



An overview of small satellite activities in South Africa

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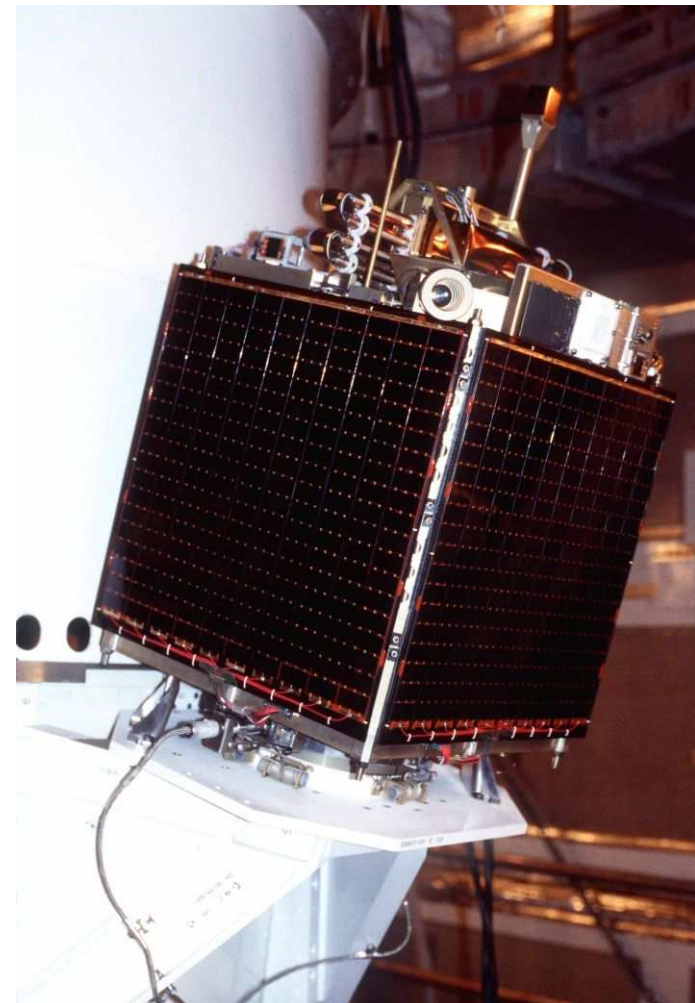
KNOWLEDGE



SUNSAT-1

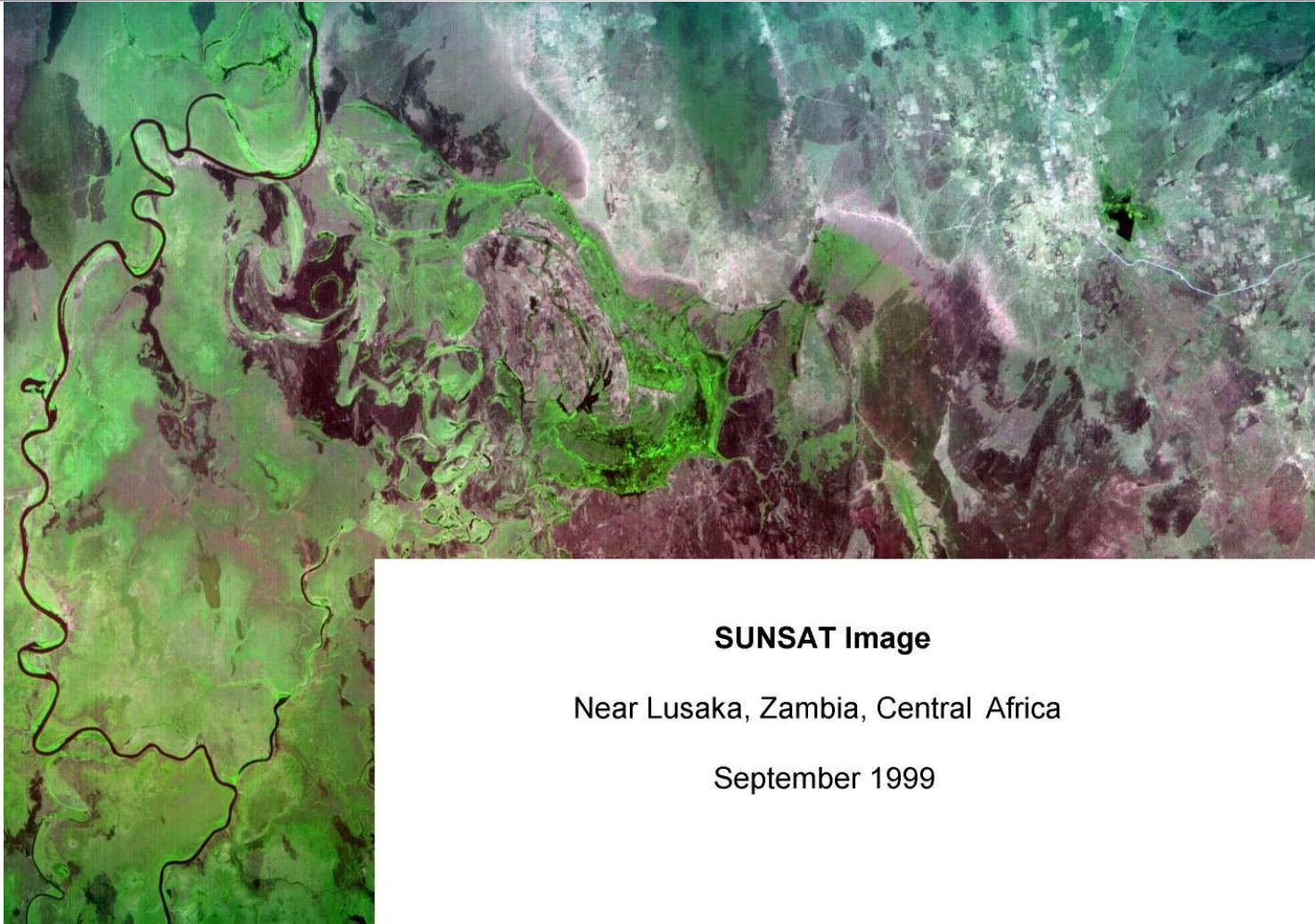


- Africa's first locally built orbiting satellite
- Graduate student project
- Developed by > 100 students in period 1992-2001
- Microsatellite with 15m GSD 3-band multi-spectral push broom imager
- Launch 23/2/99 on Delta II USAF
- Orbit altitude 640 to 850 km
- Orbital useful life almost 2 years, last contact in January 2001
- Possible collision with space debris





SUNSAT-1 Imaging



SUNSAT Image

Near Lusaka, Zambia, Central Africa

September 1999



SS-3 Satellite



- 200 kg Minisatellite
- 650 km Sun sync orbit
- Main imager:
 - » 6.5 meter/pixel
 - » 3 Spectral bands
- Design and built in South Africa by SunSpace
- Dnepr Launch April 2007
- Still fully operational





