

Strumenti e tecniche a supporto dei dati iperspettrali

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Data Exploitation della missione PRISMA, precursore delle missioni iperspettrali nazionali



Scope

- Tools and competences developed from Planetek for consulting, processing and compression of hyperspectral data.
 - Physis H2020 project
 - SpaceOP3C
 - SpaceBIT
- Usage in space and ground environment
- Exploitation scenarios

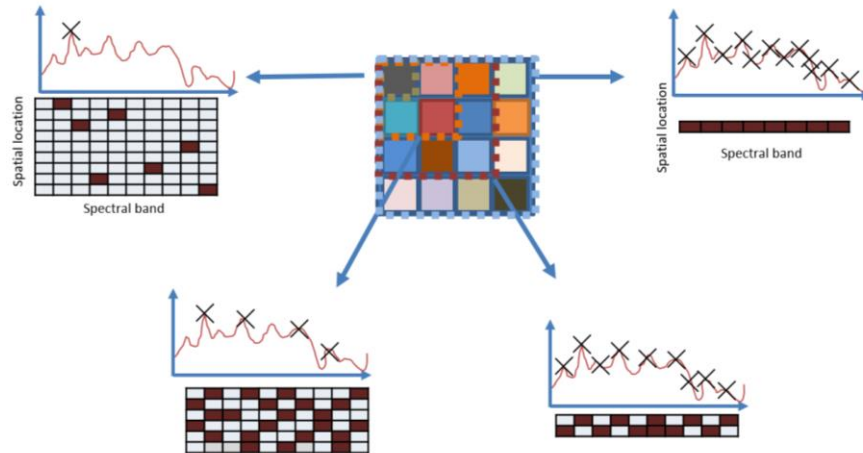
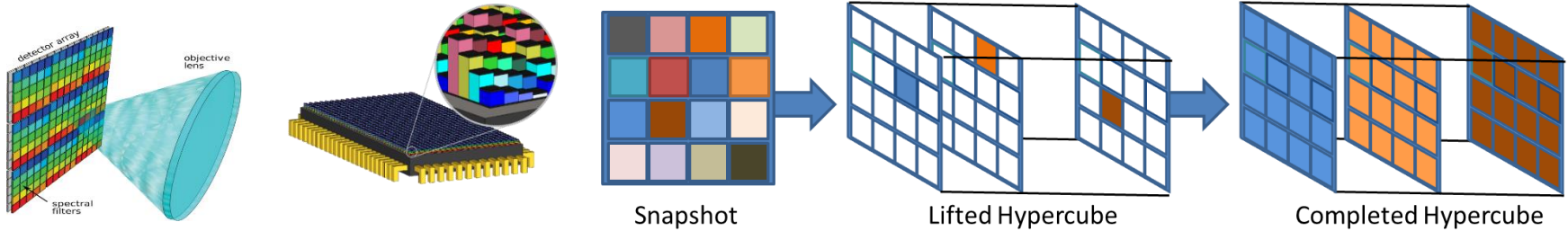
Sparse Signal Processing Technologies for Hyperspectral Imaging Systems



