Stabilization of an Inverted Pendulum Using the Reaction Wheel Mechanism

Introduction

The control of mechanic systems using the reaction wheel mechanism has become more and more attractive due to its simple configuration and recent spacecraft applications. For instance, it is particularly useful when the spacecraft must be rotated by very small amounts, such as keeping a telescope pointed at a star as shown in Fig.1. This is accomplished by equipping the spacecraft with an electric motor attached to a flywheel, which upon spinup causes the spacecraft to turn the other way. By using the reaction wheel the mass fraction needed for fuel can also be reduced. The principle of using reaction wheel is based on **conservation of angular momentum**.

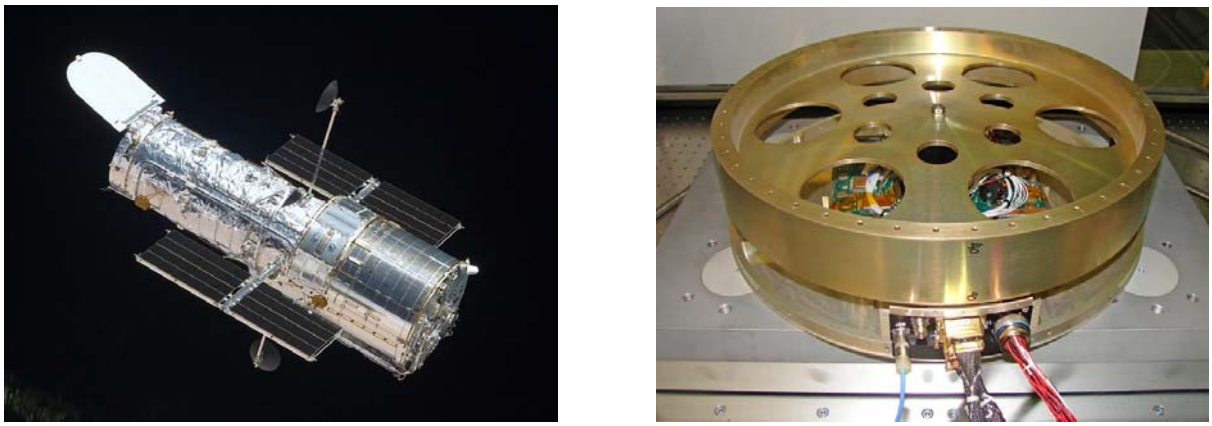

Fig.1 The Hubble Space Telescope and a reaction wheel (without cover) (lunar.gsfc.nasa.gov/gallery-hardware.html)

Objectives

The objective of this project is to investigate the stabilizing control of an inverted pendulum using the reaction wheel mechanism. A setup as shown in Fig.2 has been developed by some previous group in AAUE. The task of the project is to develop some classical control method to stabilize the inverted pendulum from some small initial tilt angle. Thereby the project contents could include:

- Be familiar with the hardware and software of the current setup;
- Mathematical modeling and analysis of the considered system;
- Control development and implementation;
- Testing and discussions;
- Possible improvement of the current setup, including hardware and software perspectives

Resources

- The main hardware system is available at AUE E-Laboratory;
- Some previous project reports.

Fig.2 AAUE inverted pendulum setup with a reaction wheel

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