NRSCC Introduction

Important Mission and Activities

• EO mission — TANSAT
• New generation payload technology — Intensity Correlation Imaging Technology
• Calibration & Validation
• Data Sharing
NRSCC was one of branch centers of Ministry of Sciences and Technology of China (MOST), and established in 1981 with its mandate in domain of RS, GIS and Navigation:

- to guide and coordinate R&D activities,
- to manage China National Scientific project
- to facilitate the actions of Expert group of RS, GIS, Space explore and Navigation domain

- To support the development of innovation capacity and to foster the new industry
- Ten official staffs at present but many secondments
- The mode of “condensed kernel, wide network”
49 branches of NRSCC

- Technical support from the 49 branches of NRSCC, involved in most remote sensing teams in China

- Specific expert teams
  - Consultant team
  - Technical development and application team
  - Operation team
Overview of TANSAT

- Global CO₂ observation and monitoring
  - 4ppm CO₂ retrieval accuracy
- Satellite Mass: ~600 kg
- Launch: expected in 2015
- Lifetime: 3 years

2011.01~2013.05
Phase B

2013.06~2014.06
Phase C

2014.06~2015.03
Phase D
Payloads of TANSAT

CO₂ Spectrometer

Cloud and Aerosol Polarimetry Imager (CAPI)
A wide field of view moderate resolution imaging spectrometer with polarization channel

Platform

CO₂ Spectrometer
20km

CAPI
400km
Cal/Val of TANSAT

• **Specification**
  – 5%(absolute), 3%(relatively)

• **CO₂ Spectrometer(Once a day)**
  – Cal:
    • LED in instrument for spectrometric
    • Sun Calibration (by diffuser)
      – Spectrometric: look through atmosphere(limb)
      – Radiometric: look directly to
  – Val: TCCON

• **CAPI(radiometric, once a month)**
  – Calibration
    • LED in instrument
    • Sun: for relative and absolute
    • Moon for redundancy of Sun
  – TCCON for Validation
Ground-based Measurement Sites in China

**Ground sites**

<table>
<thead>
<tr>
<th>Site</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beijing</td>
<td>IFS125/HR +325mTower+7 Licor</td>
</tr>
<tr>
<td>Shenzhen</td>
<td>IFS125/HR CIMEL+MWR</td>
</tr>
<tr>
<td>Mobile St.</td>
<td>IFS 125/M</td>
</tr>
<tr>
<td>Shandong</td>
<td>Optical Spectrum Analyzer(OA)</td>
</tr>
<tr>
<td>Inner Mongol</td>
<td>Optical Spectrum Analyzer(OA)</td>
</tr>
<tr>
<td>Hainan Island</td>
<td>Optical Spectrum Analyzer(OA)</td>
</tr>
<tr>
<td>Urumqi</td>
<td>FGGGA/LGR</td>
</tr>
<tr>
<td>Waliguan</td>
<td>FGGGA/LGR</td>
</tr>
</tbody>
</table>

Calibration, Validation & a priori information
Intensity Correlation Imaging — an extension of GI

Ghost Imaging

Non-imaging bucket detector $D_1$

Entangled photon pair

Unknown target

no target

Photodetect or array $D_2$

Laser — laser 3D intensity correlation imaging

Sunlight — Single frame exposure multi spectral intensity correlation imaging

Microwave — Microwave staring correlation imaging
Intensity Correlation Imaging

- The first laser 3D intensity correlation imaging engineering prototype system (single-pixel 3D camera)

Left: normal image  Right: 3D image

Engineering prototype system
The first microwave staring correlation imaging verification experiment device

The acquired image is 10 times of the traditional real aperture imaging resolution according to the antenna size
Intensity Correlation Imaging

- Hyperspectral imagery reconstruction based on sparse dictionary

The hyperspectral imagery can be reconstructed with the intensity correlation imaging technique at the spectral-space.

