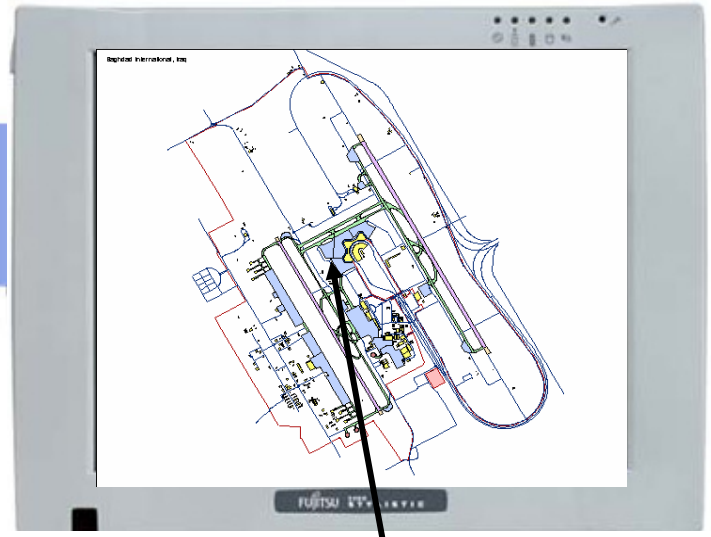


Baghdad

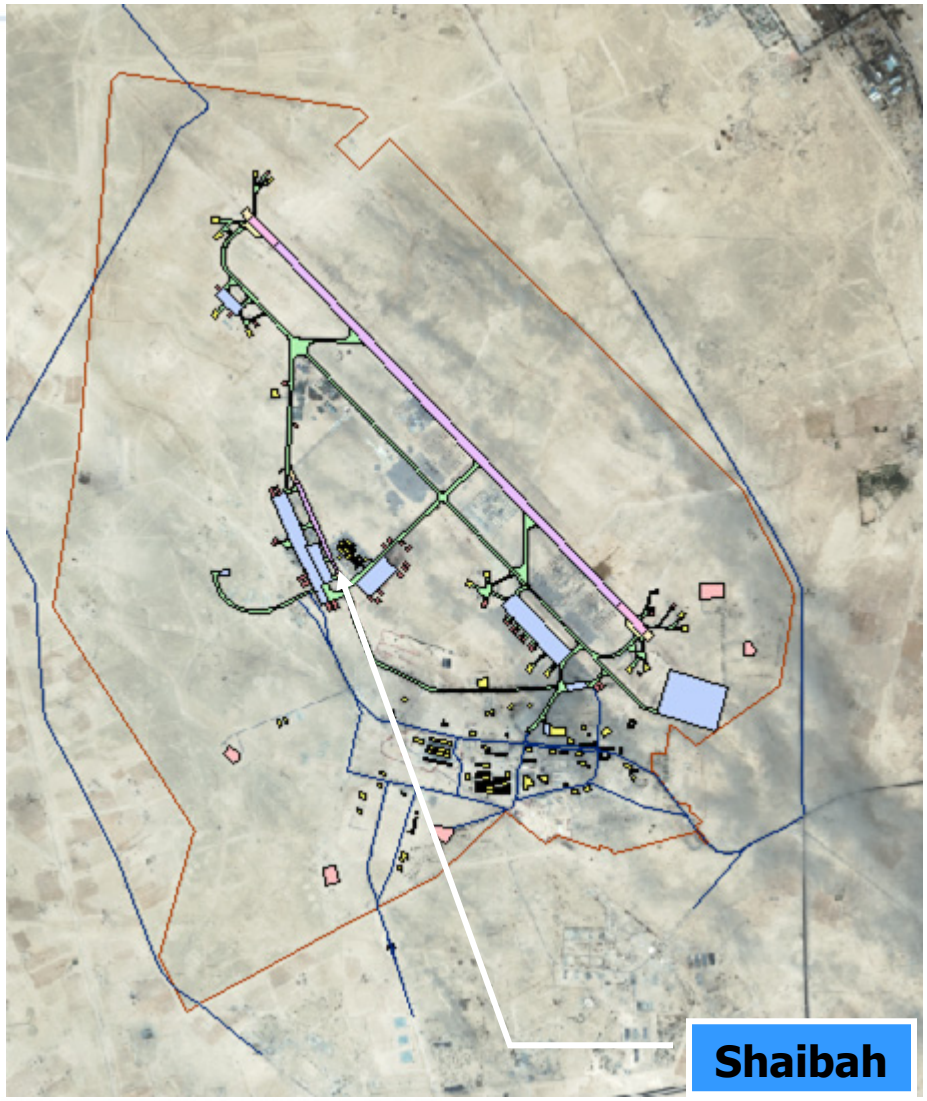
# JACIE 2004 – Day 2: Airport Mapping and Perpetual Monitoring using IKONOS

