Guidance SDK API

API Specifications

2015/8/4

This document describes the Guidance SDK API framework for Guidance system.

Revisions History

Revision	Date	Modifications
1.0.0	2015/8/4	Create

Table of Content

1 Background

This guide assumes that you have

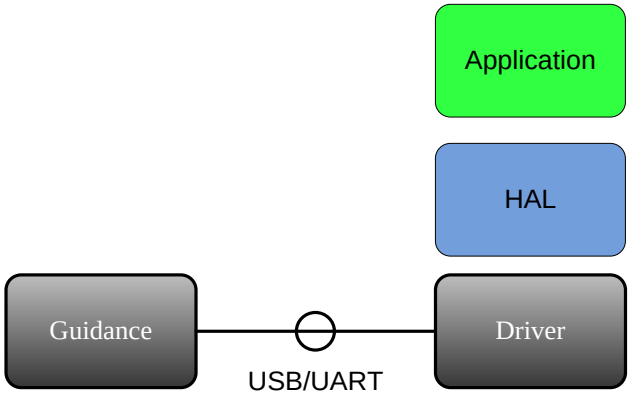
- a Guidance system,
- a computer with OpenCV installed,

and you are:

- familiar with Linux programming,
- or familiar with Windows programming and Microsoft Visual Studio.

2 Introduction

This section introduces the structure of the Guidance SDK. The SDK is divided into three layers:



- **Application:** This layer processes data from the HAL layer. It is written by developers.
- **HAL:** This layer packs/parses the data to/from the Driver layer. It is implemented by the sample code (for UART) or SDK library (for USB), e.g. *libDJI_guidance.so*.
- **Driver:** This layer receives data from the Guidance system through USB/UART. It is implemented by OS or 3rd party libraries, e.g. *libusb*.

2.1 Interface

The Guidance SDK supports two communication protocols: USB&UART.

2.1.1 USB

The supported data types are Velocity Data, Obstacle Distance Data, IMU Data, Ultrasonic Data, Greyscale Image, and Depth Image.

There are two ways to subscribe the data through USB.

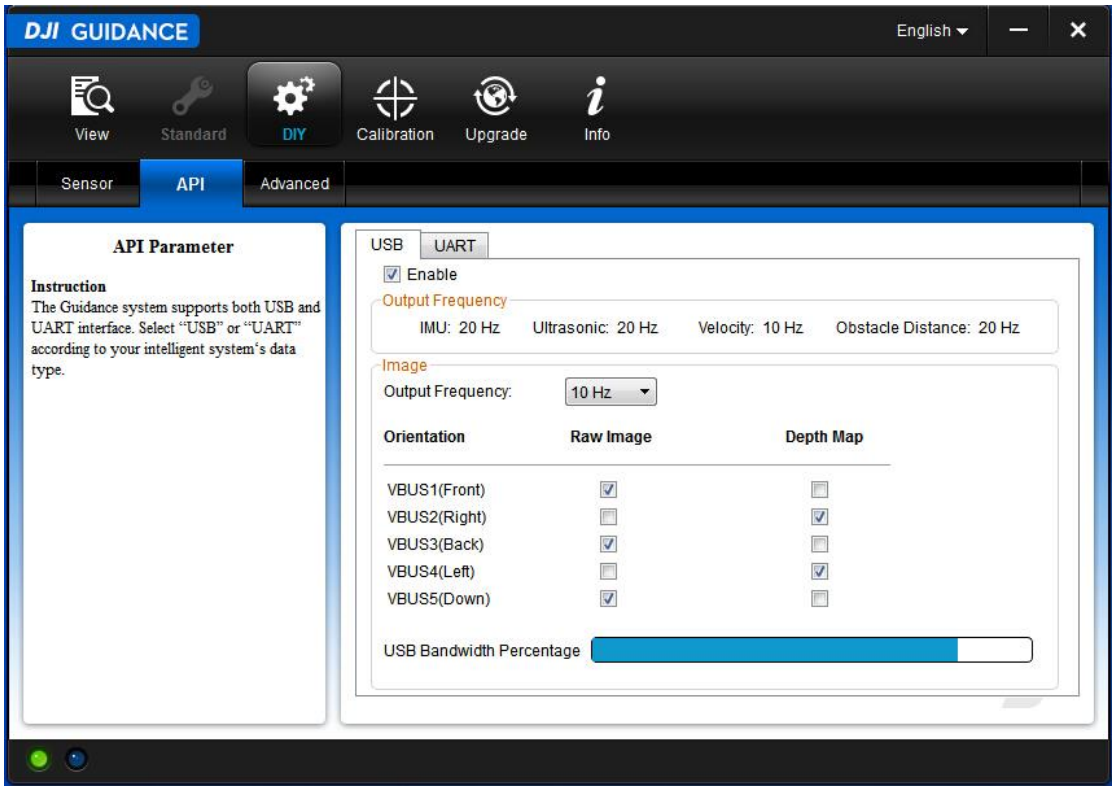
1. Guidance Assistant Software

   User can use Guidance assistant software to subscribe the data in "DIY→API→USB" tab.