- It was found that the reconstruction with sparse spectral dictionary has better performance than those with sym2 and DCT.
Stepwise Cal&Val System — To reduce the scale bias in linking the field measurement and RS data, and uncertainties of atmospheric RT simulation in the boundary layer.
Calibration & Validation

- Standard airborne Payloads
  - Hyperspectral camera
  - Large field multispectral imager
  - Interferometric SAR
  - Polarimetric SAR
- **Standard Targets** — various targets are integrated in one site.

Artificial portable targets

Artificial permanent targets

Natural ground scenes

Geometric calibration field
Calibration & Validation

- Ground measurement technical system

- VIS-IR Field Spectrometers
- Total station and GPS
- Water-leaving radiance measurement system
- Automatic Meteorological Station

- Multi-angle Observation System
- 3-D geometric calibration system
- Sun-photometer Cimel CE318
- Upper-air meteorological radar system
Based on Cal&Val site, radiometric calibration and sensors' performance testing have been performed against several Chinese high resolution satellite.

Calibration results of ZY-1 02C Multi-spectral camera

Calibration results of SJ-9A Multi-spectral camera

Calibration results of GF-1 Pan/Multi-spectral camera
Participate in the form of RADCALNET

Aims at an prototype of “global calibration” traceable to SI, CEOS/IVOS WG agreed to set up the RADCALNET (Radiometric Calibration Network of Automated Instruments). The first RADCALNET WG meeting took place at ESTEC on 13th and 14th of January 2014.

- Four sites to provide data to RADCALNET:
  - AOE Baotou site (China)
  - La Crau site (France)
  - Railroad Valley Playa site (US)
  - ESA Site TBD (ESA/CNES)

- NPL (UK) provides support in harmonization, traceability, instrument calibration and QA4EO
Aerospace application coordination system for emergency response and data sharing (ArcSer)

- ArcSer provides functions to schedule in harmony various civil aerospace resources to acquire aerospace remote sensing data of stricken area, and distributes the data to relevant institutions involved in disaster reduction as soon as possible.
- AOE acts as the Earth Observation Data Center for Emergency Response which is one of the most important supporting units of ArcSer.
During the emergency response for the Ms7.0 earthquake happened in Lushan County of Ya'an, Sichuan Province at UTC 0:02 on April 20, 2013. AOE aggregated a huge amount of aerospace remote sensing data acquired before and after the earthquake, and distributed them to more than 45 institutions which are affiliated with 20 different Ministries.

<table>
<thead>
<tr>
<th>Before earthquake</th>
<th>After earthquake</th>
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<tbody>
<tr>
<td>• HJ-1A/1B/1C</td>
<td>• HJ-1A/1B</td>
</tr>
<tr>
<td>• ZY1-02C</td>
<td>• UAV airborne image of YaAn</td>
</tr>
<tr>
<td>• ZY3</td>
<td>• UAV airborne image of LuShan</td>
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<tr>
<td>• SPOT2/4/5</td>
<td>• RISAT</td>
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<tr>
<td>• SJ-9</td>
<td>• SJ-9</td>
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<tr>
<td>• Rapid eye</td>
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<tr>
<td>• Radarsat-2</td>
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Remote Sensing Data Sharing

CEOS catalogue service standard access system

This system can integrate Chinese satellite data and provide information to CEOS/WGISS Integrated Catalogue (CWIC) System.

- **Data service access system**
- Conform to the OGC standards CSW and ISO 19115-2
- Promote international sharing and using of Chinese remote sensing satellite data
Remote Sensing Data Sharing

Situation of EO for Emergency Response

- Hardly to be satisfied in single mission
- Technical requirements of the sensor are inter-restricted
Virtual Image Construction Based on Sparse Coding

- Satellite image pre-processing
- Redundant dictionary construction based on LR and HR image
- HR variation image construction based on sparse coding
- HR reconstruction image
- Unified integration model of spatial and temporal data
Virtual Image Construction Based on Sparse Coding

Remote Sensing Data Sharing
Virtual Image Construction Based on Sparse Coding

Observed MODIS Image

Observed LANDSAT Image

Predicted LANDSAT Image
Thank you for attention!