Research & Application Session – 13:30

SPACE IMAGING®
Visual Information. Visible Results.

# Airport Mapping Databases from IKONOS

- Iraqi Freedom Experience
- Overview & Problem
- Airport Mapping Databases
- Complete Life Cycle
- Common Repository
- Automated Feature Extraction
- Questions?



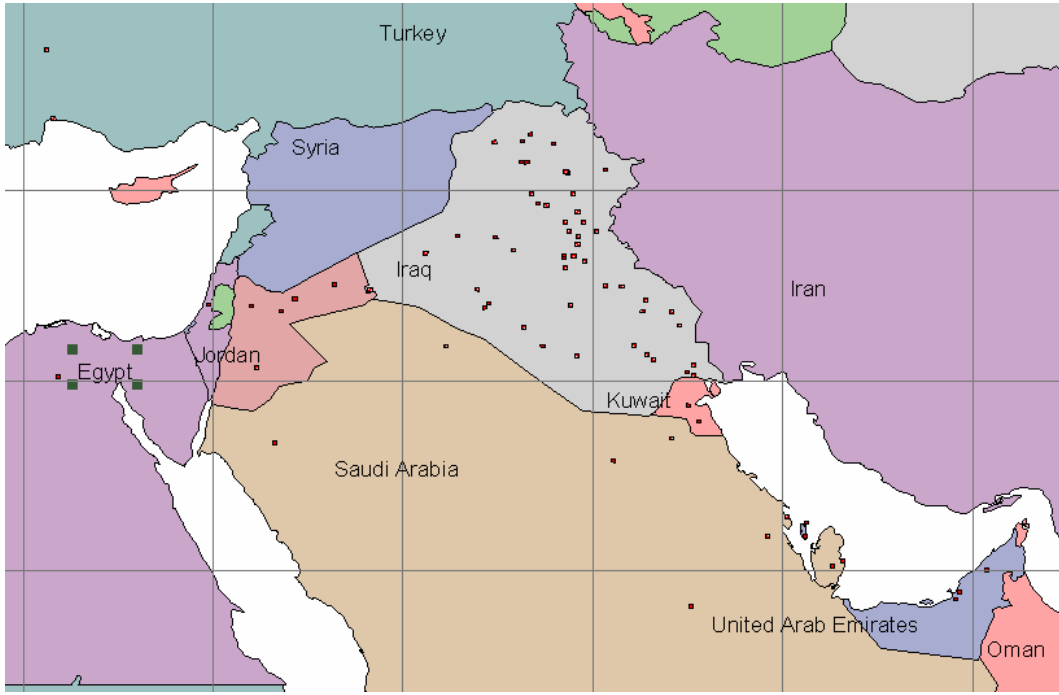



SPACE IMAGING®
Visual Information. Visible Results.

# What was the problem we were solving?

SI was approached by USAF to aid their operations in Iraq:

- Imagery & Vector Feature Extraction at Coalition Airfields
- Imagery & Vector Feature Extraction at Iraqi Airfields
- **Close to 100 airfields in total for USAF/ACC & USCENTAF**






SPACE IMAGING®
Visual Information. Visible Results.

# The Problem:

- How can be build Airport Mapping Databases for all potential Civil & Military airports worldwide in a cost-effective manner, to enhance operational & all-weather safety?
- How can we keep those AMDB's up to date with changes due to construction or unplanned events (wars, floods, other natural or political events).
- How can we alert the user community that an updated AMDB has been issued for a particular airport, so that they use the correct one for all future missions?

