SpaceLab ADCS Module - MDR/SRR

Rebecca Q. Do Ó, Bruno Benedetti, Caique S. de M. Gomes, Gabriel M. Marcelino, André M. P. de Mattos, Matheus Wagner

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SpaceLab - UFSC

Summary

Project Overview

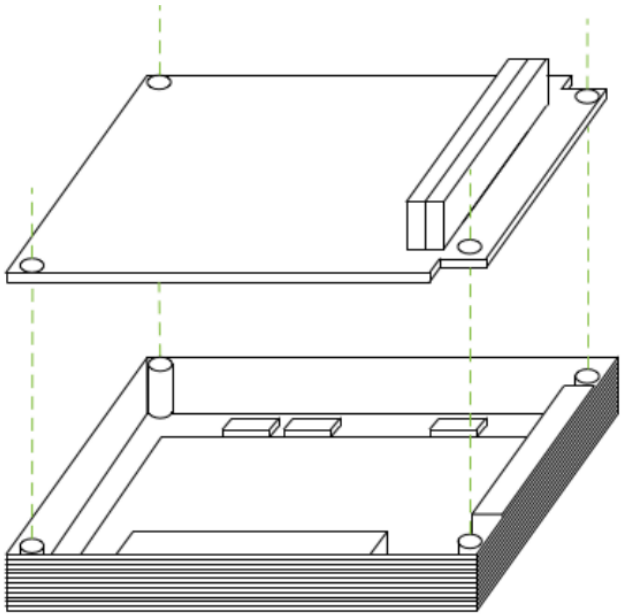
Related Projects and References

Management

Project Overview

Proposal and Objectives

- ADCS (Attitude Determination and Control System) Module
- Project name: "*ADCS Module*"
- Main objective: Create a module with basic instrumentation for an active magnetic ADCS system



Requirements

- **SLB-ADCS-REQ-001:** The module must be compliant with CubeSat and PC-104 standards;
- **SLB-ADCS-REQ-002:** The module should be designed for 3U CubeSats (considering soft requirements for stabilization);
- **SLB-ADCS-REQ-003:** The module must include compact magnetic coils on 3-axis;
- **SLB-ADCS-REQ-004:** The module must have a microcontroller with sufficient performance for basic ADCS algorithms;
- **SLB-ADCS-REQ-005:** The module must include built-in sensors: magnetometer (3-axis), gyroscope (3-axis), voltage/current (each coil), temperature (each coil), and sun sensor (photodiode interfaces for 3-axis);

Requirements

- **SLB-ADCS-REQ-006:** The module must have current (H-bridge) drivers with a safe operation for the magnetic coils;
- **SLB-ADCS-REQ-007:** The module should assume moderate power consumption during stabilization;
- **SLB-ADCS-REQ-008:** The power circuits must have overcurrent/overvoltage/overtemperature protection (fuses, load switches, overtemperature shutdown, ...);
- **SLB-ADCS-REQ-009:** The board should be designed to minimize overheating elements and mixing digital/analog/power circuits;
- **SLB-ADCS-REQ-010:** The board should have 4 layers, including continuous power planes for better electrical/heat/noise performance.

Related Projects and References

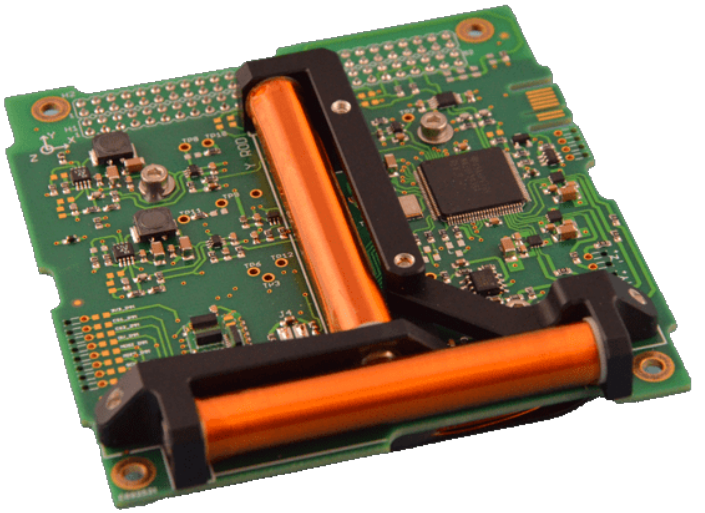
Comercial ADCS modules for CubeSats

A few commercial ADCS modules for CubeSats are available in the market:

- ISIS - iMTQ Magnetorquer Board
- GomSpace - NanoTorque GST-600
- NanoAvionics - CubeSat Magnetorquer SatBus MTQ
- ...

