

MPU6050 Data Fusion

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This tutorial demonstrates: how to print MPU6050 data fusion through serial port.

1. Software and Hardware

- KEIL5
 - MSPM0G3507 Development Board
 - MPU6050 Module
 - Type-C data cable or DAP-Link

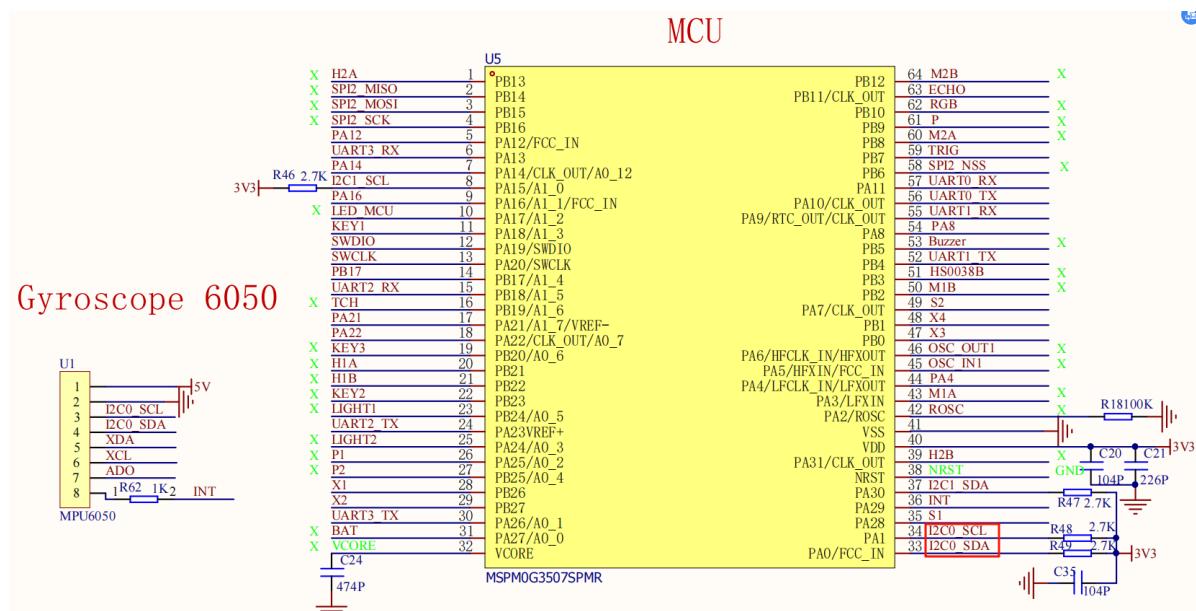
For programming download or simulation to the development board