Image Example 1





Image Example 2

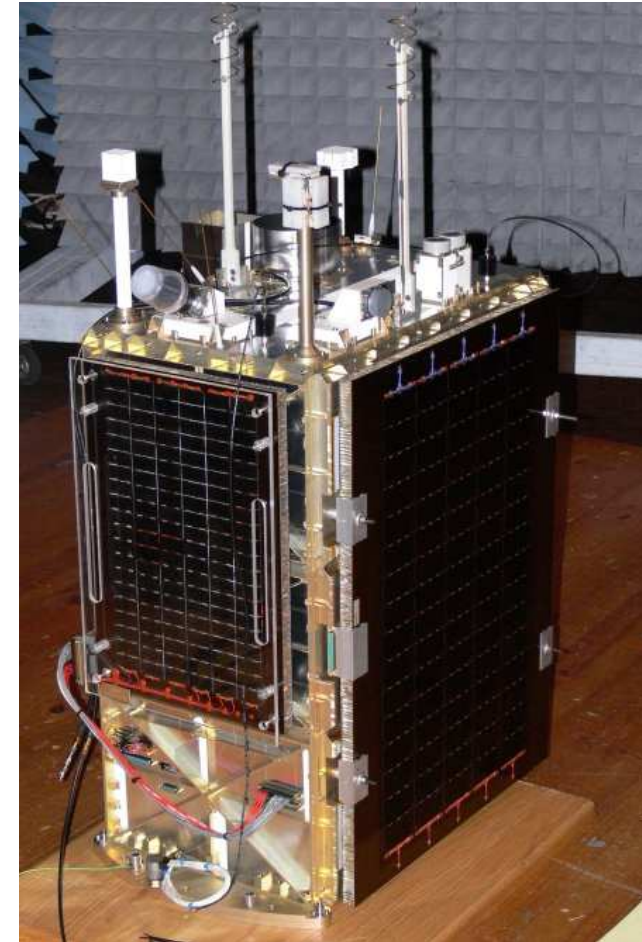




Sumbandila Satellite Project

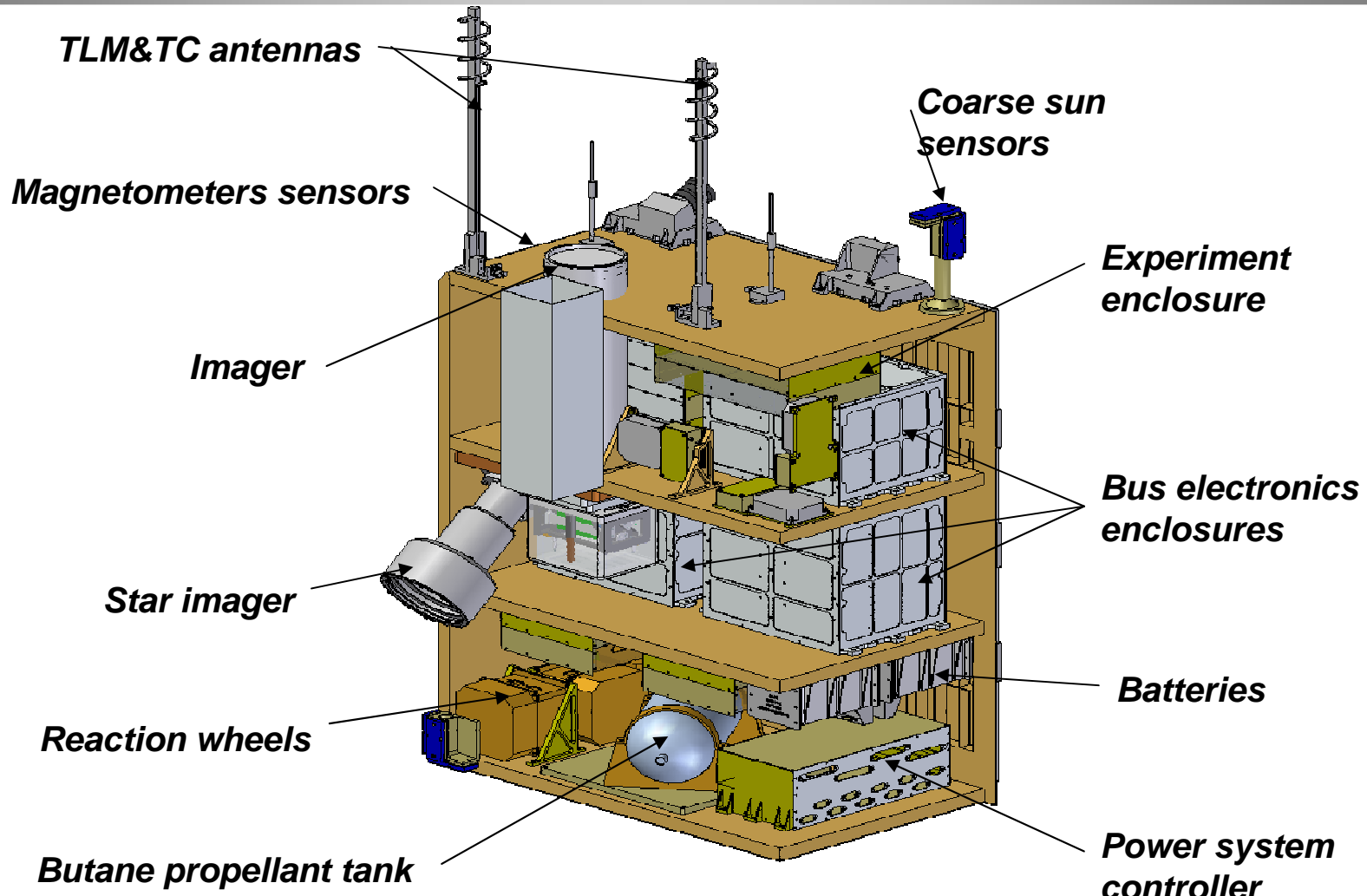


- 83 kg Microsatellite for DST
 - » 505 km 9 am/pm sun-synchronous orbit
 - » 6.25 m GSD Imaging in 6 spectral bands
 - » Email Communication system for DOC
 - » Propulsion system for drag compensation
 - » Expected orbital life 5 years
- Satellite build by SunSpace in 15 months
- Stellenbosch University did project management
- 20 Masters and 2 PhD students and 8 interns in satellite engineering trained
- Launch 17 Sept 2009 @ 17h55:07 from Baikonur Kazakstan on a Soyuz/Fregat





