Quick guide for UAV collision avoidance: lateral, above and below

Table of contents

Introduction

The objective of this quick guide is to explain how to implement full drone collision avoidance using Terabee sensors in Pixhawk platforms with Ardupilot autopilot (copter).

Our solutions can be configured to provide 360° lateral collision protection as well as obstacle detection above and below the drone. This can be particularly useful for drone navigation indoors or in confined spaces such as in tunnels, sewage systems or under bridges.

In order to implement automated collision avoidance with our sensors, they need to use the Ardupilot stack. Please refer to Ardupilot Wiki for updates and more detailed information: https://ardupilot.org/copter/docs/common-simple-object-avoidance.html

Section 1 explains how to use Terabee's standard Tower array to connect to Pixhawk platforms, and the parameters needed to activate the Ardupilot control avoidance law.

Section 2 explains how to build your own collision avoidance array.

TeraRanger Tower Evo 60m enables peripheral collision detection using the collision avoidance law from Ardupilot. The following link shows how to connect this sensor to Pixhawk:
https://www.terabee.com/connection-to-pixhawk-autopilots-teraranger-tower-evo/
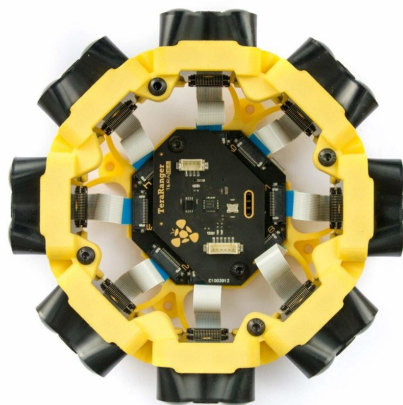
Evo Tower