   - Connect Guidance with PC using USB cable, power on the Guidance

- Choose the “Enable” check box
- Choose the data according your requirement

Notes: The available bandwidth is subject to the selection of image data and the output frequency. The selection of subscribed image data and output frequency will be saved and take effect when the Guidance system is turned off and on again.



2. Guidance API

User can subscribe the data using Guidance API. Identity these API functions that are named with “select”.

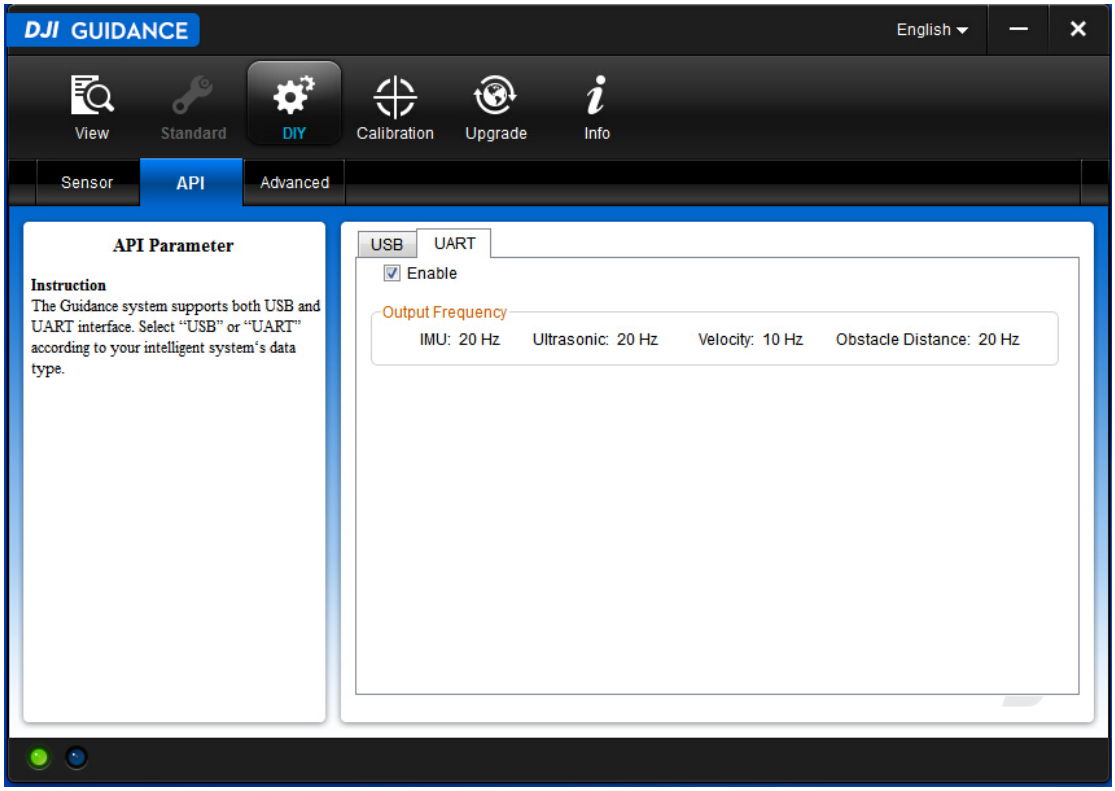
Notes: If user subscribes the image data and output frequency using Guidance API functions, it will only temporarily override the data selection that is made in the Guidance Assistant software when the Guidance system is still powered on. However, the data selection that is made through the Guidance API will not permanently change the data subsections options stored in the Guidance system, unless you de-select the “Enable” option in the “USB” tab.

2.1.2 UART

The supported data types are Velocity Data, Obstacle Distance Data, IMU Data, and Ultrasonic Data.

1. Subscribe Data

You may only use Guidance assistant software to subscribe UART data. Enable this selection from “DIY→API→UART” page. Same as USB, the configuration will be saved in Guidance Core, unless you de-select the “Enable” option in the “UART” tab.



2. Protocol Description

Protocol Frame Format:

SOF	LEN	VER	RES	SEQ	CRC16	DATA	CRC32

Protocol Frame Explanation:

Field	Byte Index	Size（bit）	Description
SOF	0	8	Frame start number, fixed to be 0xAA
LEN	1	10	Frame length, maximum length is 1023 bytes
VER	1	6	Version of the protocol
RES	5	40	Reserved bits, fixed to be 0

SEQ	8	16	Frame sequence number
CRC16	10	16	Frame header CRC16 checksum
DATA	12	--①	Frame data, maximum length 1007bytes
CRC32	--②	32	Frame CRC32checksum

① ： Frame data size can vary, 1007 is the maximum length.

② ： The index of this field depends on the length of the data field.