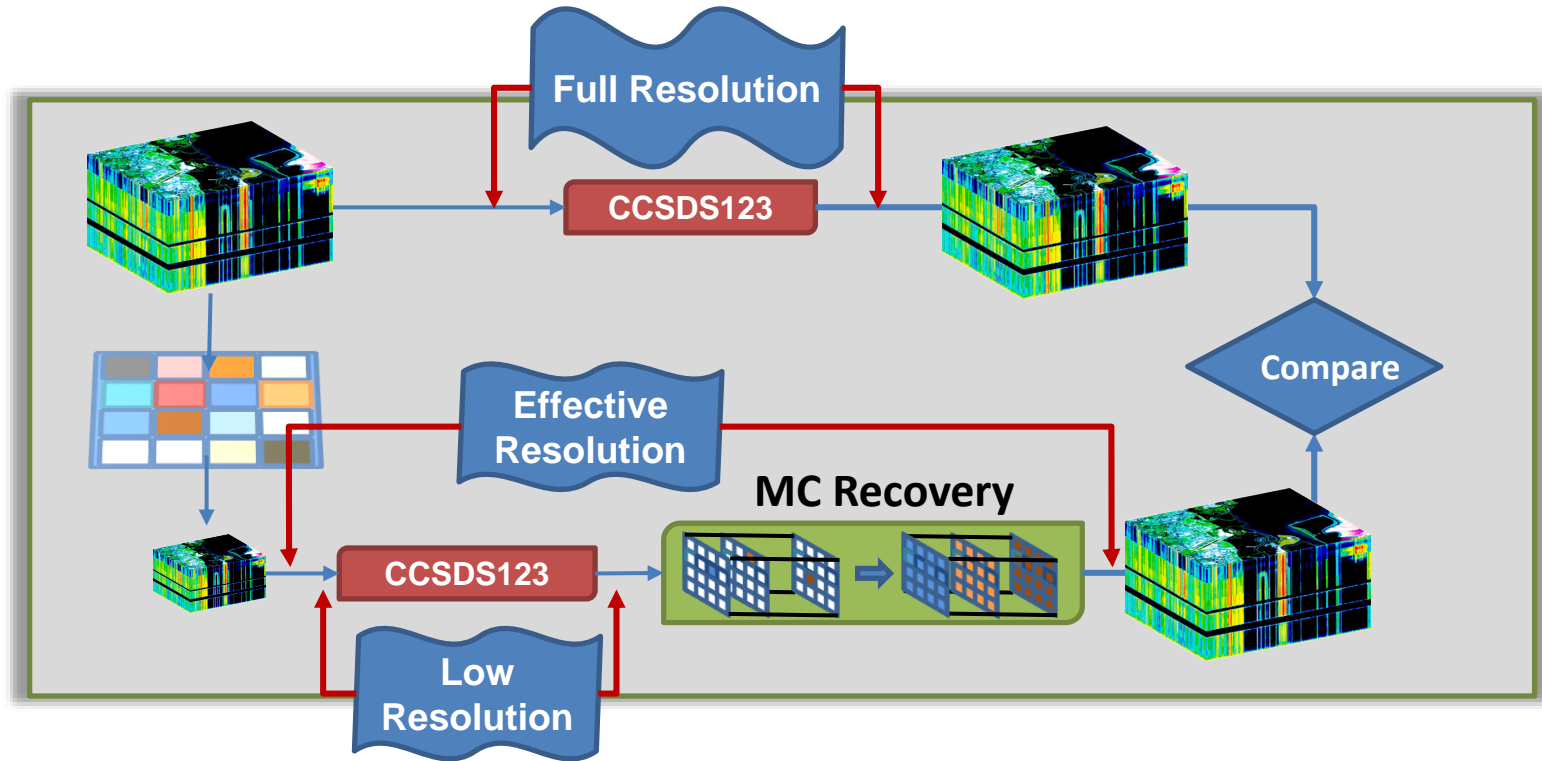
- Compressive signal representations and sparsity-enforcing recovery technologies for the Acquisition, Compression, Restoration and Understanding of hyperspectral data
- H2020-COMPET-6-2014
 - Bottom-up space technologies at low TRL