The altimeter and ceiling detect is achieved thanks to our Evo sensor family (Evo 60m, 40m, 15m, 3m) with the I2C/UART backboard. The following link shows how to connect these sensors to Pixhawk:
https://www.youtube.com/watch?v=rV8i9hRYtyQ&t=165s
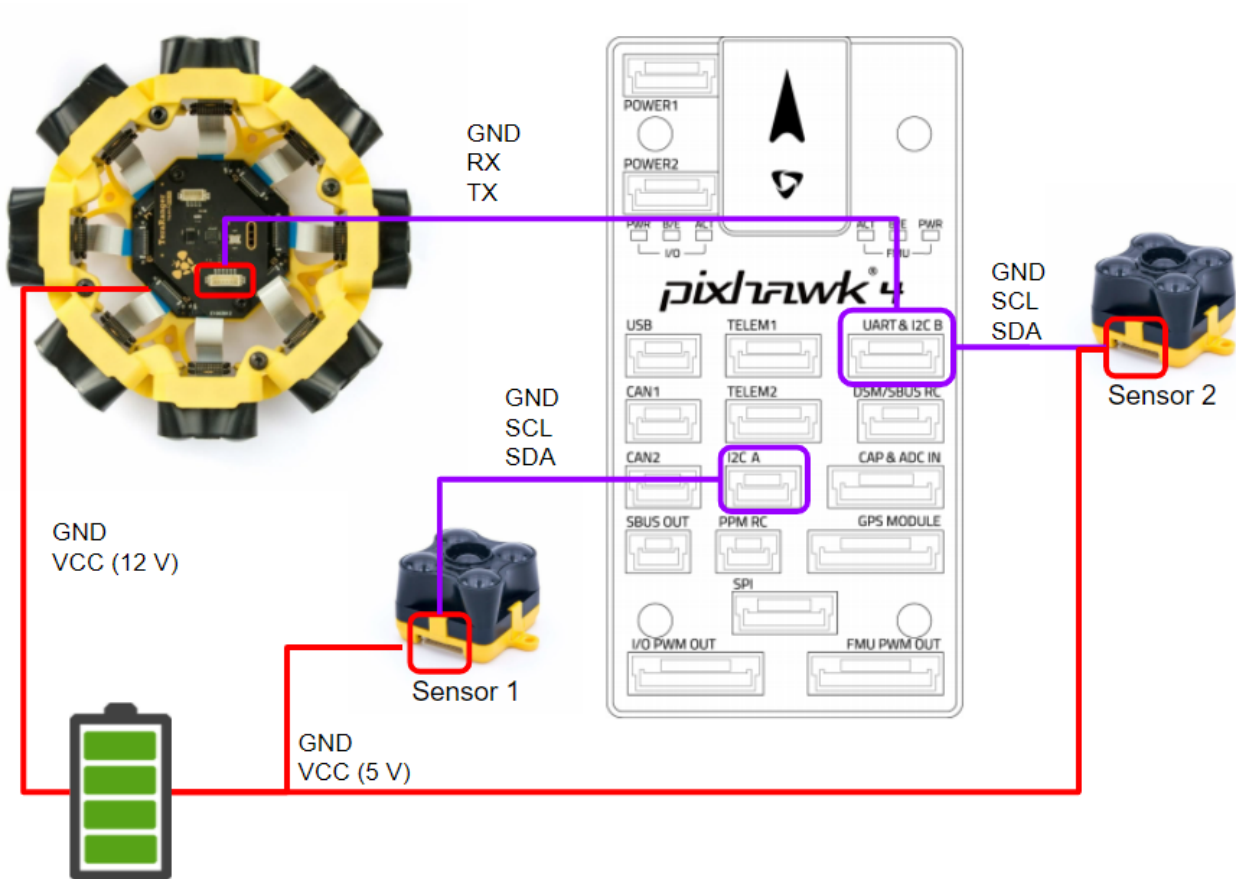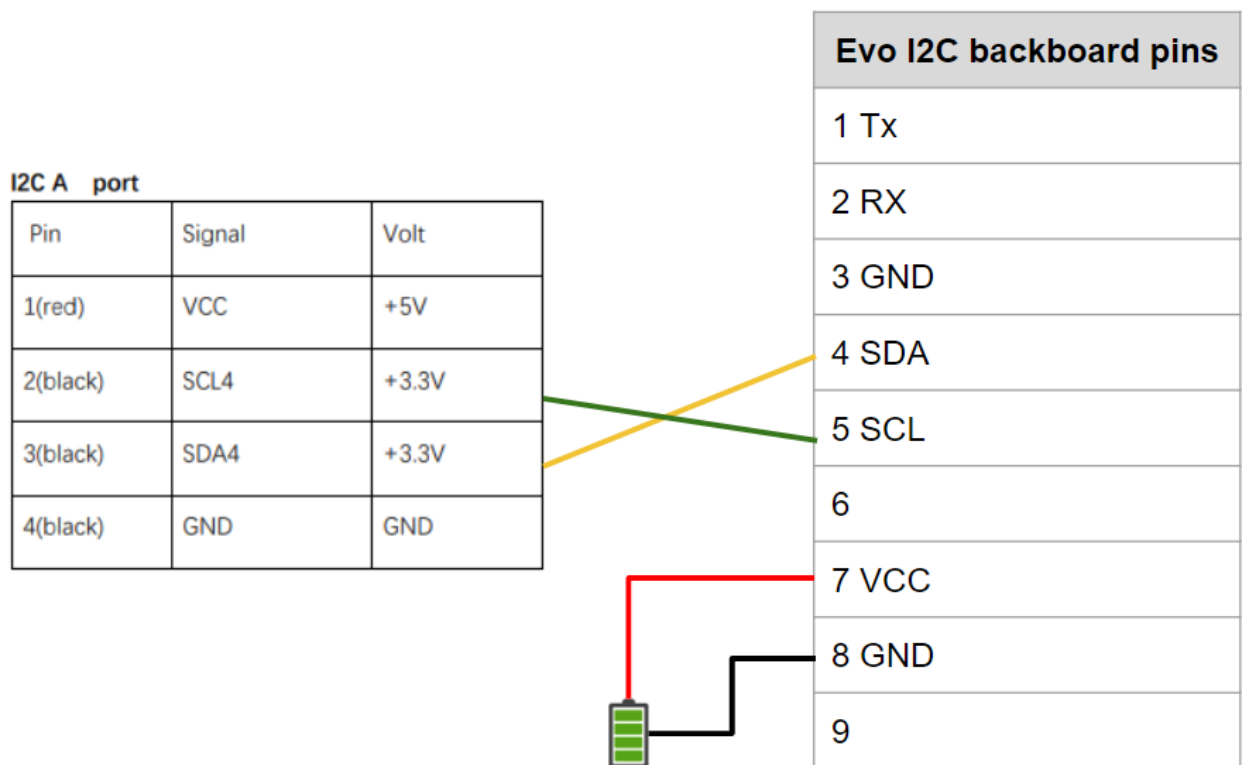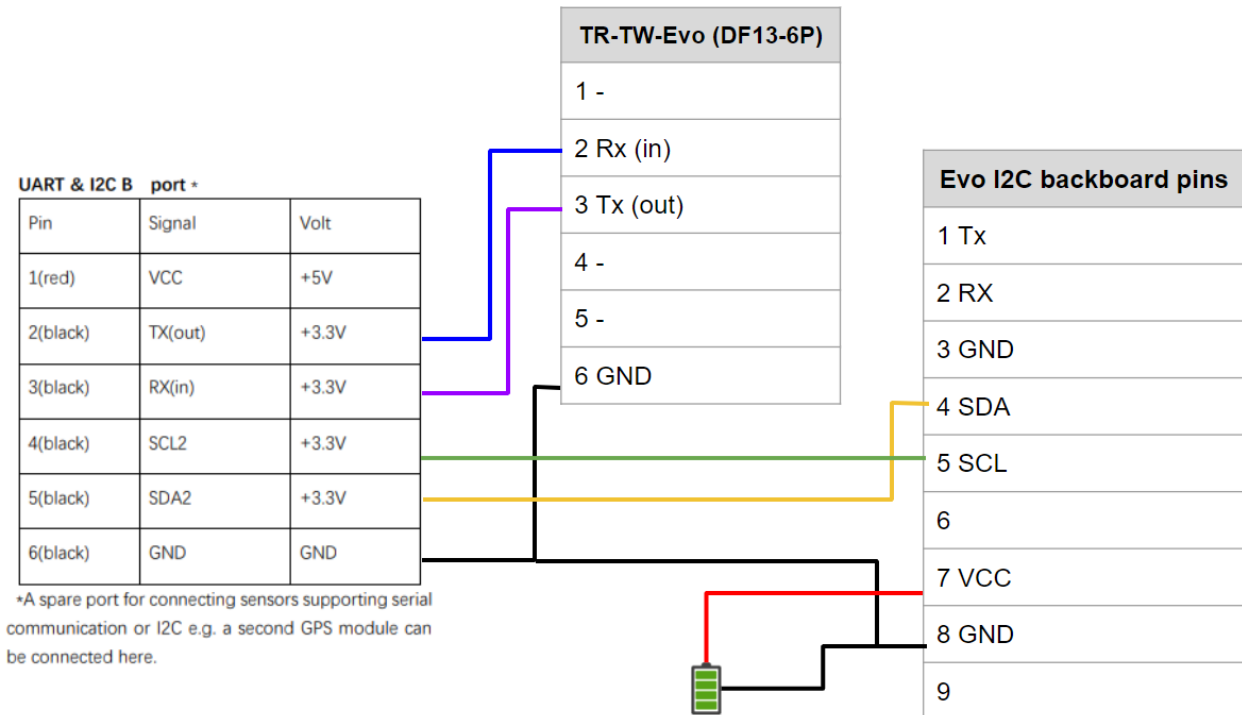
Evo 3m   Evo 15m, 40m