Data Field Format:

COMMAND SET	COMMAND ID	COMMAND DATA

Data Field Explanation:

Data Field	Byte Index	Size（byte）	Description
COMMAND SET	0	1	Always 0x00
COMMAND ID	1	1	e_image: 0x00 e_imu: 0x01 e_ultrasonic: 0x02 e_velocity: 0x03 e_obstacle_distance: 0x04
COMMAND DATA	2	--	Data body

2.2 Data Types

Each of the supported data types is described below.

- **Velocity Data:** Outputs velocity information. The unit is **millimeter/second** and the frequency is 20 Hz.

- **Obstacle Distance Data:** Outputs obstacle distance for five directions. The unit is **centimeter** and the frequency is 20 Hz.
- **IMU Data:** Outputs IMU data, including accelerometer (in unit of meter/second) and attitude (in quaternion format) data. The frequency is 20 Hz.
- **Ultrasonic Data:** Outputs ultrasonic data for five directions, including obstacle distance (in unit of meter) and reliability of the data. The frequency is 20 Hz.
- **Greyscale Image:** Outputs Greyscale images for five directions. The image size is 320*240 bytes for individual sensor. The default frequency is 20 Hz and can be scaled down using Guidance API.
- **Depth Image:** Outputs depth images for five directions. The image size is 320*240*2 bytes for each direction. The default frequency is 20 Hz and can be scaled down using Guidance API.

  Notes: In order to achieve best performance, it is suggested that large data (e.g. images) be copied instead of processing the data in-place, if the received data will be processed for a long time.

3 Getting Started

Guidance SDK have provided examples to get data from Guidance system. This section guides you how to execute these examples.

3.1 Run USB example in Linux

1. **Setup the environment.**

   The Guidance SDK use *libusb-1.0* library to read data from Guidance system. Please reference *http://www.libusb.org* to compile and install the *libusb-1.0* library.

2. **Copy related files.**

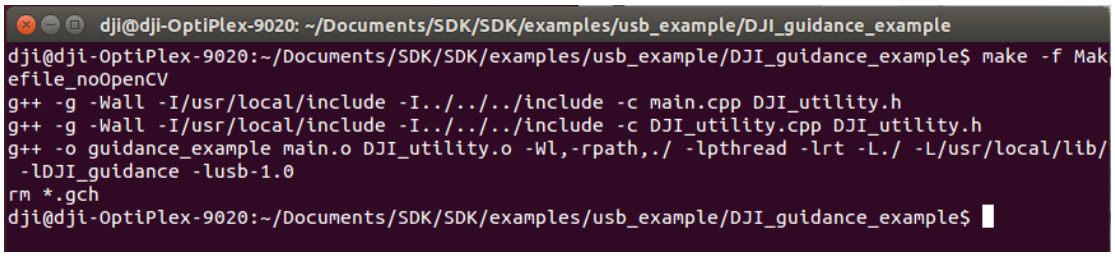
   Makefiles are provided and tested. The user does not need to change anything to run the example code.

   To use Guidance in their own projects, the user can follow the instructions below:

- Copy *libDJI_guidance.so* to "library file path" of your project.
- Copy *DJI_guidance.h* to "header file path".
- Add the library in the Makefile of your project as shown below.

```
LDFLAGS = -Wl,-rpath,./ -lpthread -lrt -L./ -L/usr/local/lib/ -lDJI_guidance -lusb-1.0
```

3. **Compile the example project.**



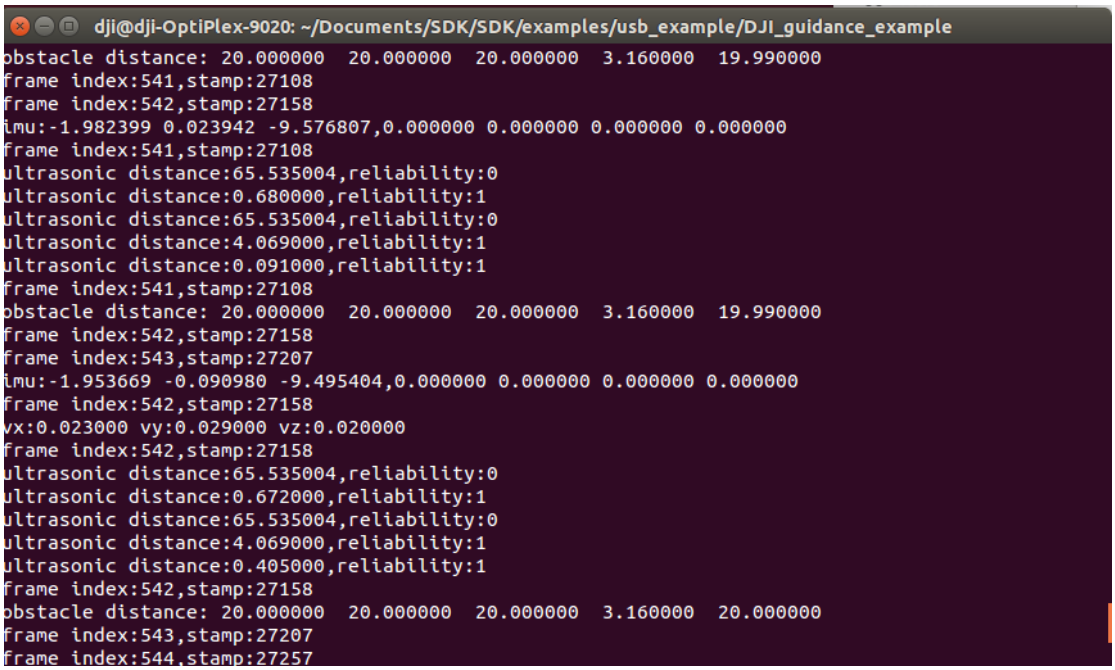
Note: The default makefile assumes you don't have OpenCV installed and uses *Makefile_noOpenCV*. You can specify the makefile during make according to your own case. For example if you have OpenCV installed, use the other makefile:

```
$ make –f Makefile
```