Sumbandila layout

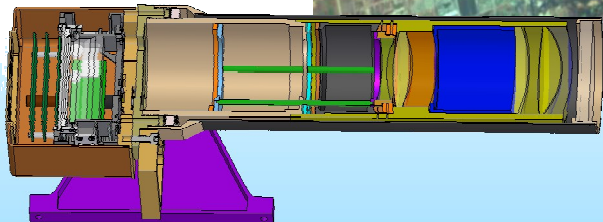
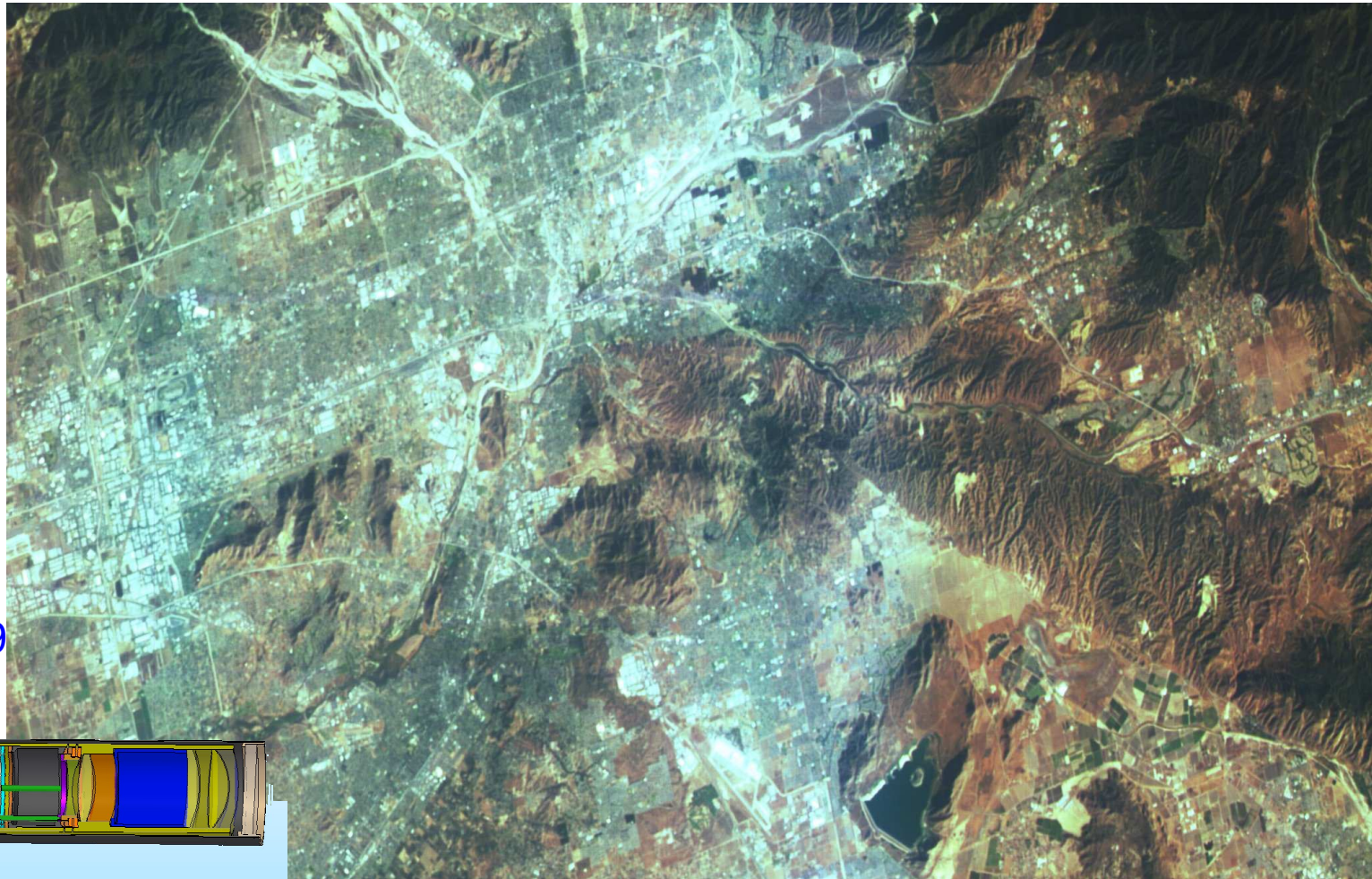




Imaging Product (1)



Resolution:
GSD = 6.25m
Window size:
45 x 30 km
Full image:
45 x 60 km
Location:
Santa Barbara
USA @ 25/11/09





Imaging Product (2)