Evo 60m

Evo Sensor Family

Section 1: Using Evo Tower and individual sensors for collision avoidance

Schematics

This schematic figure shows the wiring needed between Terabee sensors and the Pixhawk platform (we have taken as example Pixhawk 4)

The following images show the Pin-to-pin connection between Terabee sensors and Pixhawk 4.

TR-TW-Evo (DF13-6P)

1 -	
2 Rx (in)	
3 Tx (out)	
4 -	
5 -	
6 GND	

UART & I2C B port *

Pin	Signal	Volt
1(red)	VCC	+5V
2(black)	TX(out)	+3.3V
3(black)	RX(in)	+3.3V
4(black)	SCL2	+3.3V
5(black)	SDA2	+3.3V
6(black)	GND	GND

*A spare port for connecting sensors supporting serial communication or I2C e.g. a second GPS module can be connected here.

Evo I2C backboard pins

1 Tx	
2 RX	
3 GND	
4 SDA	
5 SCL	
6	
7 VCC	
8 GND	
9	

I2C A port

Pin	Signal	Volt
1(red)	VCC	+5V
2(black)	SCL4	+3.3V
3(black)	SDA4	+3.3V
4(black)	GND	GND

Evo I2C backboard pins

1 Tx	
2 RX	
3 GND	
4 SDA	
5 SCL	
6	
7 VCC	
8 GND	
9	

TERABEE

Parameters

The following parameters enable the collision avoidance for Single Object Avoidance law from Ardupilot, https://ardupilot.org/copter/docs/common-simple-object-avoidance.html For more information related to other control laws from Ardupilot, please refer to the Wiki pages from Ardupilot.

Ardupilot Parameters	Tower Evo
PRX_ORIENT	0
PRX_TYPE	6
SERIAL(X)_BAUD	921
SERIAL(X)_PROTOCOL	11

Ardupilot Parameters	Evo 60m (1)
RNGFND1_ADDR	49
RNGFND1_MAX_CM	6000
RNGFND1_MIN_CM	50
RNGFND1_ORIENT	25 (Looking Down / Altimeter)
RNGFND1_TYPE	14

Ardupilot Parameters	Evo 60m (2)
RNGFND2_ADDR	50 (Follow Procedure for Changing I2C address)
RNGFND2_MAX_CM	6000
RNGFND2_MIN_CM	50
RNGFND2_ORIENT	24 (Looking Up / Ceiling detection)
RNGFND2_TYPE	14

TERABEE

Section 2: Build a custom array for collision avoidance

You can build your own sensor array without the yellow Tower frame provided by Terabee.

The Hub Evo option is the easiest option to use multiple sensors simultaneously. It enables you to connect up to eight TeraRanger Evo distance sensors and to synchronize distance measurements from each sensor, triggering these in a sequence which avoids crosstalk. The sensors connected to the hub must be of the same type.
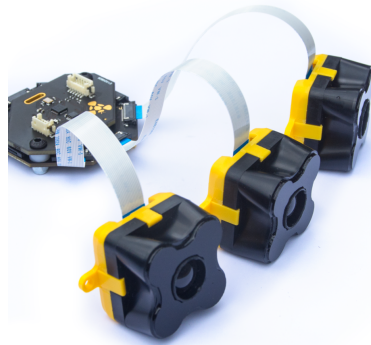
You can make your own array for collision avoidance with the following components. Example for six Evo 60m sensors :

Terabee Hub EVO X 1
Terabee Evo 60m X 6   (HUB backboard option) (You can choose between Evo Mini, 3m, 15m, 40m and 60m - all sensors must be the same, you cannot mix and match)
Flat Flex Cables X 1 (pack of 8 cables) Choose your desired length.

These items can be ordered on the Terabee website, or through our Reseller network.

ATTENTION:
The Hub Evo has eight numbers on it which specify the order of the sensor readings. It is VERY important that the Hub Evo is configured with the sensor numbered 1 pointing forward. All the consecutive sensor numbers are in a clockwise order.

In addition to consecutive order of sensors, the control law from Ardupilot has preset sensor angles. This means that sensors have to be placed on one of the following positions: 0, 45, 90, 135, 180, 225, 270, 315.

If the sensors are not positioned in one of those positions, the control algorithm defined by Ardupilot could lead to your drone crashing, causing damage or total destruction of the drone.

For more information about the Ardupilot control law visit the following link and wiki pages related to it: https://ardupilot.org/copter/docs/common-simple-object-avoidance.html

TERABEE