4. **Connect Guidance via USB and run.**

You need root permission to run this example:

```
$ sudo ./guidance_example
```



3.2 Run USB example in Windows

1. **Setup the environment.**

The Guidance SDK uses the *libusb* library to read data from Guidance system. Please make sure the Guidance Assistant Software is installed properly which includes DJI USB driver.

2. **Configure Visual Studio.**

Solutions for different versions of Visual Studio are provided and tested. The user do not need to change anything to run the example code.

To use Guidance in their own projects, it is suggested to use the property sheets provided in the examples\usb_example folder. The user only needs to change the directories of header and library files.

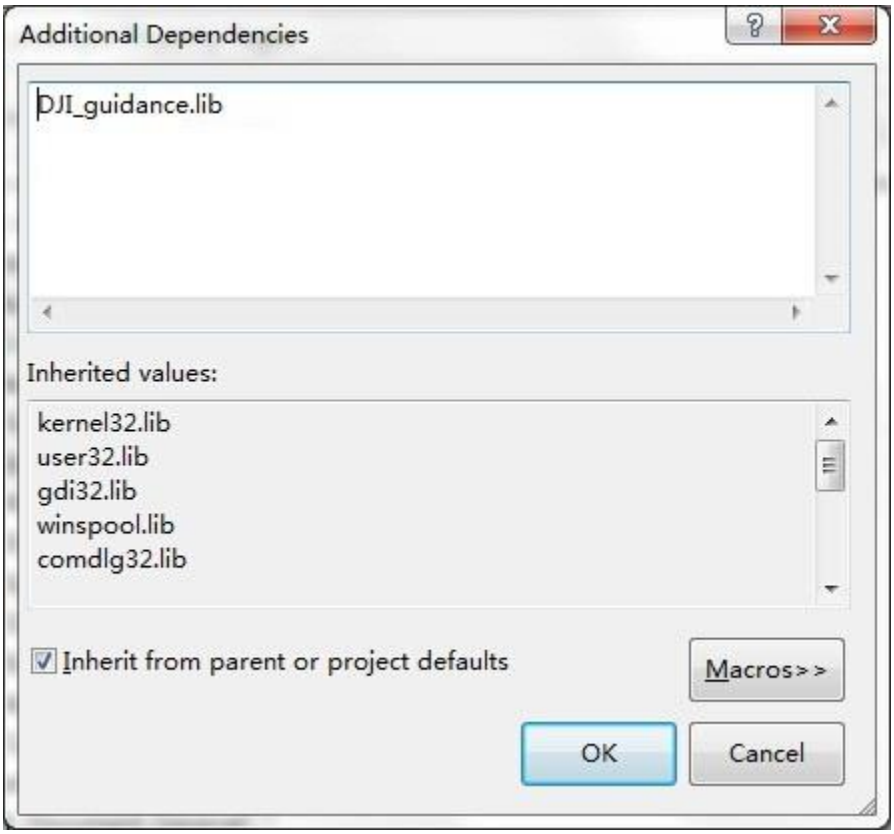
```
<?xml version="1.0" encoding="utf-8"?>
<Project ToolsVersion="4.0" xmlns="http://schemas.microsoft.com/developer/msbuild/2003">
  <ImportGroup Label="PropertySheets" />
  <PropertyGroup Label="UserMacros" />
  <PropertyGroup />
```

```
  <ItemDefinitionGroup>
    <ClCompile>

<AdditionalIncludeDirectories>$(SolutionDir)..\..\include; %(AdditionalIncludeDirectories);</AdditionalIncludeDirectories>
      <AdditionalOptions>/DWIN32 %(AdditionalOptions)</AdditionalOptions>
    </ClCompile>
    <Link>
<AdditionalLibraryDirectories>$(SolutionDir)..\..\lib\2010\x86;%(AdditionalLibraryDirectories);</AdditionalLibraryDirectories>
<AdditionalDependencies>DJI_guidance.lib;%(AdditionalDependencies)</AdditionalDependencies>
    </Link>
  </ItemDefinitionGroup>
  <ItemGroup />
</Project>
```