- **Serial Port Assistant**

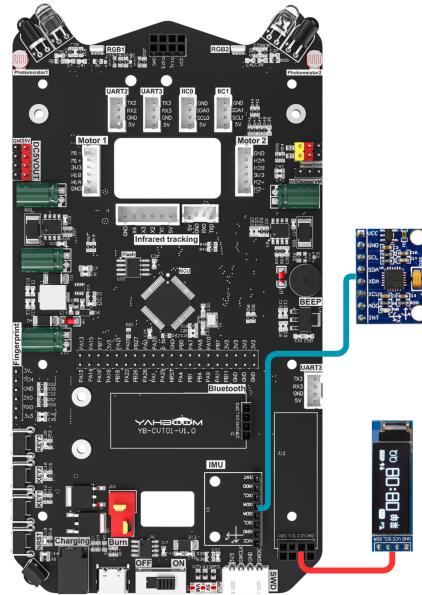
Receive and print serial port data

2. Basic Principles

2.1 Hardware Schematic



2.2 Physical Connection Diagram



2.3 Control Principle

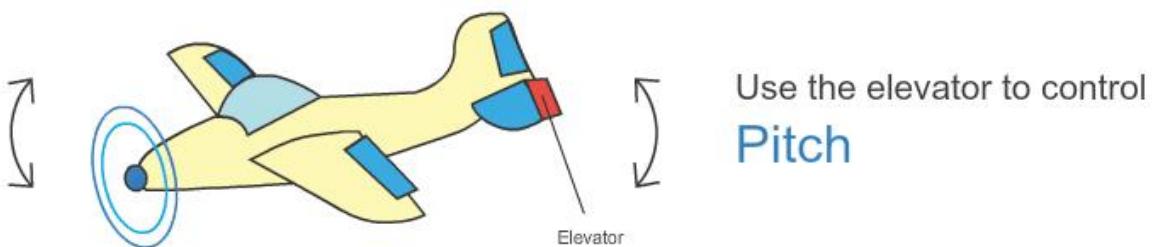
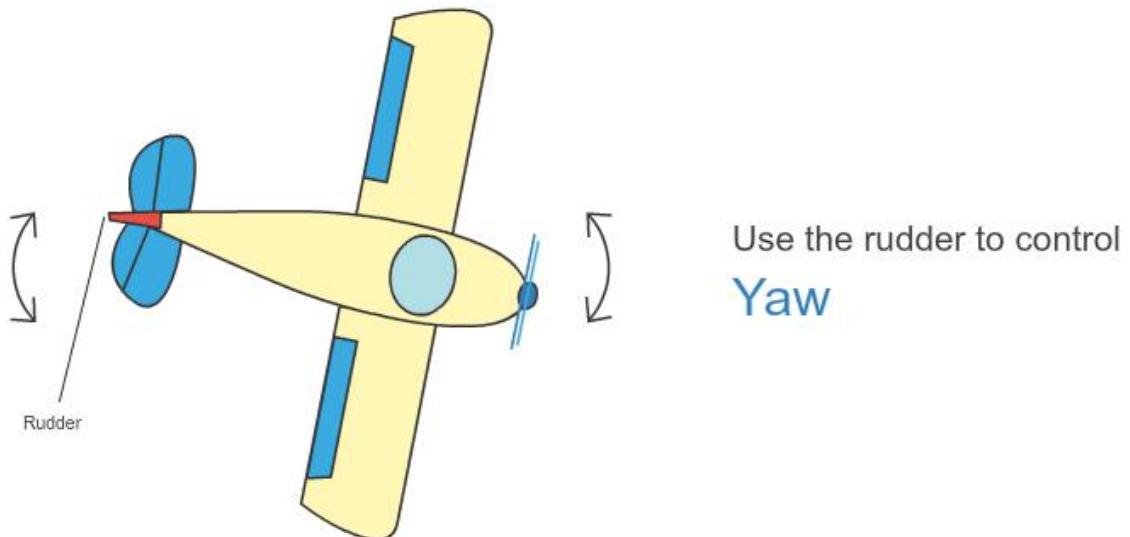
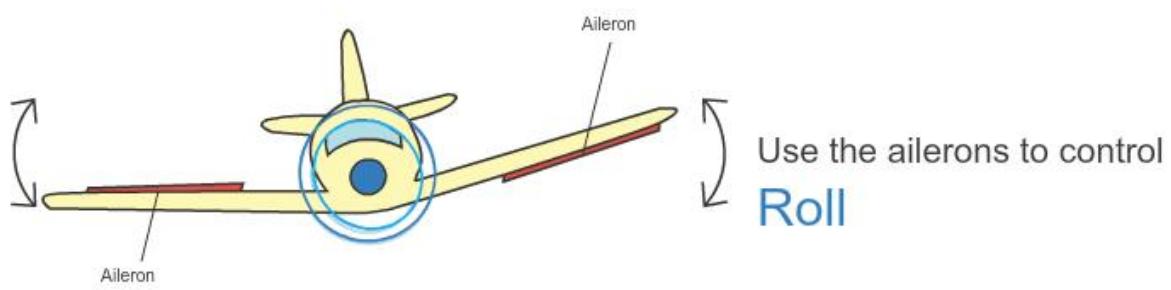
(Schematic Name)	Control Pin	Specific Meaning
I2C2_SCL	PB10	I2C Clock End
I2C2_SDA	PB11	I2C Data End
ADO	PE1	Controls the lowest bit of I2C address
INT	PE0	Whenever MPU6050 has data output, the INT pin has corresponding level changes. It can trigger external interrupt as control cycle.

Attitude Angles (Euler Angles) pitch yaw roll The aircraft's attitude angles do not refer to a specific angle, but are a general term for three angles. They are: pitch, roll, yaw. You can imagine them as the angles formed by the aircraft rotating around the X, Y, and Z axes respectively.

pitch: pitch, rotating the object around the X axis (localRotationX)

yaw: heading, rotating the object around the Y axis (localRotationY)

roll: roll, rotating the object around the Z axis (localRotationZ)



We read six data from MPU6050 through I2C (three-axis acceleration AD values, three-axis angular velocity AD values) and obtain Pitch, Roll, Yaw angles after attitude fusion.

The fusion algorithm used in this experiment is **Quaternion Method**:

Quaternions, a mathematical concept invented by Irish mathematician [William Rowan Hamilton] (1805-1865) in 1843. Quaternion multiplication does not follow the commutative law.

A quaternion is a number of the form

$$ai + bj + ck + d$$

a, b, c, d is a real number

$$i^2 = j^2 = k^2 = -1$$

$$ij = k, \quad ji = -k, \quad jk = i, \quad kj = -i, \quad ki = j, \quad ik = -j$$

$$\sqrt{a^2 + b^2 + c^2 + d^2}$$

is called the two-norm of the quaternion.