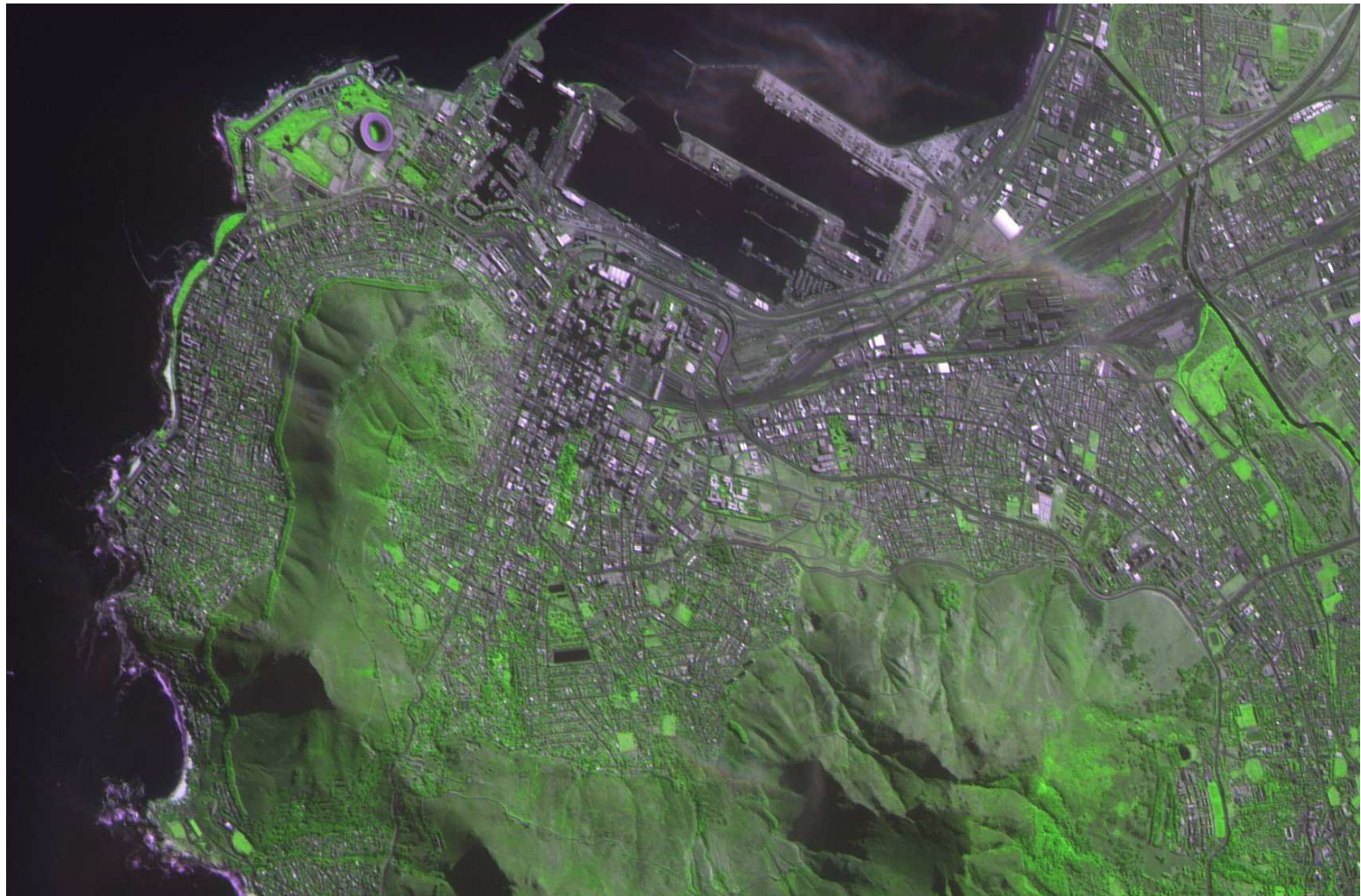
Resolution:
GSD = 6.25m

Window size:
10 x 6 km

Full image:
50 x 60 km

Location:
Cape Town

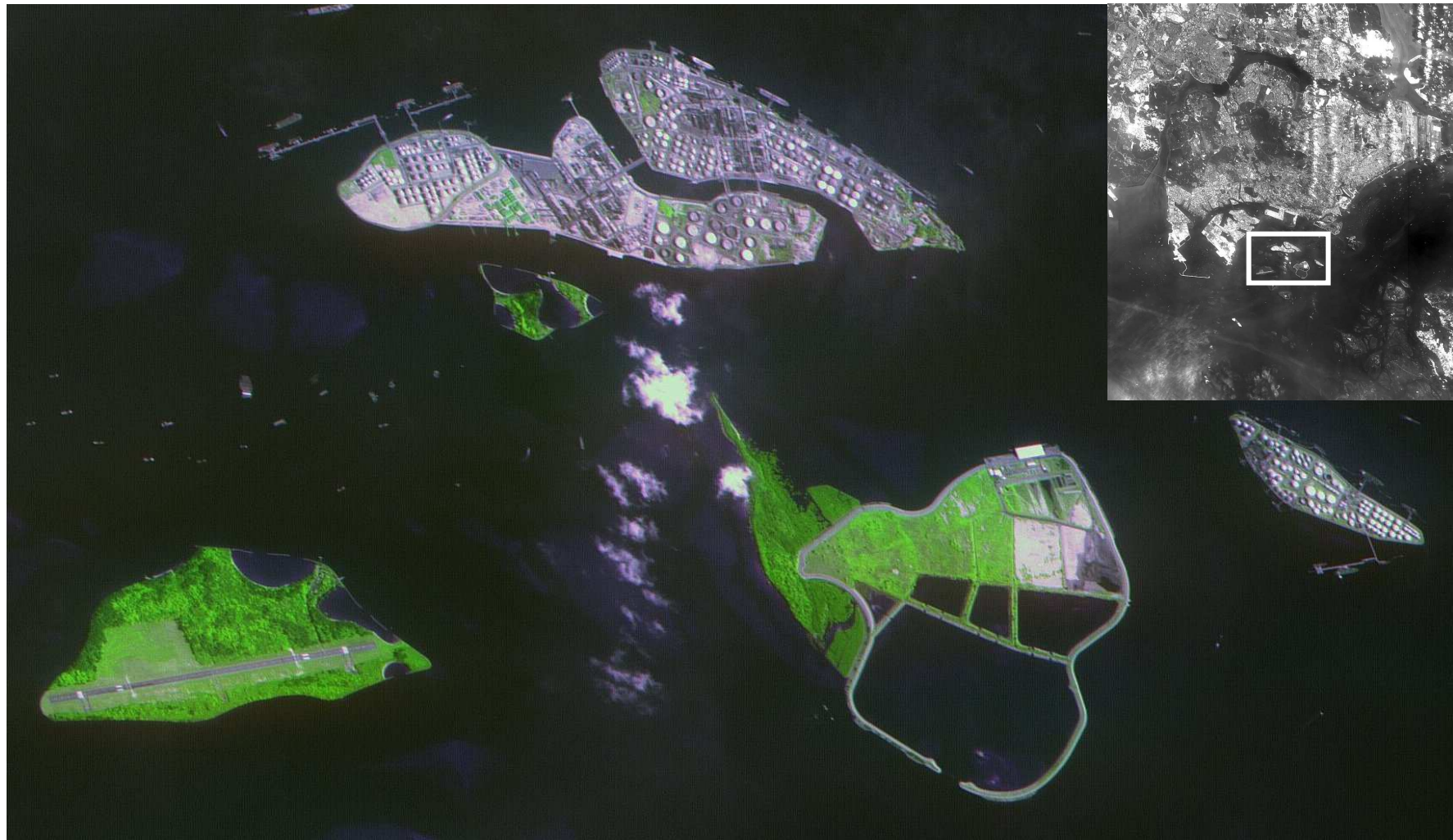
Date:
24/02/10





Imaging Product (3)

(Singapore Bay Islands ($\approx 10 \text{ km} \times 6 \text{ km}$))





Propulsion: Orbit Maintenance

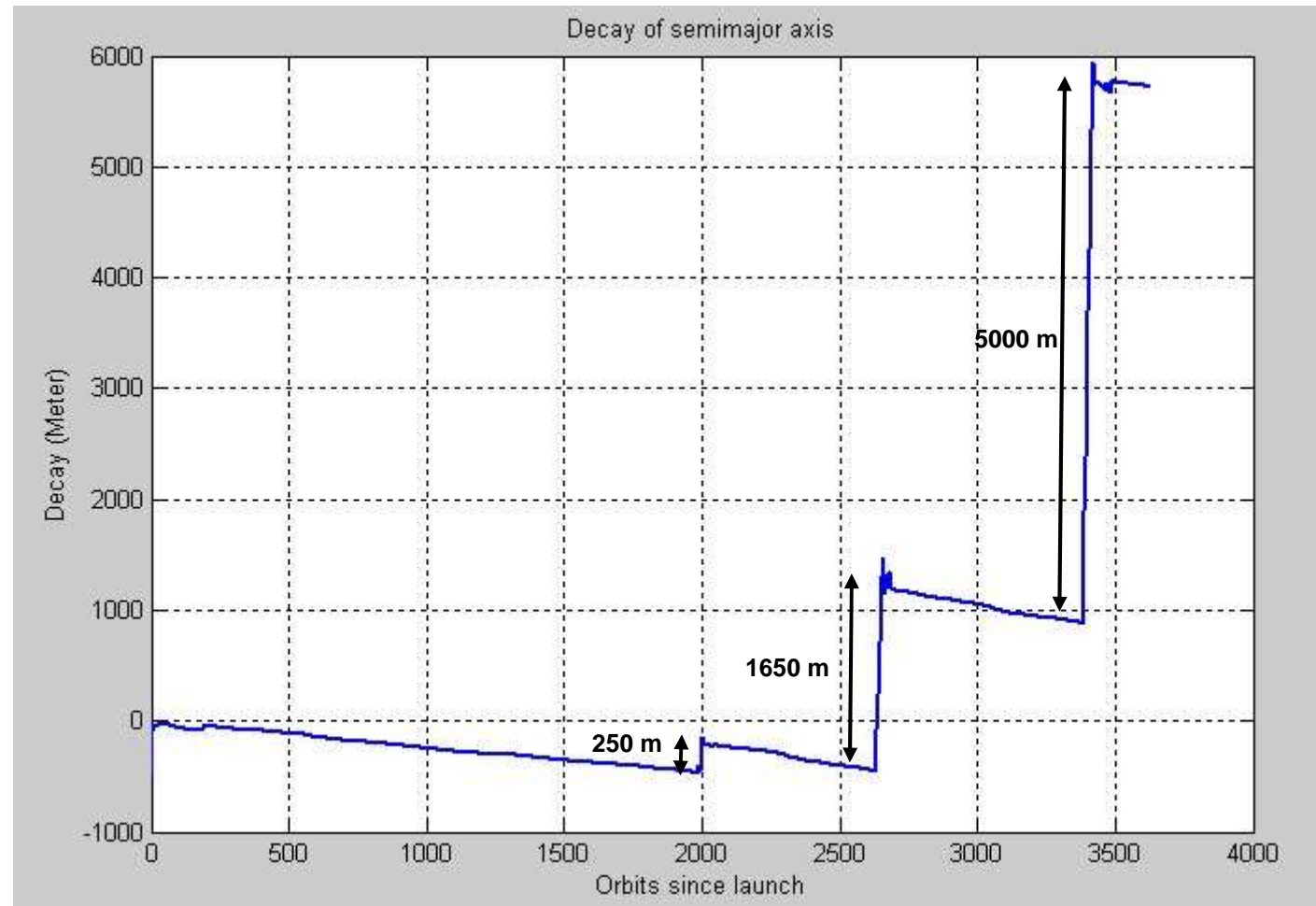


On 26th January 2010 the butane propulsion fired for a total of 75 sec to lift the orbit \approx 250 m