SPACE IMAGING®
Visual Information. Visible Results.

# Airfield Surface - APRON

**Features to be collected as part of airfield surfaces**

- **Aprons**
- Area that is not runway, nor taxiway, used for the surface movement of aircraft.
- Must be accessible by the aircraft!
- All Yellow areas in this image

SPACE IMAGING®
Visual Information. Visible Results.

# Airfield Surface – Hard Stands

**Features to be collected as part of airfield surfaces**

- **Hardstands**
- Area that is not runway, nor taxiway, used for the **Parking** of aircraft
- This would be a subset of the entire Apron
- Yellow areas in this image, highlighted by the blue circle.

SPACE IMAGING®
Visual Information. Visible Results.

# Airfield Surface – Hard Stands

**Features to be collected as part of airfield surfaces**

- **Hardstands**
- These may also be isolated from the ramp area, as is often the case in military fields

SPACE IMAGING®
Visual Information. Visible Results.

# Airfield Surface - Runways

**Features to be collected as part of airfield surfaces**

- **Runways**
- Actual landing surface for the aircraft.
- Numbers on the end indicated magenetic heading, less the last digit = e.g. 240 degrees is runway 24
- Red areas in this image, highlighted by the green circle.

SPACE IMAGING®
Visual Information. Visible Results.

# Airfield Surface – Runway Ends

**Features to be collected as part of airfield surfaces**

- **Runways ends**
- Actual landing threshold for the aircraft.
- Numbers on the end indicated magenetic heading, less the last digit = e.g. 240 degrees is runway 24
- Red areas in this image, highlighted by the green circle.

SPACE IMAGING®
Visual Information. Visible Results.

# Airfield Surface - Overruns

**Features to be collected as part of airfield surfaces**

- **Overruns**
- Portion of the runway used to stop the aircraft in the case of rejected takeoff.
- This would be a subset of the entire runway at the end of the runway
- Yellow areas in this image, highlighted by the blue circle.

SPACE IMAGING®
Visual Information. Visible Results.

# Airfield Surface - Taxiway

**Features to be collected as part of airfield surfaces**

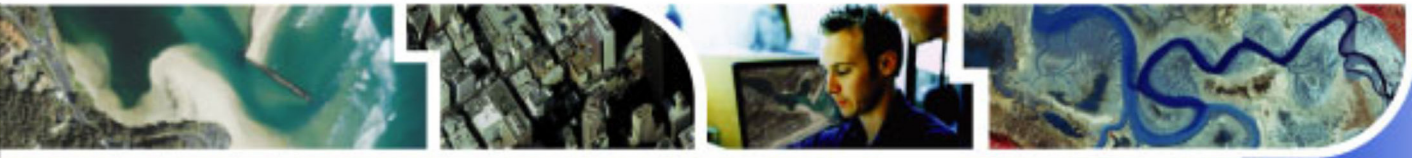
- **Taxiway**
- Used to move aircraft from Apron or Hardstand to Runway
- International convention is that they are numbered by letters, and segmented by numbers after the letter
- Orange areas in this image, highlighted by the blue square.

SPACE IMAGING®
Visual Information. Visible Results.

# A Common Repository of many standards?

Here is a partial list of current airport standards being used:

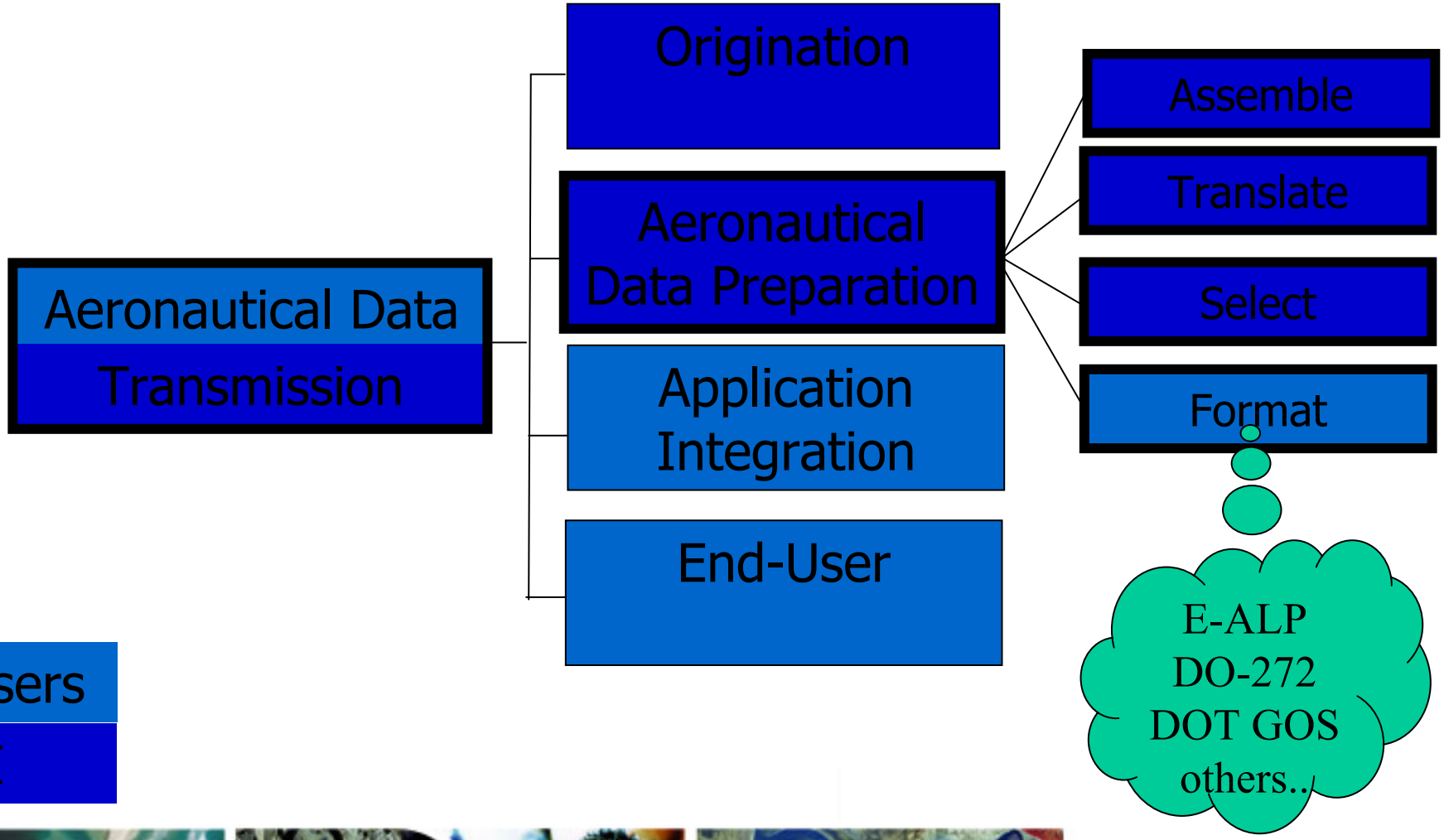
- United States Imagery and Geospatial Information Service(USIGS) Conceptual Data Model, Transportation View Extract, published by NGA
- Spatial Data Standards (SDS) for Facilities, Infrastructure, and Environment (FIE) , published by the ACE
- FAA AC-150/5300-13 Airport Layout, published by RTCA
- DoD-FLIP Digital Working Group, published by NGA
- Electronic ALP initiative, published by the FAA
- DO-272 AMDB, published by the RTCA
- Geo-Spatial One-Stop AirMAT, published by DOT





SPACE IMAGING®
Visual Information. Visible Results.

# DO-200A: For Aeronautical Data, a common Quality Standard




Users

SI



SPACE IMAGING®
Visual Information. Visible Results.