Acquisition & Demosaicing



Experimental Protocol



Datasets

- Salinas
- Botswana
- Pavia University

CCSDS-123

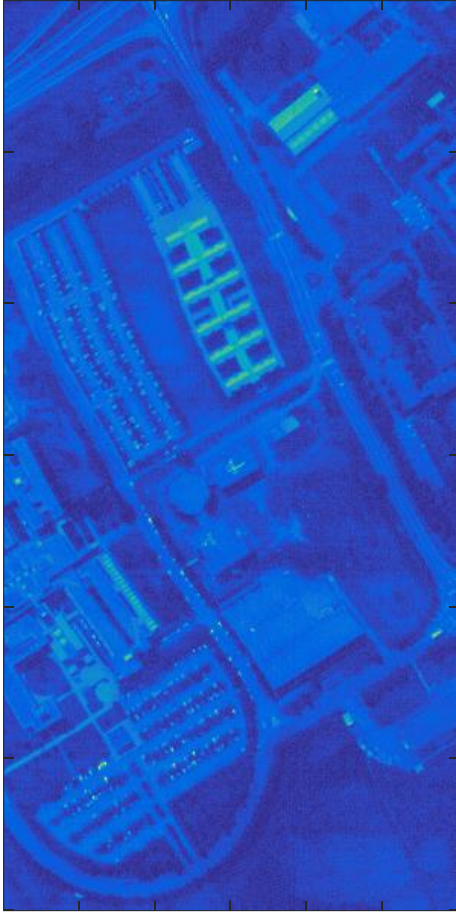
- eRice Encoder
- 15 band prediction

Metrics

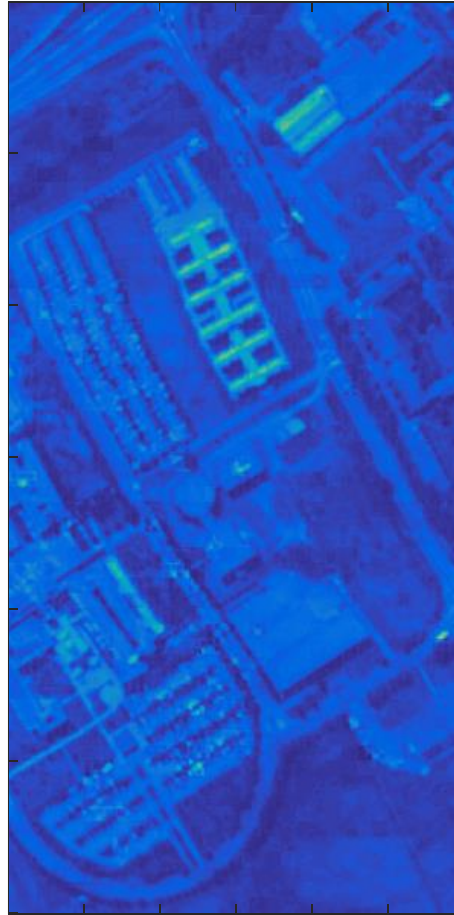
- Peak SNR
- Structural Similarity IM
- Compression Ratio

Salinas – 25 bands

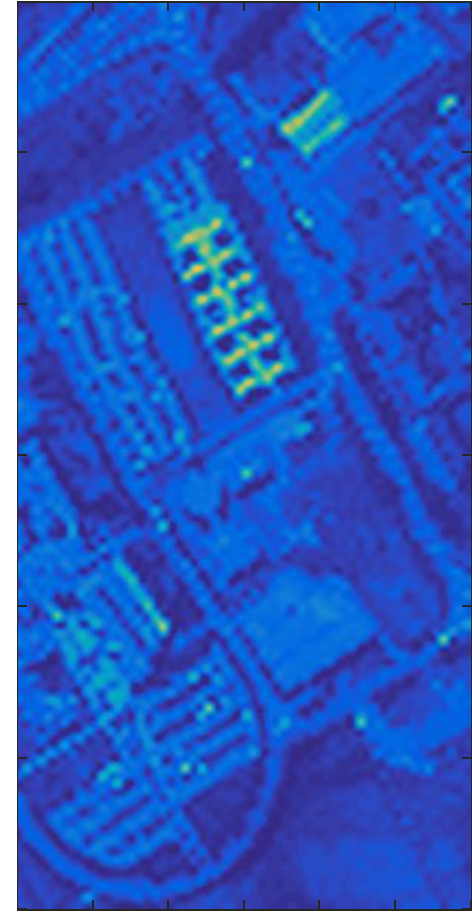
High resolution GT, Band 4



Reconstructed (MC), Band 4, 31.07dB



Reconstructed (INT), Band 4, 24.92dB



Reconstruction Quality & Compression Ratio

| Sequence | PSNR | | | | SSIM | | | |
|----------|----------|------|----------|------|----------|------|----------|------|
| | 16 bands | | 25 bands | | 16 bands | | 25 bands | |
| | MC | INT | MC | INT | MC | INT | MC | INT |
| Salinas | 40.3 | 27.2 | 37.9 | 26.7 | 0.96 | 0.81 | 0.95 | 0.81 |
| Botswana | 31.1 | 22.9 | 45.0 | 37.3 | 0.79 | 0.58 | 0.97 | 0.93 |
| Pavia U | 31.0 | 26.5 | 29.7 | 25.1 | 0.82 | 0.67 | 0.82 | 0.64 |