On 9 & 10th March 2010 a total of 20 x 30 sec firings was used to lift the orbit another \approx 1650 m

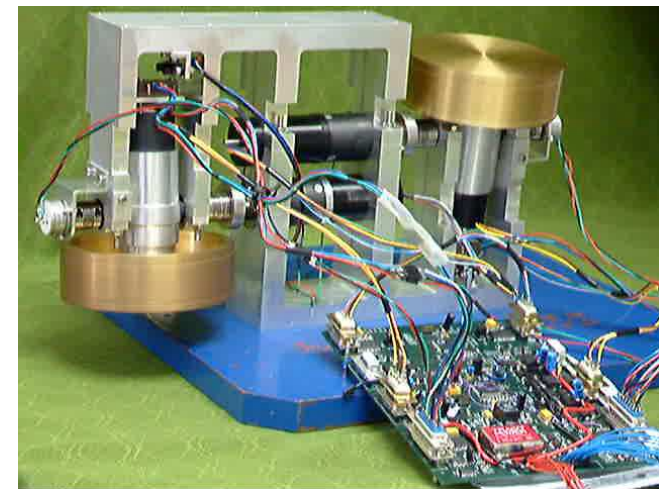
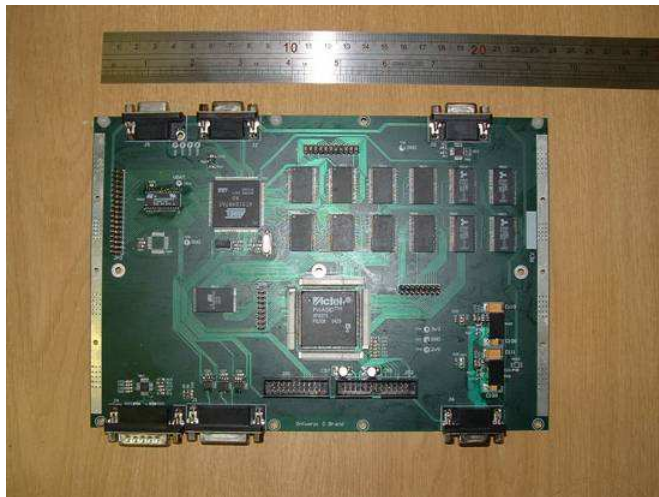
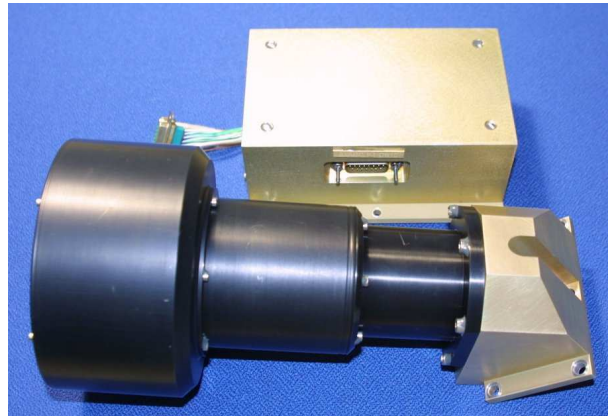
On 27 & 30th April 2010 a total of 34 x 60 sec firings was used to lift the orbit another \approx 5000 m

Current orbit perigee and apogee: 502 x 505 km





ADCS Product Examples



1st Nanosat Symposium

11th June 2010

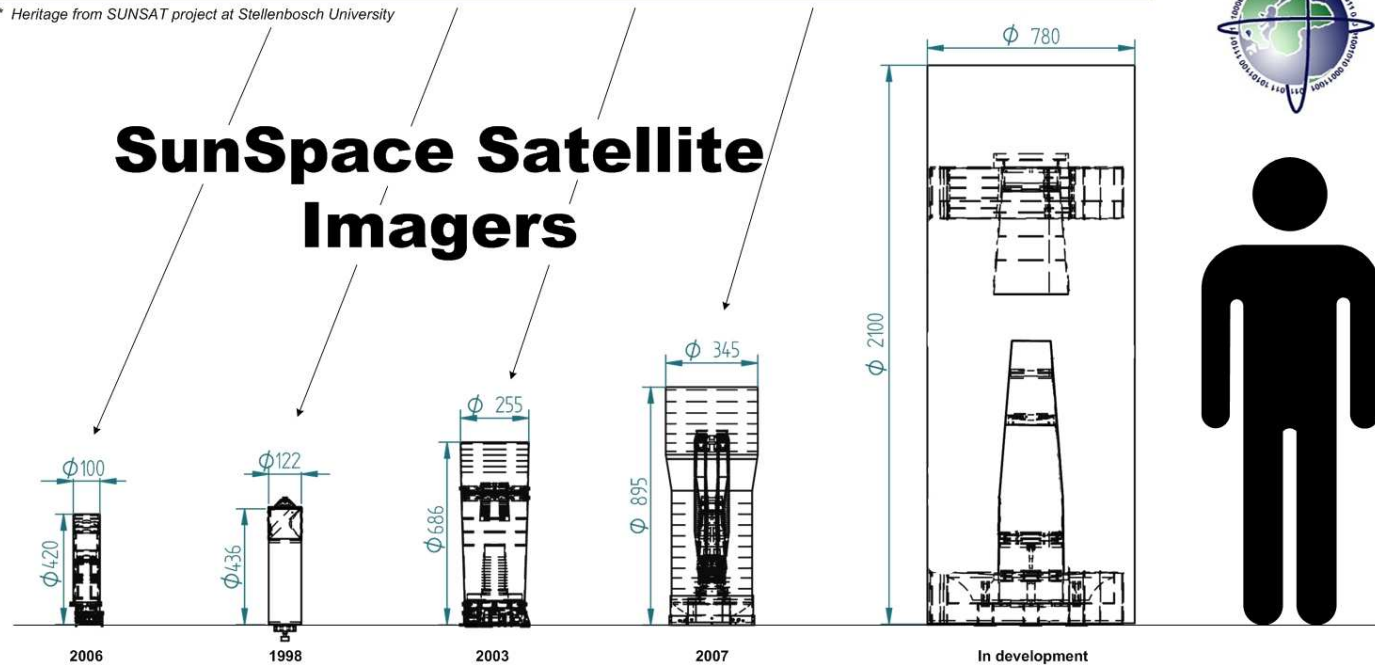


Satellite Imagers

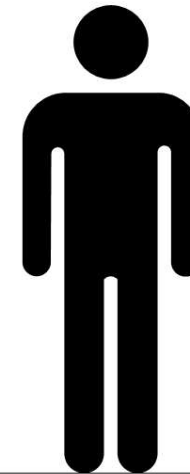


	Sumbandila	Sunsat*	SS180	MSMI	SS360	
f/#	5	5.6	7.2	6.14	10	-
FL	400	560	1440	1720	6000	mm
Aperture	80	100	200	280	600	mm
Focal plane diam	52	37	73	76	162	mm
Min sensor size	6.7	10.7	7	6.7	5	um
Min wavelength	440	520	450	400	440	nm
Max Wavelength	900	870	850	2350	900	nm
Mass	6	8	18	58	140	kg