Comercial ADCS: ISIS - iMTQ Magnetorquer Board

- Three-axis actuators: two magnetorquers with magnetic core and one with air core; Nominal dipole strength: $0.2 Am^2$;
- Current and temperature sensors for each magnetorquer;
- Suitable to detumble up to 12U (24kg) CubeSats.



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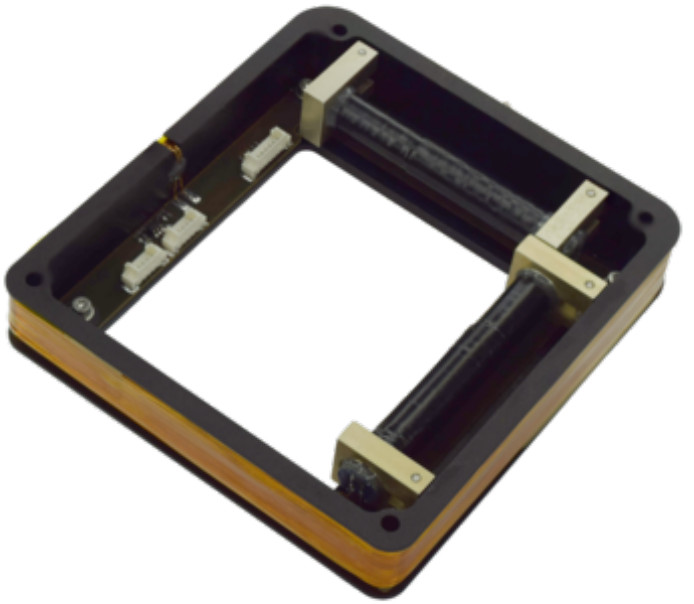
Comercial Coils: GomSpace - NanoTorque GST-600

- 3-axis magnetorquer;
- Torque $> 0.3Am^2$ per axis;
- Build-in temperature sensor;
- High torque and low residual dipole.



Comercial Coils: NanoAvionics - CubeSat Magnetorquer MTQ

- 2 magnetorquer rods with soft magnetic cores and 1 coil with air core;
- Dipole magnetic moment strength: $0.3Am^2$ (X/Y axis), $0.34Am^2$ (Z axis);
- Supply voltage: up to 5 V;
- Power consumption: 0.4 W.