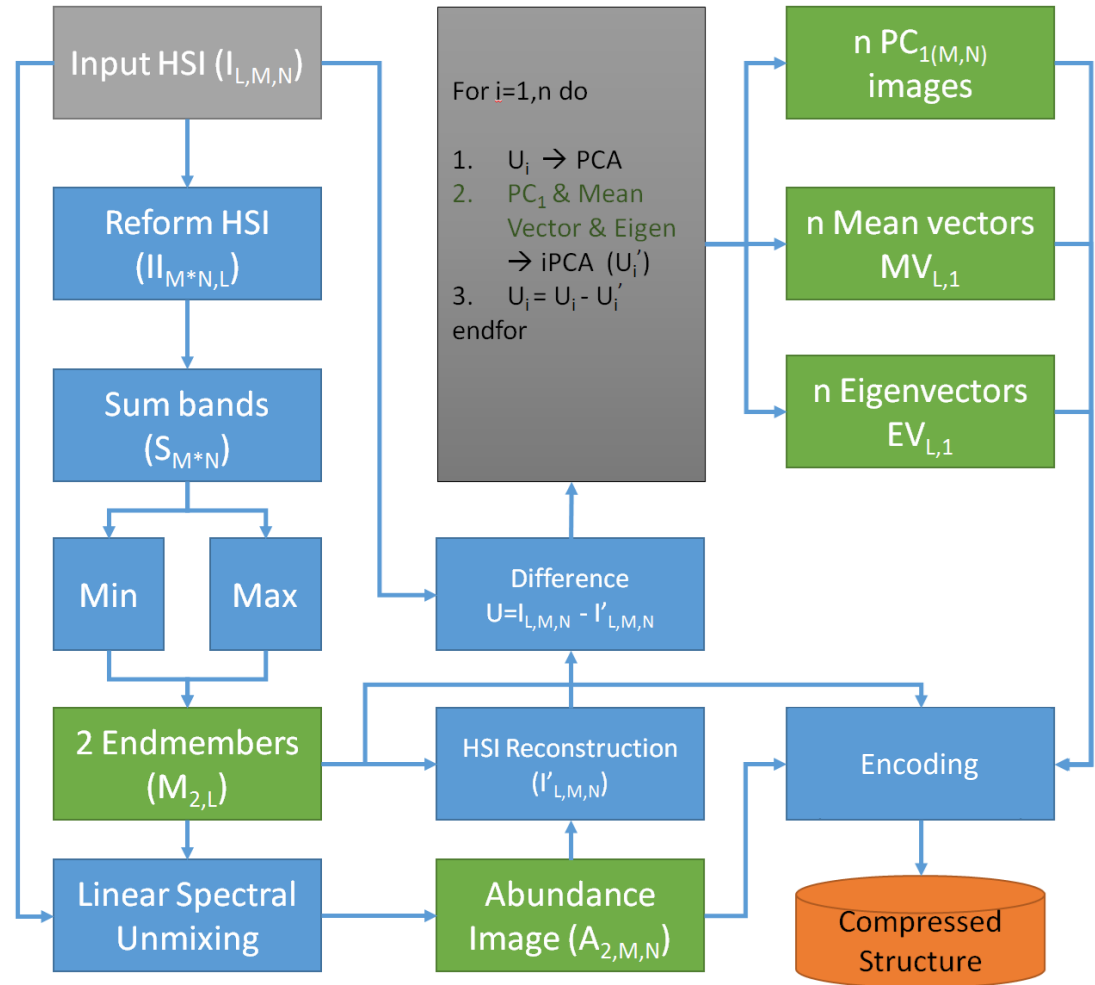
| Sequence | 4x4 | | | 5x5 | | |
|----------|-------------------|------------------|----------------------|-------------------|------------------|----------------------|
| | Full Res lossless | Low Res lossless | Effective Resolution | Full Res lossless | Low Res lossless | Effective Resolution |
| Salinas | 11.36 | 4.53 | 72.48 | 11.43 | 4.25 | 106.25 |
| Botswana | 7.34 | 3.47 | 55.52 | 6.98 | 3.52 | 88.0 |
| Pavia U | 9.87 | 3.99 | 63.84 | 9.76 | 3.85 | 96.25 |



- **O**n-board **P**rocessing for **C**ompression and **C**louds **C**lassification
- A near-lossless algorithm named HUNPCA (Hybrid Un-mixing Principal Component Analysis) exploiting
 - spectral un-mixing and
 - principal component analysis
- A clouds classification technique to identify “un-useful” samples and optimize performances.