* Heritage from SUNSAT project at Stellenbosch University

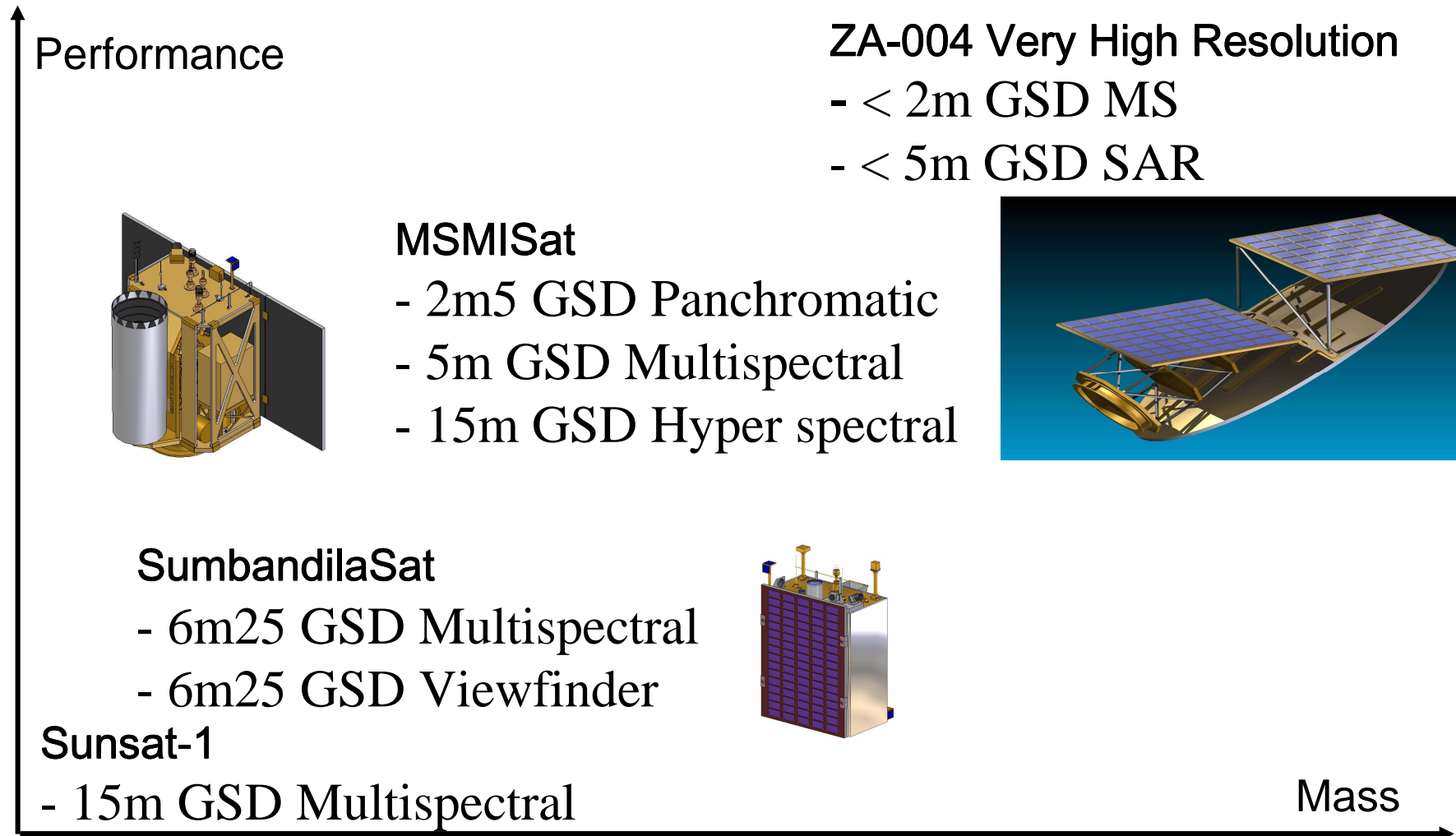


SunSpace
INNOVATIVE SATELLITE SOLUTIONS



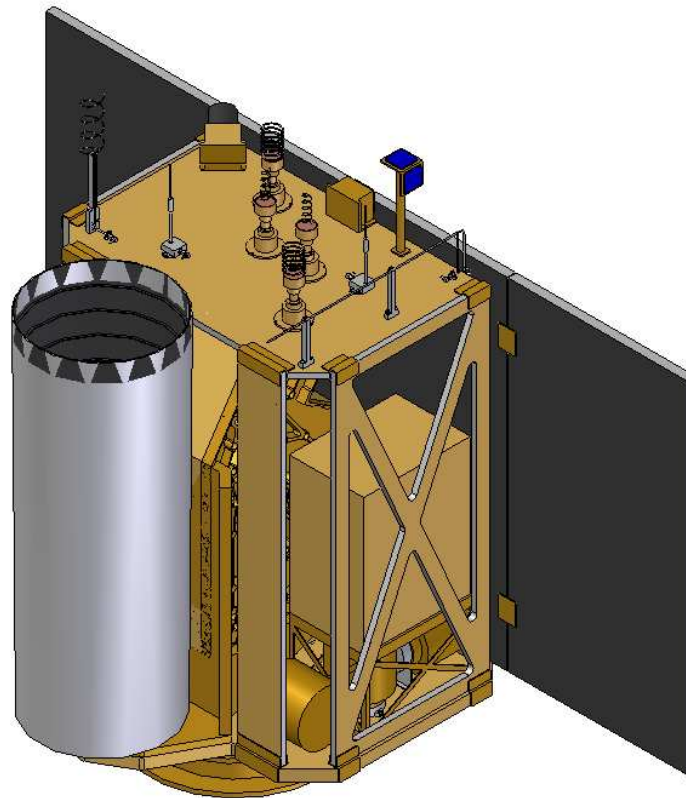


RSA EO Satellite Roadmap



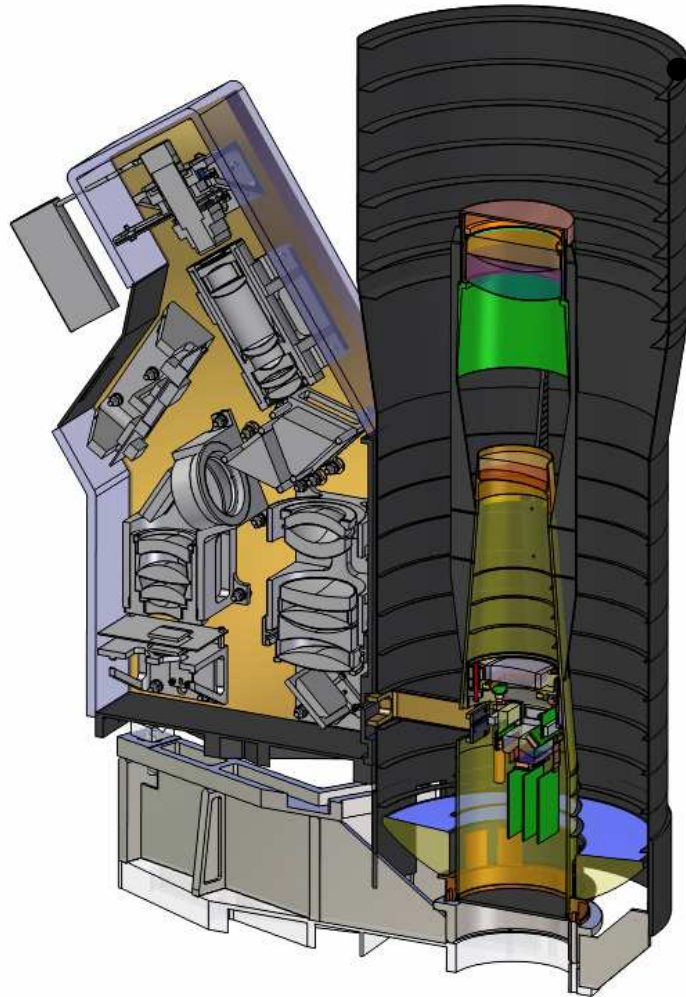


Next SA Satellite ? MSMISat





MSMI Camera

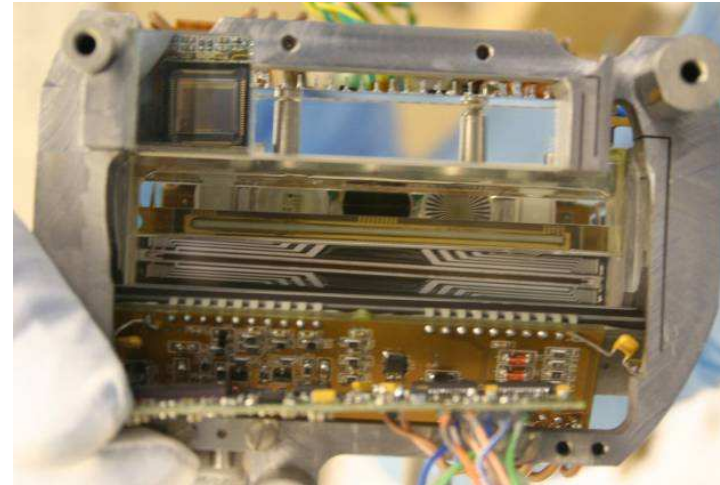


Core innovative concept:

- » Dissimilar sensors on focal plane of a single telescope
 - Multi-spectral (VNIR) and panchromatic
 - Hyperspectral: VNIR & SWIR
 - Video (Snap shot or real time motion)
- » Included
 - Selectable combinations of EO data for storage/downloading
 - On board mass memory & data compression
 - Bore sight motion detection to assist ADCS
- » Compact & light for micro/mini-satellites
