Inertial Measurement Unit (IMU)

Status: Available

Group Members: TBD

Sponsor(s): MacDonald, Dettwiler and Associates Ltd. (MDA)

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Project Description

INTRODUCTION:

Picasso is a Cubesat class spacecraft being developed by MDA. Cubesats are a new class of spacecraft that are very popular due to their low cost, and short development time. The first Cubesats were cubes of 10 cm to a side, weighing up to 1.3 kg, known as a 1U. Picasso, which is a 3U cubesat, is 30 cm x 10 cm x 10 cm.

Current Cubesats typically use measurements of the Sun and the Earth's magnetic field in order to determine where they are pointing. Larger spacecraft typically also include gyros to directly measure the rate of rotation of the spacecraft. Existing rate gyros with the accuracy needed for Picasso are expensive, bulky and generally not suitable for a Cubesat. As part of the Picasso project, MDA is interested in the potential of developing a low cost, high accuracy IMU using off the shelf game sensors. While these sensors have a low accuracy, by combining the outputs of many of these sensors, it is believed that sufficient accuracy can be achieved.

OBJECTIVES:

1. Design an Inertial Measurement Unit suitable for a Cubesat application.
2. Build and test a prototype to demonstrate the design.

TASKS:

Interact with the MDA Picasso team to derive the performance and interface requirements for a Cubesat implementation, such as mass, power, rate resolution, noise and drift.

Take the requirements and come up with several potential IMU designs looking at different quantities and orientations of game sensors.

Prepare a set of criteria for evaluating the potential designs and use the criteria to select one design.

Develop the algorithms and select the hardware to perform the sensor fusion of the selected design.

Build a ground based prototype to demonstrate the design and identify issues and limitations.

Develop a test setup and test the prototype design to determine if it can measure a known rate accurately (instantaneous rates as well as the rate over a longer period of time).

Identify the key design challenges in adapting the ground based solution for the space environment.

DELIVERABLES:

1. IMU requirements specification.
2. Preliminary Design Review package containing conceptual design alternatives.
3. Critical Design Review package containing final design and interface details.
4. Prototype & breadboards as needed to demonstrate a ground based solution.
5. Test report describing the tests performed and showing how the design compares to the requirements.
6. Discussion of changes required for space environment adaptation.
7. Open issues and recommendations for future work.