SpaceOP3C Compression schema

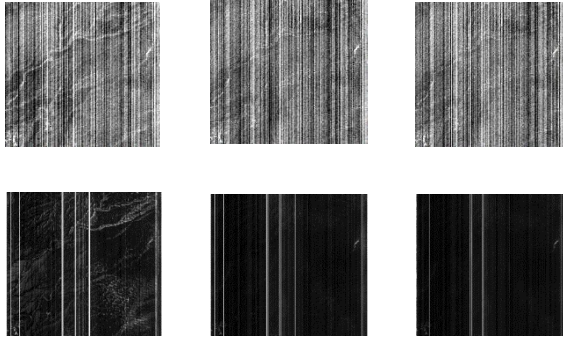
- Un-mixing
- Principal Components Analysis
- Encoding



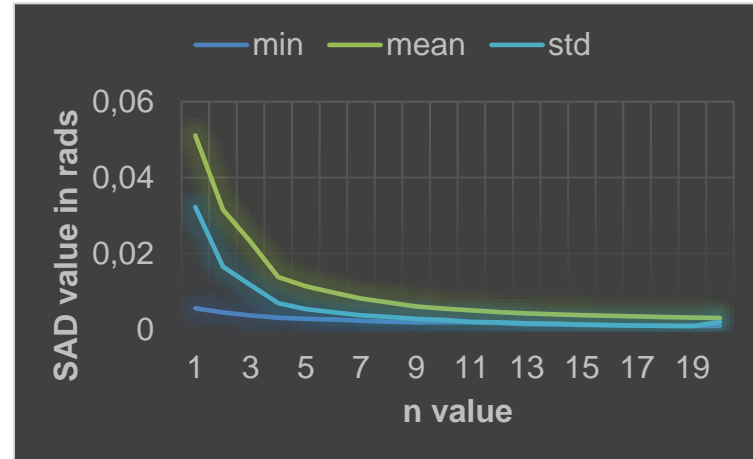
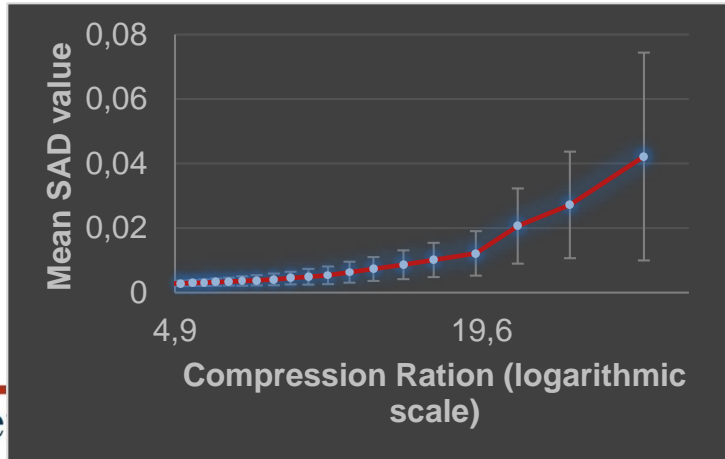
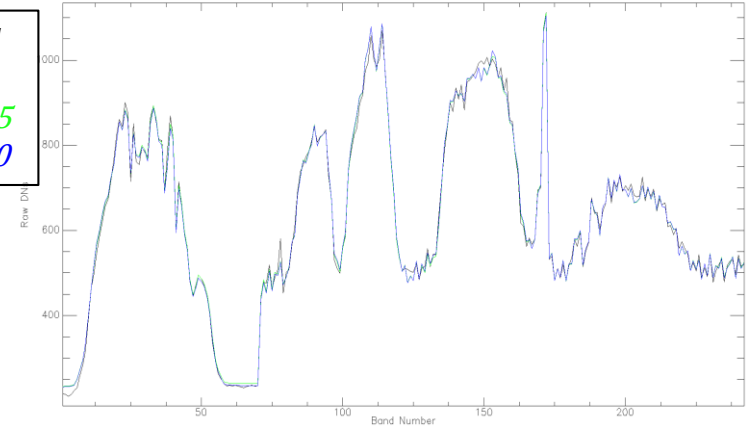
SpaceOP3C Result on Hyperion Dataset

