, wmsg, reportID*)

Write to a hid device.

Throws: CommError: Error during communication with device InvalidHandle: Handle to USB-device not valid

Notes

- Will print an error if there is a mismatch between the buffer size and the reported number of bytes written.

Append a 0 at the front for HID report ID

1.7 usbBrickIO

`class source.usbBrickIO (varargin)`

List of methods:

- `open()`
- `close()`
- `read()`
- `write()`
- `setProperties()`

USB interface between MATLAB and the brick

Notes

- Uses the hid library implementation in `hidapi.m`
- The default parameters should always work when you try to connect to an EV3 brick, so in nearly all use-cases, the constructor does not need any parameters (besides 'debug' eventually).

debug

bool – If true, each open/close/read/write-call will be noted in the console. Defaults to false.

vendorID

numeric – Vendor-ID of the USB device. Defaults to 0x694 (EV3 vendor ID).

productID

numeric – Product-ID of the USB device. Defaults to 0x0005 (EV3 product ID).

nReadBuffer

numeric – Read-buffer size in bytes. Defaults to 1024.

nWriteBuffer

numeric – Write-buffer size in bytes. Needs to be 1 Byte bigger than actual packet. Defaults to 1025 (EV3 USB maximum packet size = 1024).

timeOut

numeric ≥ 0 – Milliseconds after which a timeout-error occurs if no packet could be read. Defaults to 10000.

Examples

```
% Connecting via USB commHandle = usbBrickIO(); % % Connecting via USB with enabled debug output  
commHandle = usbBrickIO('debug', true); %
```

close (brickIO)

Closes the usb connection the brick through the hidapi interface.

open (brickIO)

Opens the usb connection to the brick through the hidapi interface.

read (brickIO)

Reads data from the brick through usb using the hidapi interface and returns the data in uint8 format.

setProperties (*brickIO*, *varargin*)

Sets multiple usbBrickIO properties at once using MATLAB's inputParser.

The syntax is as follows: `commHandle.setProperties('propertyName1', propertyValue1, 'propertyName2', propertyValue2, ...)`. Valid, optional properties are: `debug`, `vendorID`, `productID`, `nReadBuffer`, `nWriteBuffer`, `timeOut`.

See also `USBBRICKIO.DEBUG`, `USBBRICKIO.VENDORID`, `USBBRICKIO.PRODUCTID`, `USBBRICKIO.NREADBUFFER`, `USBBRICKIO.NWRITEBUFFER`, `USBBRICKIO.TIMEOUT`

write (*brickIO*, *wmsg*)

Writes data to the brick through usb using the hidapi interface.

Parameters `wmsg` (*uint8 array*) – Data to be written to the brick via usb

1.8 btBrickIO

`class source.btBrickIO` (*varargin*)

List of methods:

- `open()`
- `close()`
- `read()`
- `write()`
- `setProperties()`

Bluetooth interface between MATLAB and the brick

Notes

- Connects to the bluetooth module on the host through a serial connection. Hence be sure that a serial connection to the bluetooth module can be made. Also be sure that the bluetooth module has been paired to the brick before trying to connect.
- **Usage is OS-dependent:**
 - Windows: the `deviceName`- & `channel`-properties are needed for connection. The implementation is based on the Instrument Control toolbox.
 - Linux (and potentially Mac): `serialPort`-property is needed for connection. The implementation is based on MATLAB's serial port implementation.
- For general information, see also `BrickIO`.

debug

bool – If true, each open/close/read/write-call will be shown in the console. Defaults to false.

serialPort

string – Path to the serial-port object. Only needed when using MATLAB's serial class (i.e. on linux/mac). Defaults to `'/dev/rfcomm0'`.

deviceName

string – Name of the BT-device = the brick. Only needed when using the Instrument Control toolbox (i.e. on windows). Defaults to `'EV3'`.

channel

numeric > 0 – BT-channel of the connected BT-device. Only needed when using the Instrument Control toolbox (i.e. on windows). Defaults to 1.

timeOut

numeric >= 0 – seconds after which a timeout-error occurs if no packet could be read. Defaults to 10.

backend

'serial' | 'instrumentControl' – Backend this implementation is based on. Is automatically chosen depending on the OS. Defaults to *'serial'* on linux/mac systems, and to *'instrumentControl'* on windows systems.

Examples

```
% Connecting on windows commHandle = btBrickIO('deviceName', 'MyEV3', 'channel', 1); % % Connecting on windows using MATLABs default serial port implementation for testing commHandle = btBrickIO('deviceName', 'MyEV3', 'channel', 1, 'backend', 'serial'); % % Connecting on mac/linux commHandle = btBrickIO('serPort', '/dev/rfcomm0');
```

close (*brickIO*)

Closes the bluetooth connection the brick using fclose.

open (*brickIO*)

Opens the bluetooth connection to the brick using fopen.

read (*brickIO*)

Reads data from the brick through bluetooth via fread and returns the data in uint8 format.

setProperties (*brickIO*, *varargin*)

Sets multiple btBrickIO properties at once using MATLAB's inputParser.

The syntax is as follows: `commHandle.setProperties('propertyName1', propertyValue1, 'propertyName2', propertyValue2, ...)`. Valid, optional properties are: `debug`, `serPort`, `deviceName`, `channel`, `timeOut`.