 - More affordable revisits by small satellite constellations



Camera Components



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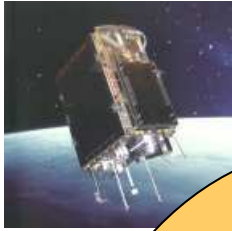
11th June 2010



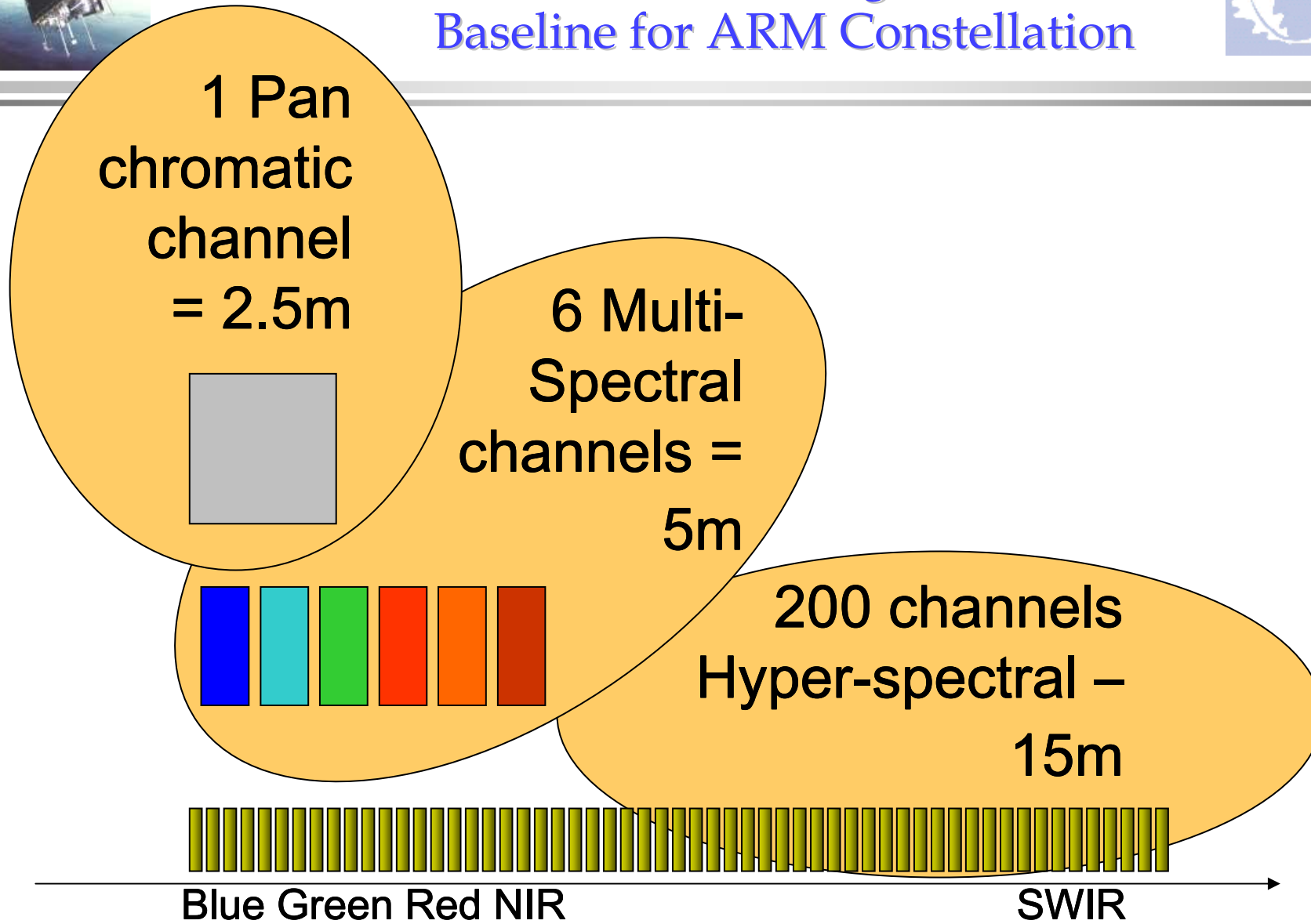
Mission Requirements



- Track crop production for predicting final yield
 - » about once every 10 days
 - => **Multi-spectral data**
- Provide statistical estimates of cultivated areas
 - » especially small field sizes typical of developing countries
 - » estimate population density
 - => **High resolution panchromatic data**
- Identify crop variety planted
 - » using unique spectral signatures
 - => **Hyper-spectral data**



MSMI Imager: Baseline for ARM Constellation

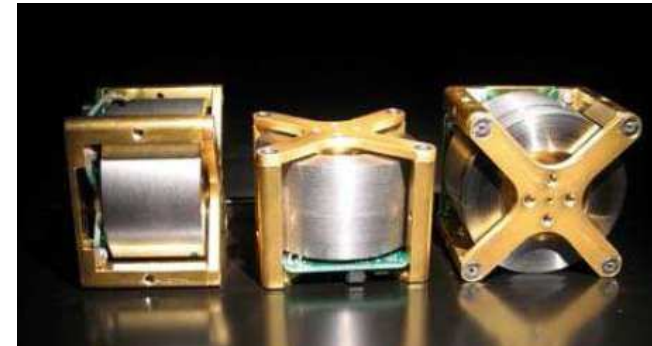
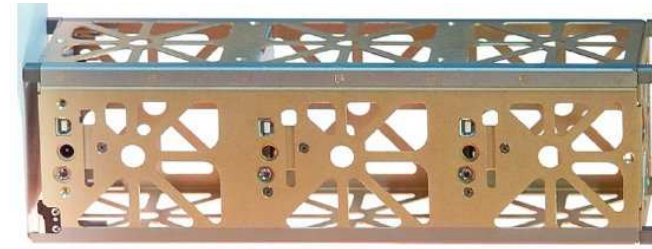