Absolute and Spectral Angle Distance Errors

$n = 3$ $n = 5$ $n = 10$



(black) full
 (red) $n=3$
 (green) $n=5$
 (blue) $n=10$



SpaceOP3C Results on Hyperion

Comparison with CCSDS Recommended Standards

| Compressor | CR | Mean SAD | RMSE |
|------------------------|-------------|--------------|----------------|
| CCSDS 121.0 (lossless) | 1.28 | | |
| CCSDS 122.0 (lossless) | 1.11 | | |
| CCSDS 122.0 (lossy) | 2.99 | 0.10 | 20.831 |
| CCSDS 123.0 (lossless) | 2.39 | | |
| OP3C (near lossless) | 4.8 – 15.97 | 0.01 – 0.002 | 6.823 – 17.603 |

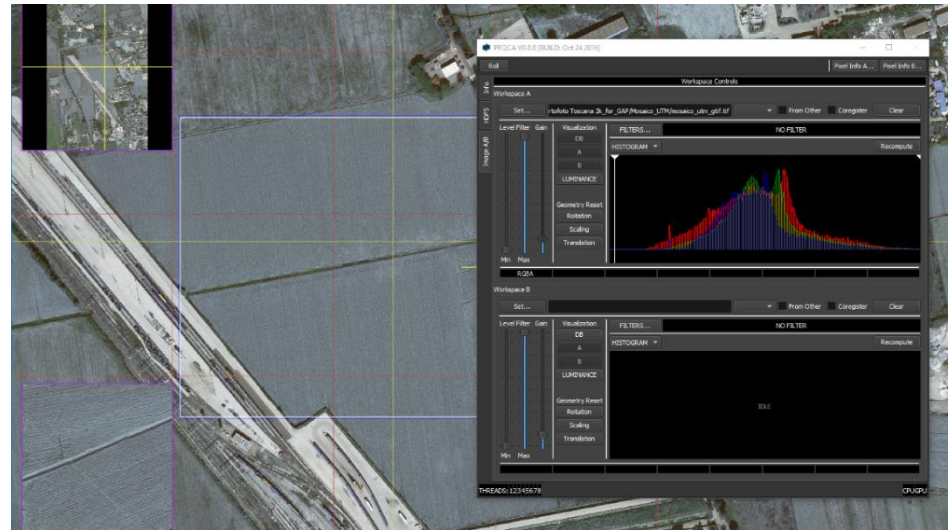
SpaceBIT



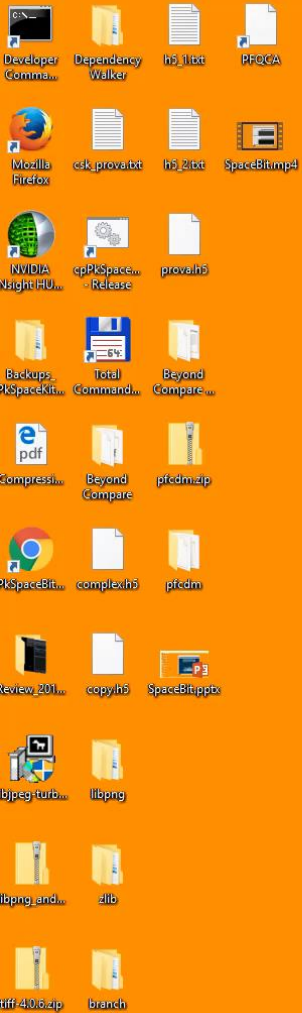
Very Big Image Tool based on GPU

- Desktop application for Big Image & Data visualization (HDF5 & Tiff)
- GPU based acceleration Engine (OpenGL, Vulkan, OpenCL, Metal) for real-time visualization, graphical operation, image filtering and processing
- Integrated with FAST4MAP ASI co-funded program
- Multi-display support
- Plugin architecture
- Open to other image formats
- Open to other image processing tools
- Could be the base for activities related to Calibration & Validation, Mission Performance Assessment, Quality Control Tool

spaceBIT video



SpaceBIT



Thank you!

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