Problem Statement and Goals
Attitude Check: IMU-based Attitude Estimation

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Table 1: Revision History

Date	Developer(s)	Change
2024/01/15	Adrian Sochaniwsky	Initial document creation.

1 Problem Statement

The problem of attitude estimation is to determine the orientation of an object, such as a spacecraft, drone, or robot, using sensor measurements and mathematical models. Attitude estimation is essential for many applications, such as navigation, control, communication, and scientific exploration. However, attitude estimation is challenging due to the presence of noise, bias, drift, and uncertainty in the sensor data, as well as the complexity and nonlinearity of the dynamics and kinematics of the object. Therefore, the goal of this project is to develop and evaluate an efficient and robust attitude estimation algorithm that can handle various scenarios and requirements, such as different sensor configurations, varying sampling rates, limited computational resources, and changing environmental conditions [2].

1.1 Problem

1.2 Inputs and Outputs

Inputs to the software is data produced by a 9 degree-of-freedom (DoF) IMU

$$\text{input} = [\vec{\text{accel}}, \vec{\text{gyro}}, \vec{\text{mag}}]$$

where accel is the acceleration vector, gyro is the angular rotation vector, and mag is the magnetic field vector.

The output of this software is the attitude of the IMU sensor.

1.3 Stakeholders

A stakeholder for such an attitude estimation algorithm could be anyone who is interested in or affected by the performance, accuracy, and reliability of the algorithm [1]. Some possible stakeholders are:

- The developers and engineers who design, implement, and test the algorithm.
- The customers and users who rely on the algorithm for their applications, such as navigation and control.
- The researchers and scientists who use the algorithm to study the dynamics and behavior of the object.
- The competitors and collaborators who offer or seek alternative or complementary solutions to the algorithm.

1.4 Environment

Ubuntu 20.04 is officially supported. However, any system that can compile C++17 should work.

2 Goals

3 Stretch Goals

References

[1] Bing Chat with GPT-4. "Who would be a stakeholder for a Attitude estimation algorithm?" [Online]. Available: https://sl.bing.net/dnfjOHJSXDg. [Accessed: Jan. 15, 2024].

[2] Bing Chat with GPT-4. "can you create a problem statement for a attitude estimation project" [Online]. Available https://sl.bing.net/hakggcilB2y. [Accessed: Jan. 15, 2024].