3. Project Configuration

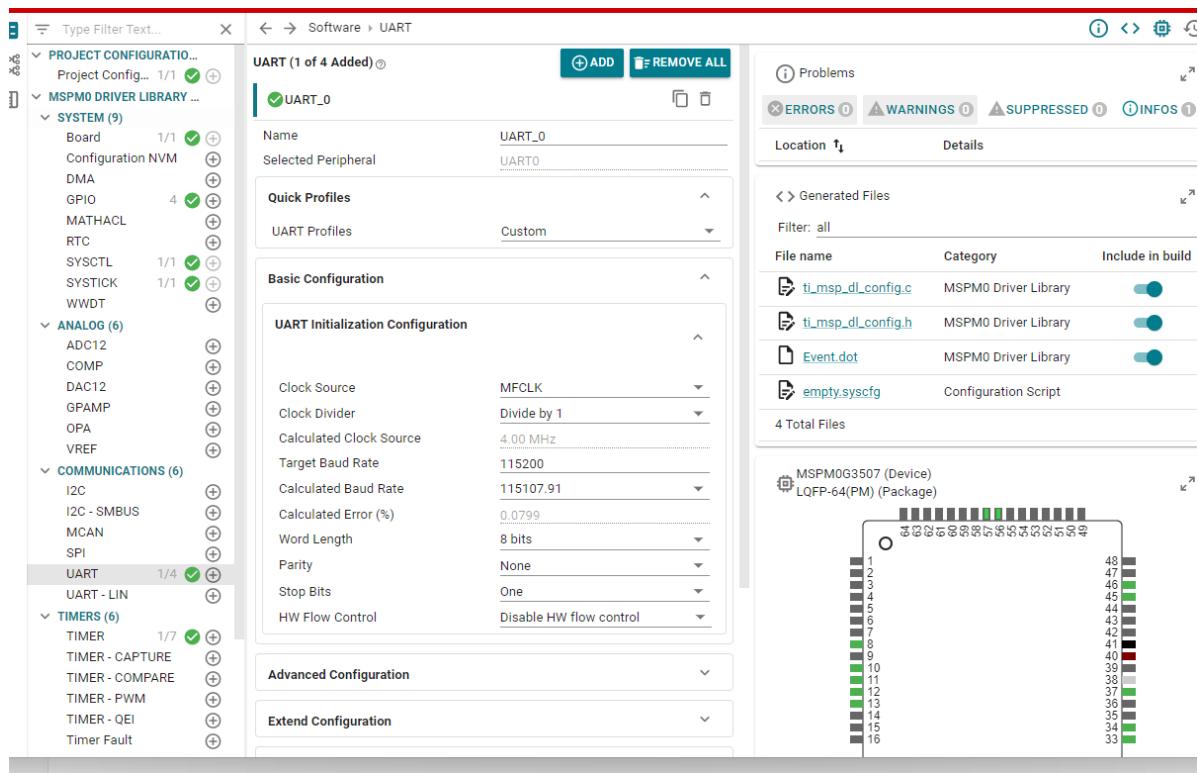
3.1 Description

You can refer to the basic tutorial to complete the development environment setup.

3.2 Pin Configuration

The screenshot shows the TI LaunchPad IDE's GPIO configuration interface for the MSPM063507 device. The left sidebar lists various peripherals and their assigned pins. In the main area, under the 'GPIO' section, two pins are assigned to the MPU6050: SDA and SCL. The pin map on the right shows the physical layout of the pins on the LQFP-64 package, with pins 1 through 64 numbered along the edges.

This screenshot is identical to the one above, showing the TI LaunchPad IDE's GPIO configuration interface for the MSPM063507 device. The configuration remains the same, with SDA and SCL assigned to the MPU6050. The pin map on the right shows the physical layout of the pins on the LQFP-64 package.



4. Main Functions

4.1 User Functions

Function: MPU6050_Pose()

Function Prototype	void Get_EulerAngles(void)
Function Description	Get MPU6050 data and send through serial port
Input Parameters	None
Return Value	None

Function: MPU6050_Init

Function Prototype	char MPU6050_Init(void)
Function Description	MPU6050 initialization
Input Parameters	None
Return Value	Judge whether MPU6050 is detected

5. Experimental Phenomenon

After downloading the program, open the serial port assistant and set the parameters as shown in the figure below. Then open the serial port to receive the raw data of MPU6050.

For program download, refer to **【3. Development Environment Setup and Usage: 3. uniflash burning】**

The effect is as follows:

