

# AI as an Instrument

WORKSHOPS

Beyond Static Imagery toward Burst Video Mode in  
Very High-Resolution imaging

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ARTIFICIAL INTELLIGENCE AND EARTH OBSERVATION:  
FROM INNOVATION TO SERVICES

9 - 10 MARCH 2026

BRUSSELS, BELGIUM

Static version :  
videos and animations not included



# AI as an Instrumental Extension of Earth Observation System

A paradigm shift: from processing that supports the instrument to processing that becomes the instrument

Static version:  
videos and animations not included



01

## Traditional Paradigm



### Processing supports the instrument

Payload capture raw data; processing corrects and formats it downstream



Instrument



Processing



Static Output

- **Sequential, decoupled steps** — Instrument and processing designed independently; calibration & correction applied post-capture.
- **Hardware-bound quality** — Resolution, noise, and coverage tied directly to instrument performance, driving up mass, volume, and cost.
- **Processing ceiling** — Downstream algorithms can compensate for artefacts but cannot extend beyond what the sensor natively captures.
- **Information loss by design** — Acquired data reduced and collapsed during processing; exploitable information irreversibly discarded

02

## AI Extended Instrument



### Processing becomes the instrument

Payload, processing and AI are co-designed as a single system



Instrument

+



Processing

+



AI

New Data Products

*Extended Instrument* ▶ Unified, intelligent instrument

- **Coded apertures** - Partial-aperture optics paired with AI decoding achieve full resolution from a fraction of the collecting area.
- **Coded pupil-plane encoding** - Diffractive elements in the pupil plane encode spectral information; AI recovers multispectral bands without physical filter hardware.
- **Burst Video Mode** - TDI frames retained, not collapsed; AI denoising, optical-flow alignment & deblurring produce a superior still *and* a coherent video from a single pass.

# AI as an Instrumental Extension of Earth Observation System

Burst Video Mode – Unlocking the Temporal Dimension of VHR Imaging

Static version:  
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01

## Traditional Paradigm

Temporal data discarded after TDI



### Burst Capture

Rapid frame sequences across focal plane



### TDI Integration

Frames accumulated → single high-SNR exposure



### Frames Discarded

Temporal information permanently lost



### Static Image Only

No motion, no depth, no temporal context

• Single static output

02

## AI Integrated Paradigm

Temporal dimension preserved – processing becomes the instrument



### Burst Capture

Rapid frame sequences across focal plane



### TDI + Retention

Accumulates SNR and preserves frame sequence



Encoded Measurements



Optical Flow



Motion-Aware Deblurring



Spatio-Temporal Denoising



Super-resolution

*Extended Instrument*



Still Image



Video Clip

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## RAW

Radiometric & geometric correction

Classical Instrument

MTF

SNR

Temporal

## L0

Radiometric & geometric correction

Classical Instrument

MTF

SNR

Temporal

## L0 - Burst Video Mode

AI-driven processing

Extended Instrument

MTF

SNR

Temporal

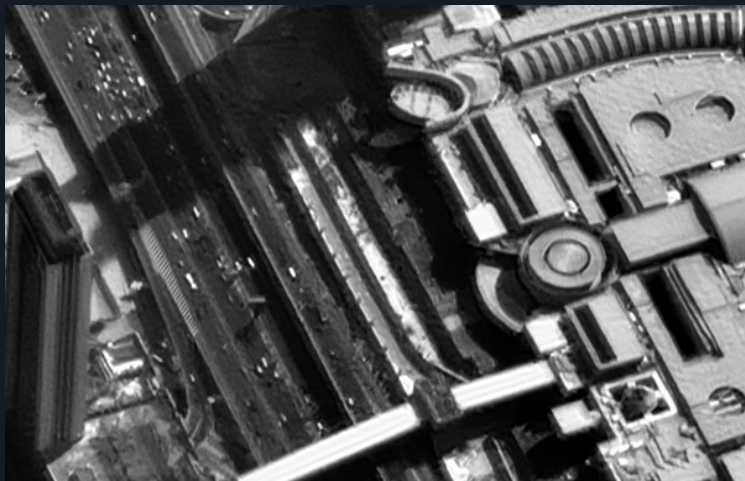
# AI as an Instrumental Extension of Earth Observation System

Burst Video Mode – Unlocking the Temporal Dimension of VHR Imaging

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ZONE A - TRAFFIC

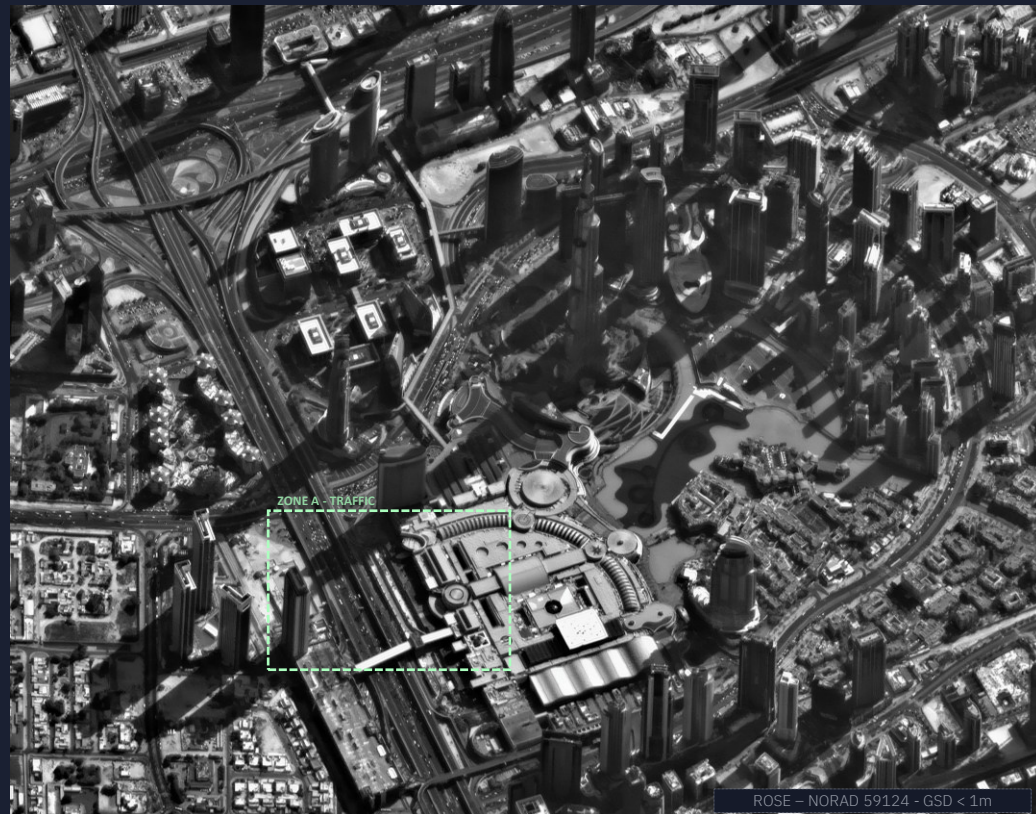
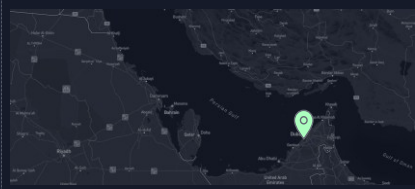


## Parallax

In this image, parallax effects can also be seen on very tall buildings, caused by differences in the viewing angle across the acquisition sequence.

## Burj Khalifa, Dubai

25° 11' 35.82" N, 55° 16' 45.25" E | 2025-10-27, 10:34:5220 UTC



ROSE – NORAD 59124 - GSD < 1m

# AI as an Instrumental Extension of Earth Observation System

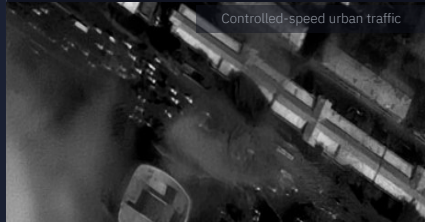
Burst Video Mode – Unlocking the Temporal Dimension of VHR Imaging

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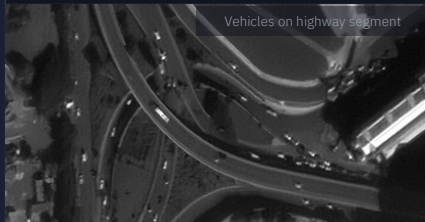
**ZONE A - TRAFFIC** ●

Controlled-speed urban traffic



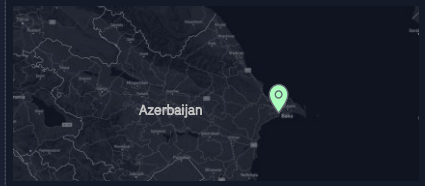
**ZONE B - TRAFFIC** ●

Vehicles on highway segment



**Baku, Azerbaijan**

40° 22.5403' N, 49° 50.0092' E | 2024-12-12, 10:57:59:410 UTC



# AI as an Instrumental Extension of Earth Observation System

Burst Video Mode – Unlocking the Temporal Dimension of VHR Imaging

Static version:  
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## Representative Sample of Ground Vehicle Motion Detected

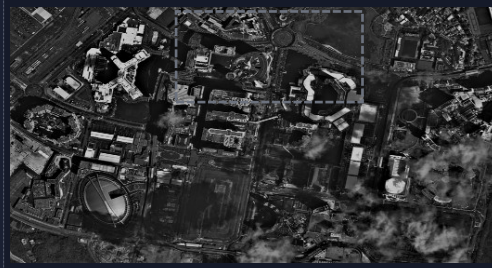
### Vehicle #1

68 km/h | 14° | -20 m  
T+0.00s | Disp 0 m | Conf 0.66

### Vehicle #6

98 km/h | 190° | -14 m  
T+0.00s | Disp 0 m | Conf 0.75

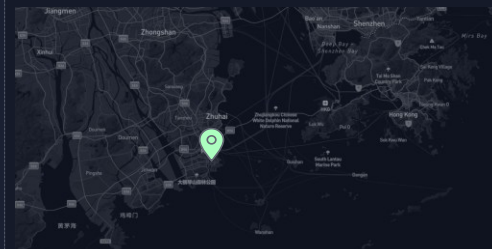
## Very-High-Resolution (VHR) - Full Scene Acquisition



## Macau, China

40° 22.5403' N, 49° 50.0092' E

2025-09-14, 06:48:14.395



# AI as an Instrumental Extension of Earth Observation System

Burst Video Mode – Unlocking the Temporal Dimension of VHR Imaging

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## Airplane #1

Take-off  
Accelerating Velocity Profile



time

velocity

## Airplane #2

Approaching Gate / Dock  
Decelerating Velocity Profile

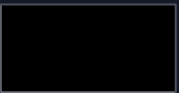


time

velocity

## Airplane #3

Maneuvering / Taxiing  
Constant Speed Profile



time

velocity

## Sydney Kingsford Smith Airport, Australia

33° 56.1957' S, 151° 10.0593' E | 2026-01-30, 03:59:18.230 UTC