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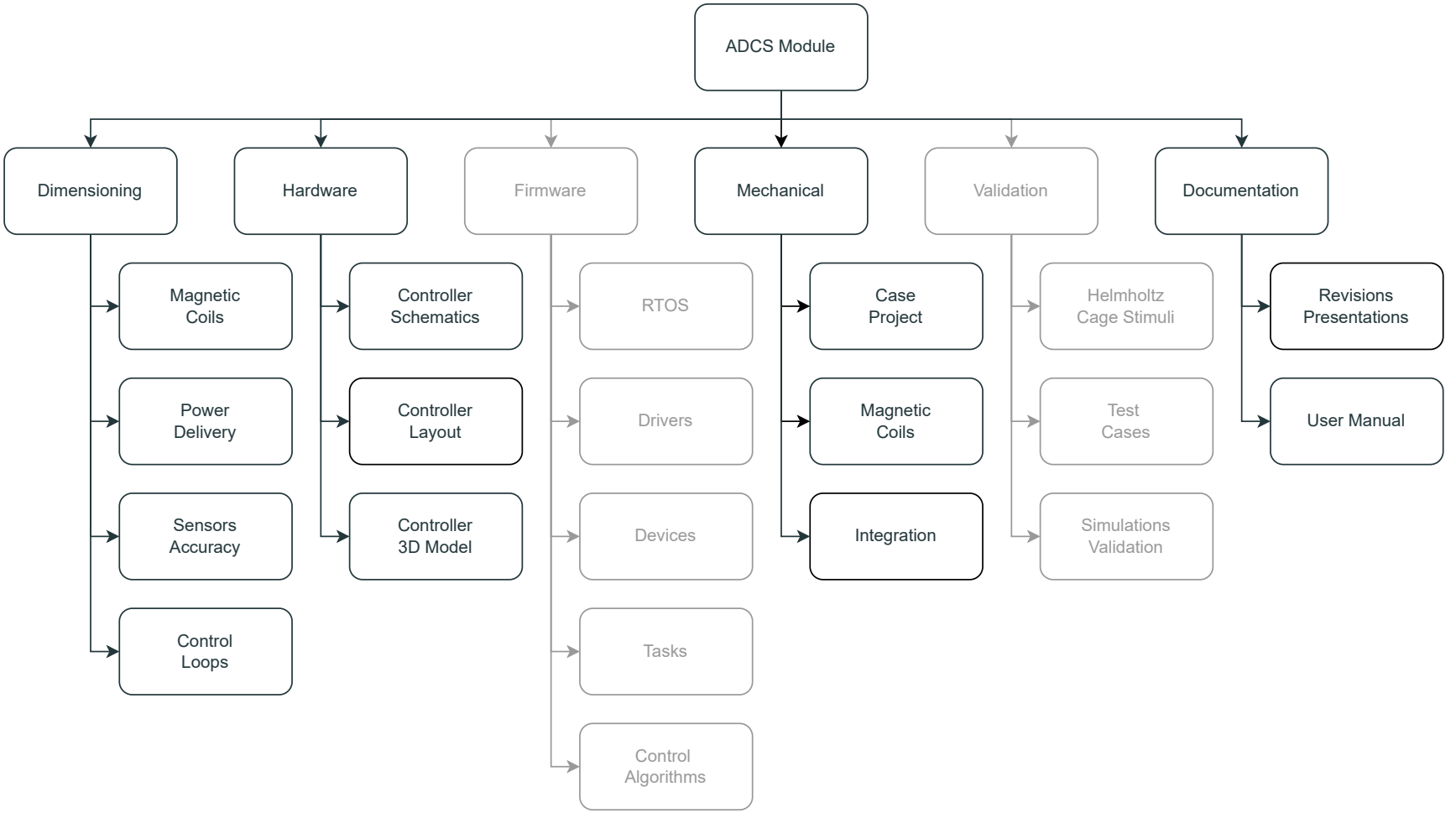
Management

Project Management

- Activities and tasks: GitHub issues/project
- Periodic meetings
- Source files and versioning control: Git/GitHub repository (https://github.com/spacelab-ufsc/adcs) with five development branches:
  - *dev_doc*: Documentation
  - *dev_hardware*: Hardware project
  - *dev_firmware*: Firmware project
  - *dev_mechanical*: Mechanical project

Product Tree



Schedule

Activity	Week											
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12
Project definition	X											
Bibliographical review	X											
Project dimensioning		X	X									
Component selection		X	X									
PDR			**X**									
Mechanical design			X	X								
Controller schematics			X	X	X							
Components aquisiton				X	X	X	X	X				
Controller PCB layout				X	X	X	X					
Mockup fabrication							X					
CDR							**X**					
Controller PCB fabrication								X	X	X	X	
Case fabrication								X	X			
User manual preparation									X	X	X	
Preliminary Electrical tests											X	
Mechanical integration											X	
AR												**X**

Schedule changes from the original presentation (besides PDR, CDR, and AR):

5.3:W2, 5.5:W5, 5.7:W9, 5.9:W13

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Team

Role	Name
Management/Support	André M. P. de Mattos Gabriel M. Marcelino
Dimensioning	Matheus Wagner
Hardware design	Rebecca Q. Do Ó Bruno Benedetti Caique S. de M. Gomes
Mechanical design	Caique S. de M. Gomes

Cost Estimation[2]

Item	Unit (US$)	Quantity	Total (US$)
STM32F103C8T6	7.31	2	14.62
TCAN330GD	3.89	2	7.78
Sensors	10.00	2	20.00
H-Bridge	2.00	2	4.00
Copper wire	10.00	1	10.00
Magnetic core	10.00	4	40.00
Passive components	5.00	1	5.00
PCB	0.50	10	5.00
Total		106.40[1]	

[1] Prices in August 2022, without delivery rates or taxes.

[2] 2 units.

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Thanks!