See also `BTBRICKIO.DEBUG`, `BTBRICKIO.SERIALPORT`, `BTBRICKIO.DEVICENAME`, `BTBRICKIO.CHANNEL`, `BTBRICKIO.TIMEOUT`

write (*brickIO*, *wmsg*)

Writes data to the brick through bluetooth via fwrite.

Parameters *wmsg* (*uint8 array*) – Data to be written to the brick via bluetooth

S

source, [17](#)

B

backend (source.btBrickIO attribute), 20
 batteryMode (source.EV3 attribute), 4
 batteryValue (source.EV3 attribute), 4
 beep() (source.EV3 method), 5
 brakeMode (source.Motor attribute), 8
 btBrickIO (class in source), 19

C

channel (source.btBrickIO attribute), 19
 close() (source.btBrickIO method), 20
 close() (source.hidapi method), 15
 close() (source.usbBrickIO method), 18
 connect() (source.EV3 method), 5
 currentSpeed (source.Motor attribute), 8

D

debug (source.btBrickIO attribute), 19
 debug (source.EV3 attribute), 4
 debug (source.Motor attribute), 8
 debug (source.Sensor attribute), 12
 debug (source.usbBrickIO attribute), 18
 deviceName (source.btBrickIO attribute), 19
 disconnect() (source.EV3 method), 5

E

enumerate() (source.hidapi method), 15
 error() (source.hidapi method), 15
 EV3 (class in source), 3
 exit() (source.hidapi method), 16

G

getHIDInfoString() (source.hidapi method), 16
 getManufacturersString() (source.hidapi method), 16
 getProductString() (source.hidapi method), 16
 getSerialNumberString() (source.hidapi method), 16

H

handle (source.hidapi attribute), 14
 hidapi (class in source), 14

I

init() (source.hidapi method), 16
 internalReset() (source.Motor method), 8
 isConnected (source.EV3 attribute), 5
 isRunning (source.Motor attribute), 8

L

limitMode (source.Motor attribute), 8
 limitValue (source.Motor attribute), 8

M

mode (source.Sensor attribute), 11
 Motor (class in source), 7
 motorA (source.EV3 attribute), 4
 motorB (source.EV3 attribute), 4
 motorC (source.EV3 attribute), 4
 motorD (source.EV3 attribute), 4

N

nReadBuffer (source.hidapi attribute), 14
 nReadBuffer (source.usbBrickIO attribute), 18
 nWriteBuffer (source.hidapi attribute), 15
 nWriteBuffer (source.usbBrickIO attribute), 18

O

open() (source.btBrickIO method), 20
 open() (source.hidapi method), 16
 open() (source.usbBrickIO method), 18

P

playTone() (source.EV3 method), 6
 power (source.Motor attribute), 7
 productID (source.hidapi attribute), 14
 productID (source.usbBrickIO attribute), 18

R

read() (source.btBrickIO method), 20
 read() (source.hidapi method), 17
 read() (source.usbBrickIO method), 18
 read_timeout() (source.hidapi method), 17
 reset() (source.Sensor method), 13
 resetTachoCount() (source.Motor method), 8

S

Sensor (class in source), [10](#)
sensor1 (source.EV3 attribute), [4](#)
sensor2 (source.EV3 attribute), [4](#)
sensor3 (source.EV3 attribute), [4](#)
sensor4 (source.EV3 attribute), [4](#)
serialPort (source.btBrickIO attribute), [19](#)
setBrake() (source.Motor method), [8](#)
setNonBlocking() (source.hidapi method), [17](#)
setProperties() (source.btBrickIO method), [20](#)
setProperties() (source.EV3 method), [6](#)
setProperties() (source.Motor method), [9](#)
setProperties() (source.Sensor method), [13](#)
setProperties() (source.usbBrickIO method), [18](#)
sheader (source.hidapi attribute), [15](#)
slib (source.hidapi attribute), [15](#)
smoothStart (source.Motor attribute), [7](#)
smoothStop (source.Motor attribute), [7](#)
source (module), [3](#), [6](#), [10](#), [14](#), [17](#), [19](#)
speedRegulation (source.Motor attribute), [7](#)
start() (source.Motor method), [9](#)
stop() (source.Motor method), [9](#)
stopAllMotors() (source.EV3 method), [6](#)
stopTone() (source.EV3 method), [6](#)
syncedStart() (source.Motor method), [9](#)
syncedStop() (source.Motor method), [10](#)

T

tachoCount (source.Motor attribute), [8](#)
timeOut (source.btBrickIO attribute), [20](#)
timeOut (source.usbBrickIO attribute), [18](#)
tonePlayed() (source.EV3 method), [6](#)
type (source.Motor attribute), [8](#)
type (source.Sensor attribute), [13](#)

U

usbBrickIO (class in source), [18](#)

V

value (source.Sensor attribute), [13](#)
vendorID (source.hidapi attribute), [14](#)
vendorID (source.usbBrickIO attribute), [18](#)

W

waitFor() (source.Motor method), [10](#)
write() (source.btBrickIO method), [20](#)
write() (source.hidapi method), [17](#)
write() (source.usbBrickIO method), [19](#)