Alternatively, the user can directly copy the files and configure Visual Studio as follows:

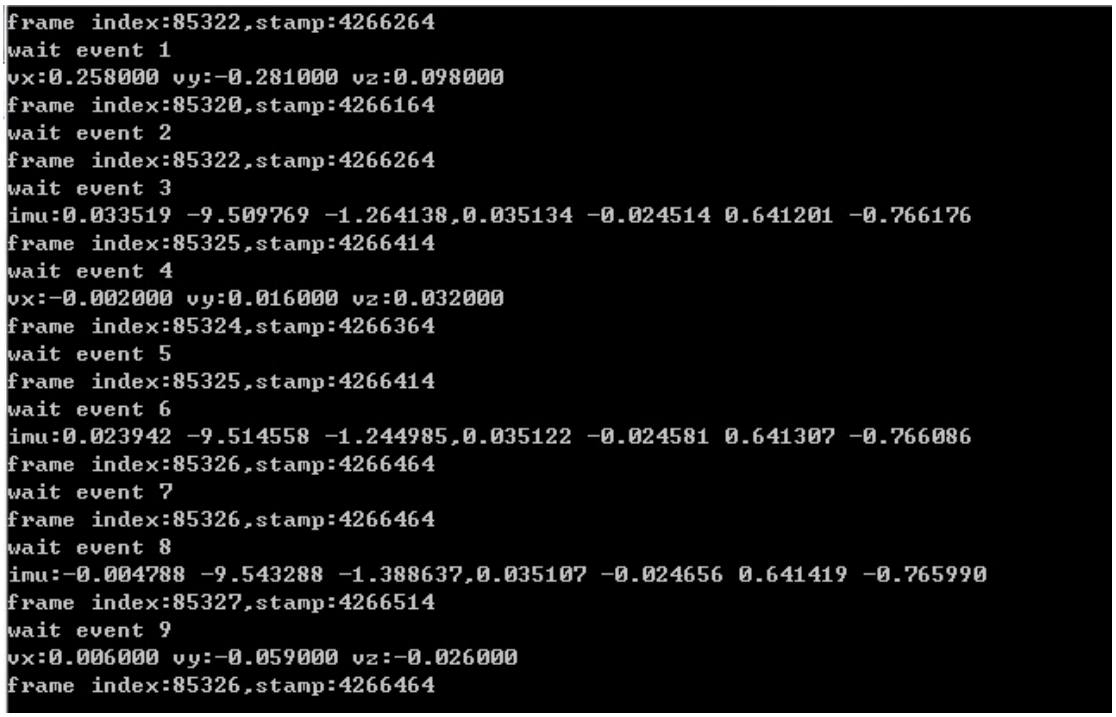
- Copy *DJI_guidance.dll* and *DJI_guidance.lib* to "library file path" of your project.
- Copy *DJI_guidance.h* to "header file path".
- Add *DJI_guidance.lib* to your Visual Studio project's additional dependencies.



3. **Compile the example project.**

   Compile the example project using Microsoft Visual Studio.

4. **Connect the Guidance system for testing.**

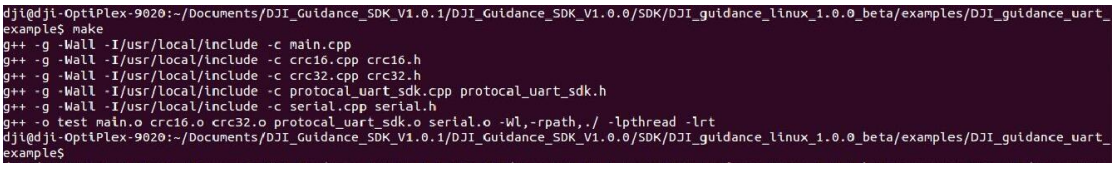


3.3 Run UART example in Linux

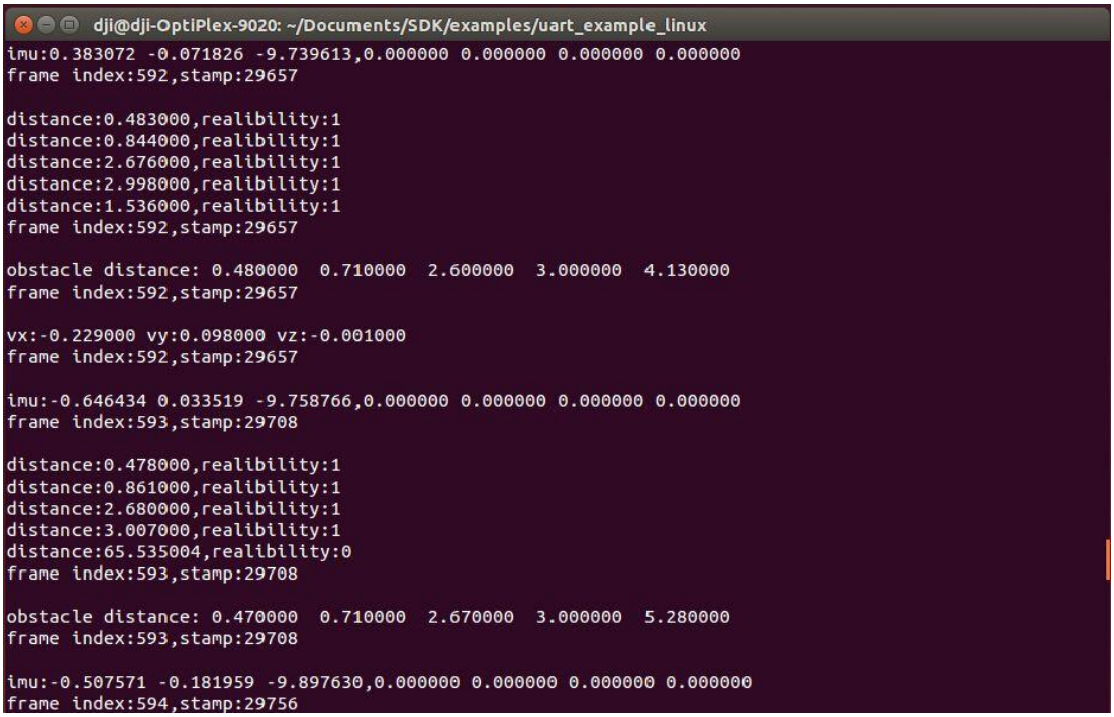
1. **Subscribe UART data.**

   Please reference Section 2.1.2 to subscribe the UART data.

2. **Compile the example project.**



3. **Connect the Guidance system for testing.**



3.4 Run UART example in Windows

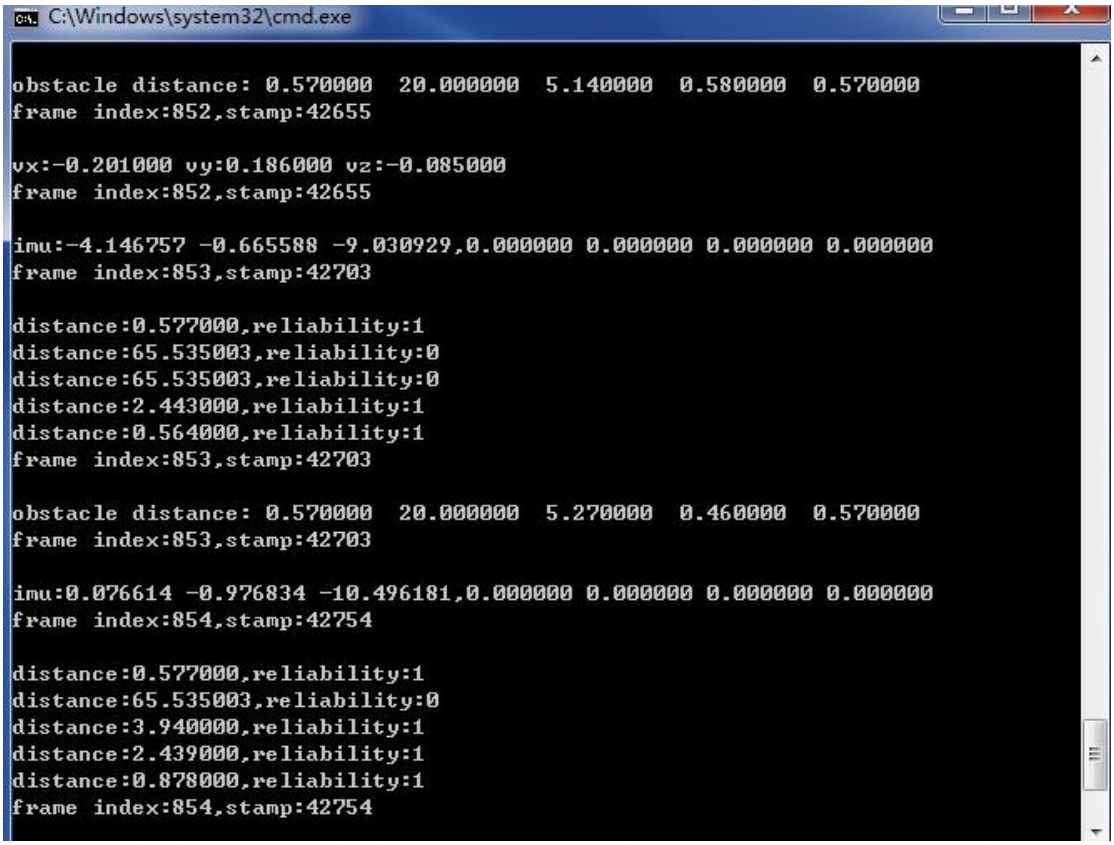
1. **Subscribe UART data.**

   Please reference Section 2.1.2 to subscribe the UART data.