CPUT & SU Cubesat Project



- **Objective:**
Train 40+ students in satellite engineering technology
- **3U Cubesat**
 - Matrix 5.2 Mpix colour camera
 - HF beacon for SANAE radar antenna calibration
 - UHF store/forward system
 - L-band transponder
 - Novel 3-axis ADCS
- **ADCS**
 - 3-axis Nanowheels
 - Nano Sun & Earth sensor
 - 3-axis Torquerods
 - Passive aerodynamic control

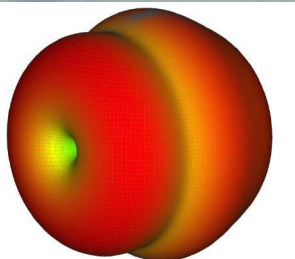
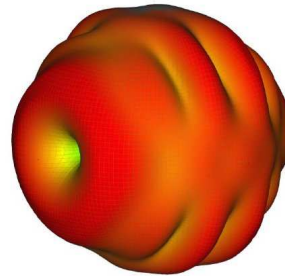
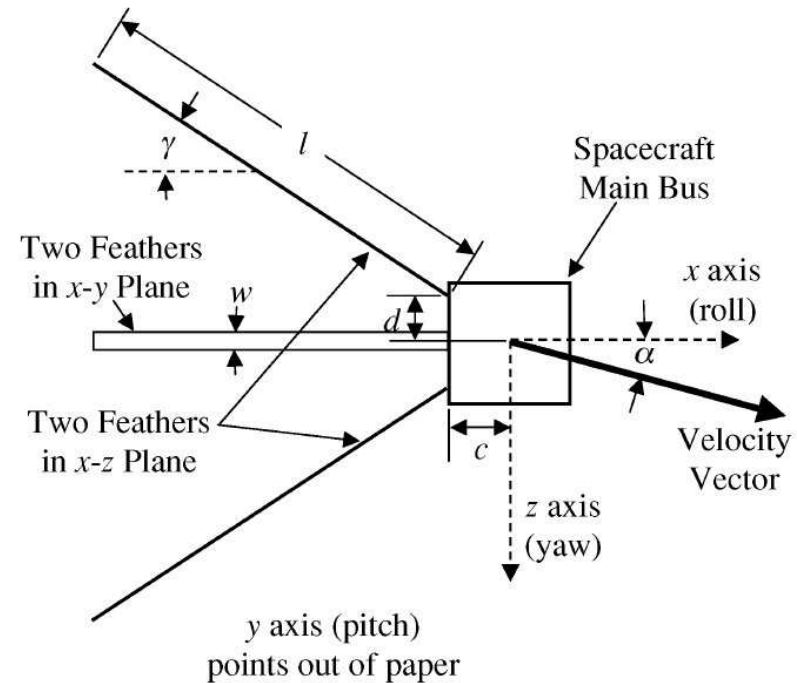




Aerodynamic control

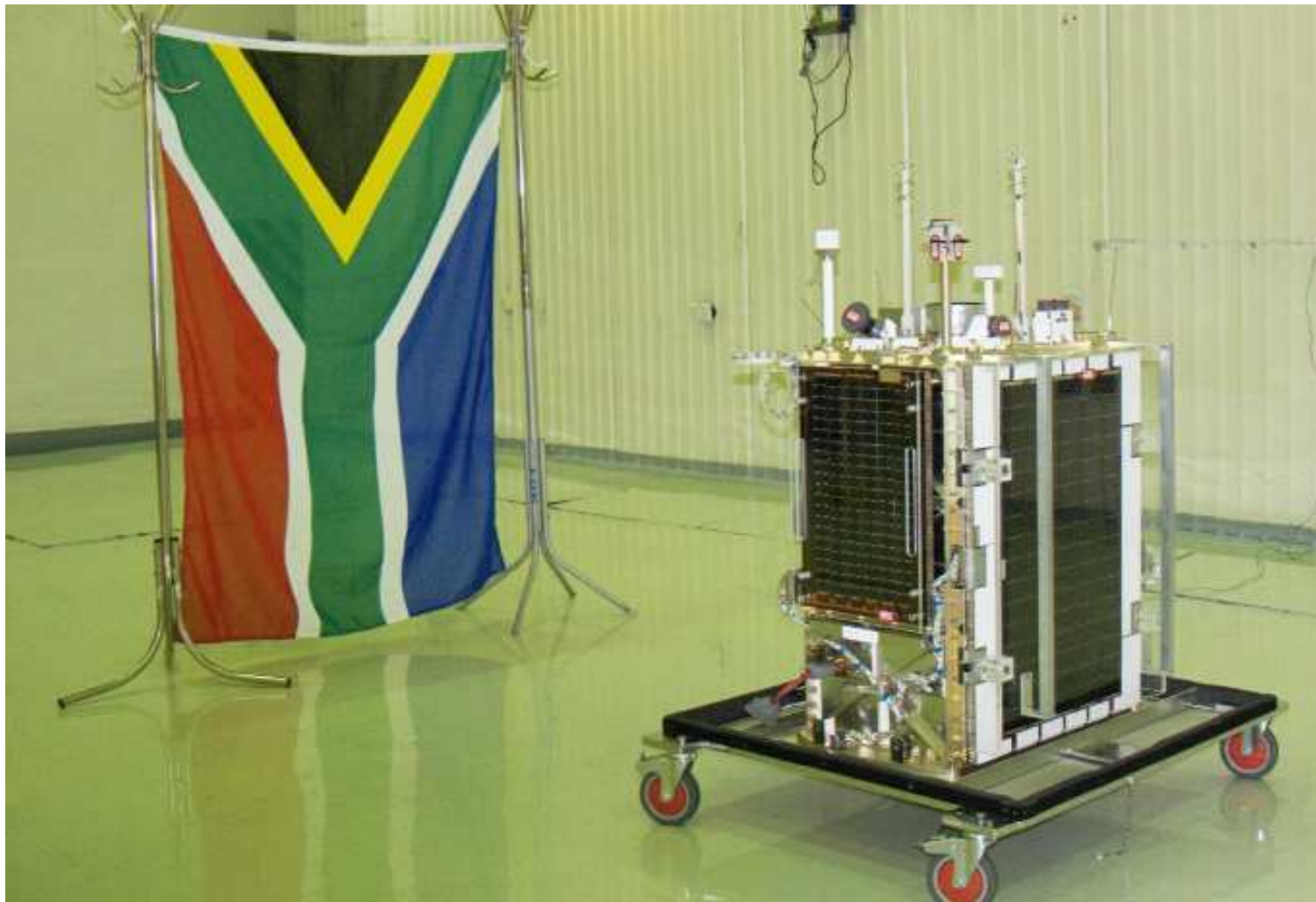


- 4 x 0.63 m feathers at $\gamma = 13$ deg angle
- Feathers also act as UHF & L-band RF antennas
- Stabilize pitch and yaw passively
- Deploy two small paddles to control roll using aerodynamic torque (wind mill effect)
- Use micro-stepper motor for paddle rotation adjustment
- Orbit altitude < 500 km preferred





Questions ?



1st Nanosat Symposium

11th June 2010