2. **Compile the example project.**

   Compile the example project using Microsoft Visual Studio.

3. **Connect the Guidance system for testing.**


C:\Windows\system32\cmd.exe
obstacle distance: 0.570000 20.000000 5.140000 0.580000 0.570000
frame index:852,stamp:42655
vx:-0.201000 vy:0.186000 vz:-0.085000
frame index:852,stamp:42655
imu:-4.146757 -0.665588 -9.030929,0.000000 0.000000 0.000000 0.000000
frame index:853,stamp:42703
distance:0.577000,reliability:1
distance:65.535003,reliability:0
distance:65.535003,reliability:0
distance:2.443000,reliability:1
distance:0.564000,reliability:1
frame index:853,stamp:42703
obstacle distance: 0.570000 20.000000 5.270000 0.460000 0.570000
frame index:853,stamp:42703
imu:0.076614 -0.976834 -10.496181,0.000000 0.000000 0.000000 0.000000
frame index:854,stamp:42754
distance:0.577000,reliability:1
distance:65.535003,reliability:0
distance:3.940000,reliability:1
distance:2.439000,reliability:1
distance:0.878000,reliability:1
frame index:854,stamp:42754

4 Data Structures

e_sdk_err_code

Description: Define error code of SDK.

```
enum e_sdk_err_code
{
    e_sdk_no_err = 0,
    e_load_libusb_err,
    e_sdk_not_inited,                // SDK software is not ready
    e_guidance_hardware_not_ready,  // Guidance hardware is not ready
    e_disparity_not_allowed,        // if work type is standard,
disparity is not allowed to be selected
    e_image_frequency_not_allowed, // image frequency must be one of
the enum type e_image_data_frequecy
    e_config_not_ready,             // get config including the work
type flag, before you can select data
    e_online_flag_not_ready, // online flag is not ready
    e_max_sdk_err = 100
};
```

e_vbus_index

Description: Define logical direction of vbus, i.e. the pair camera selected.

```
enum e_vbus_index
{
    e_vbus1 = 1,        // logic direction of vbus
    e_vbus2 = 2,        // logic direction of vbus
    e_vbus3 = 3,        // logic direction of vbus
    e_vbus4 = 4,        // logic direction of vbus
    e_vbus5 = 0        // logic direction of vbus
};
```

---

e_image_data_frequecy

Description: Define frequency of image data.

```
enum e_image_data_frequecy
{
```

```
    e_frequecy_5  = 0,  // frequecy of image data
    e_frequecy_10 = 1,  // frequecy of image data
    e_frequecy_20 = 2   // frequecy of image data
};
```

---

user_callback

Description: Call back function prototype.

Parameters: `event_type` use it to identify the data type: image, imu, ultrasonic, velocity or obstacle distance; `data_len` length of the input data; `data` input data read from GUIDANCE

Return: `error code.` Non-zero if error occurs

```
typedef int (*user_call_back)( int event_type, int data_len, char
*data );
```

---

e_guidance_event

Description: Define event type of callback.

```
enum e_guidance_event
{
    e_image = 0,          // called back when image comes
    e_imu,                // called back when imu comes
    e_ultrasonic,         // called back when ultrasonic comes
    e_velocity,           // called back when velocity data comes
    e_obstacle_distance,  // called back when obstacle data comes
    e_event_num
};
```

---

image_data

Description: Define image data structure.

```
typedef struct _image_data
{
    unsigned int     frame_index;   // frame index
    unsigned int     time_stamp;    // time stamp of image captured in
ms
```

```
    char     *m_greyscale_image_left[CAMERA_PAIR_NUM];   // greyscale
image of left camera
    char     *m_greyscale_image_right[CAMERA_PAIR_NUM];  // greyscale
image of right camera
    char     *m_depth_image[CAMERA_PAIR_NUM];   // depth image
}image_data;
```

---

ultrasonic_data

Description: Define ultrasonic data structure.

```
typedef struct _ultrasonic_data
{
    unsigned int     frame_index;   // corresponse frame index
    unsigned int     time_stamp;     // time stamp of corresponse image
captured in ms
    unsigned short   ultrasonic[CAMERA_PAIR_NUM];    // distance
    unsigned short   reliability[CAMERA_PAIR_NUM];   // reliability of
the distance data
}ultrasonic_data;
```

---

velocity

Description: Define velocity structure.

```
typedef struct _velocity
{
    unsigned int     frame_index;       // corresponse frame index
    unsigned int     time_stamp;        // time stamp of corresponse
image captured in ms
    short          vx;                  // velocity of x
    short          vy;                  // velocity of y
    short          vz;                  // velocity of z
}velocity;
```

---

obstacle_distance

Description: Define obstacle distance structure.

```
typedef struct _obstacle_distance
{
```

```
    unsigned int     frame_index;       // corresponse frame index
    unsigned int     time_stamp;        // time stamp of corresponse
image captured in ms
    unsigned short   distance[CAMERA_PAIR_NUM];     // distance of
obstacle
}obstacle_distance;
```

---

imu

Description: Define imu structure.

```
typedef struct _imu
{
    unsigned int     frame_index;            // corresponse frame index
    unsigned int     time_stamp;             // time stamp of
corresponse image captured in ms
    float            acc_x;                 // acceleration of x
    float            acc_y;                 // acceleration of y
    float            acc_z;                 // acceleration of z
    float            q[4];                  // attitude data
}imu;
```

---

5 API

Overview

The GUIDANCE API provides configuration and control methods for GUIDANCE with C interface.

Here is an overview of the key methods available in this API:

```
// Guidance initialization
SDK_API int reset_config( void );
SDK_API int init_transfer( void );

// Guidance subscribe data
SDK_API void select_imu( void );
SDK_API void select_ultrasonic( void );
SDK_API void select_velocity( void );
SDK_API void select_obstacle_distance( void );
SDK_API int set_image_frequecy( e_image_data_frequecy frequecy );
SDK_API int select_depth_image( e_vbus_index camera_pair_index );
SDK_API int select_greyscale_image( e_vbus_index camera_pair_index,
bool is_left );

// Guidance set event
SDK_API int set_sdk_event_handler( user_call_back handler );

// Guidance transfer control
SDK_API int start_transfer( void );
SDK_API int stop_transfer( void );
SDK_API int release_transfer( void );

// Guidance get status
SDK_API int get_online_status( int online_status[CAMERA_PAIR_NUM] );
```

Method

---

reset_config

Description: Clear the subscribed configure, if you want to subscribe the different data from last time.

Parameters: `NULL`

Return: `error code.` Non-zero if error occurs

```
SDK_API int reset_config ( void );
```

---

init_transfer

Description: Initialize the GUIDANCE and connect it to PC.

Parameters: `NULL`

Return: `error code.` Non-zero if error occurs

```
SDK_API int init_transfer ( void );
```

---

select_imu

Description: Subscribe to imu.

Parameters: `NULL`

Return: `NULL`

```
SDK_API void select_imu ( void );
```

---

select_ultrasonic

Description: Subscribe to ultrasonic.

Parameters: `NULL`

Return: `NULL`

```
SDK_API void select_ultrasonic ( void );
```

---

select_velocity

Description: Subscribe to velocity data, i.e. velocity of GUIDANCE in body coordinate system.

Parameters: `NULL`

Return: `NULL`

```
SDK_API void select_velocity ( void );
```

---

select_obstacle_distance

Description: Subscribe to obstacle distance, i.e. distance from obstacle.

Parameters: `NULL`

Return: `NULL`

```
SDK_API void select_obstacle_distance ( void );
```

---

set_image_frequecy

Description: Set frequency of image transfer.

(p.s. As the bandwidth of USB is limited, if you subscribe too much images (greyscale image or depth image), the frequency should be relatively small, otherwise the SDK cannot guarantee the continuity of image transfer.)

Parameters: `frequency` is the frequency of image transfer

Return: `error code.` Non-zero if error occurs

```
SDK_API int set_image_frequecy ( e_image_data_frequecy frequecy );
```

---

select_depth_image

Description: Subscribe to depth image data.

Parameters: `camera_pair_index` index of camera pair selected

Return: `error code.` Non-zero if error occurs

```
SDK_API int select_depth_image ( e_vbus_index camera_pair_index );
```

---

select_greyscale_image

Description: Subscribe to rectified grey image data.

Parameters: `camera_pair_index` index of camera pair selected; `is_left` whether the image data selected is left

Return: `error code.` Non-zero if error occurs

```
SDK_API int select_greyscale_image ( e_vbus_index camera_pair_index,

bool is_left );
```

---

set_sdk_event_handler

Description: Set callback, when data from GUIDANCE comes, it will be called by transfer thread.

Parameters: `handler` pointer to callback function.

Return: `error code.` Non-zero if error occurs

```
SDK_API int set_sdk_event_handler ( user_call_back handler );
```

---

start_transfer

Description: Send message to GUIDANCE to start data transfer.

Parameters: `NULL` .

Return: `error code.` Non-zero if error occurs

```
SDK_API int start_transfer ( void );
```

---

stop_transfer

Description: Send message to GUIDANCE to stop data transfer.

Parameters: `NULL` .

Return: `error code.` Non-zero if error occurs

```
SDK_API int stop_transfer ( void );
```

---

release_transfer

Description: Release the data transfer thread.

Parameters: `NULL` .

Return: `error code.` Non-zero if error occurs

```
SDK_API int release_transfer ( void );
```

---

get_online_status

Description: Get the online status of GUIDANCE sensors.

Parameters: `online_status[CAMERA_PAIR_NUM]` online status of GUIDANCE sensors

Return: `error code.` Non-zero if error occurs

```
SDK_API int get_online_status (int online_status[CAMERA_PAIR_NUM] );
```

Notes: These are only used for USB transfer type. Please reference the protocol of Section 2.1.2 when using UART transfer type.