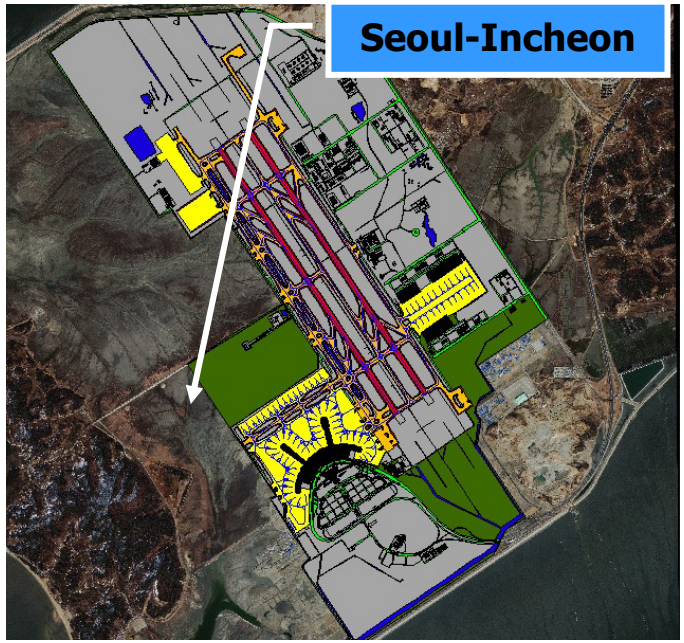
# A life Cycle for Airport Monitoring

(1) Construct GIS Database

(2) Monitor Airports

(3) Update GIS Database

(4) Advise all Users



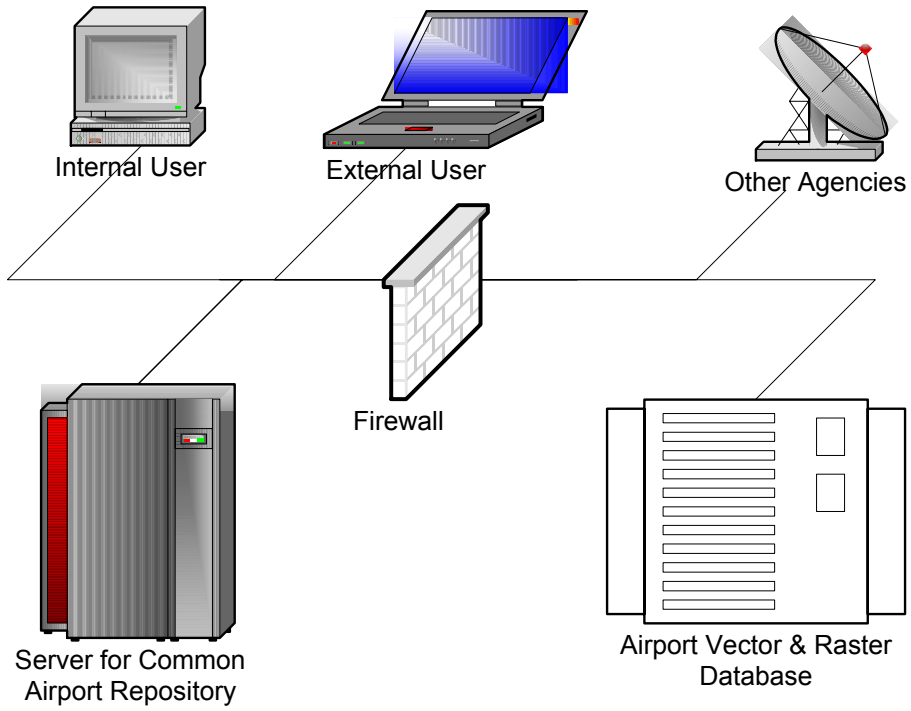



SPACE IMAGING®
Visual Information. Visible Results.

# Key Concept – Single *Logical* Repository

**Do more airport monitoring with less resources by:**

- Single logical repository that supports maintenance for multiple formats.
- Single logical repository that collects all appropriate imagery metadata for change history tracking.
- Single Life Cycle process(s) to collect, import, and make decisions based on published government source and other published information. Also support non-standard inputs to airport change notification, such as Intel.
- Single logical point of notification when changes occur, to all affected parties.






SPACE IMAGING®
Visual Information. Visible Results.

# (1) Construct AMDB

Implement the following program:

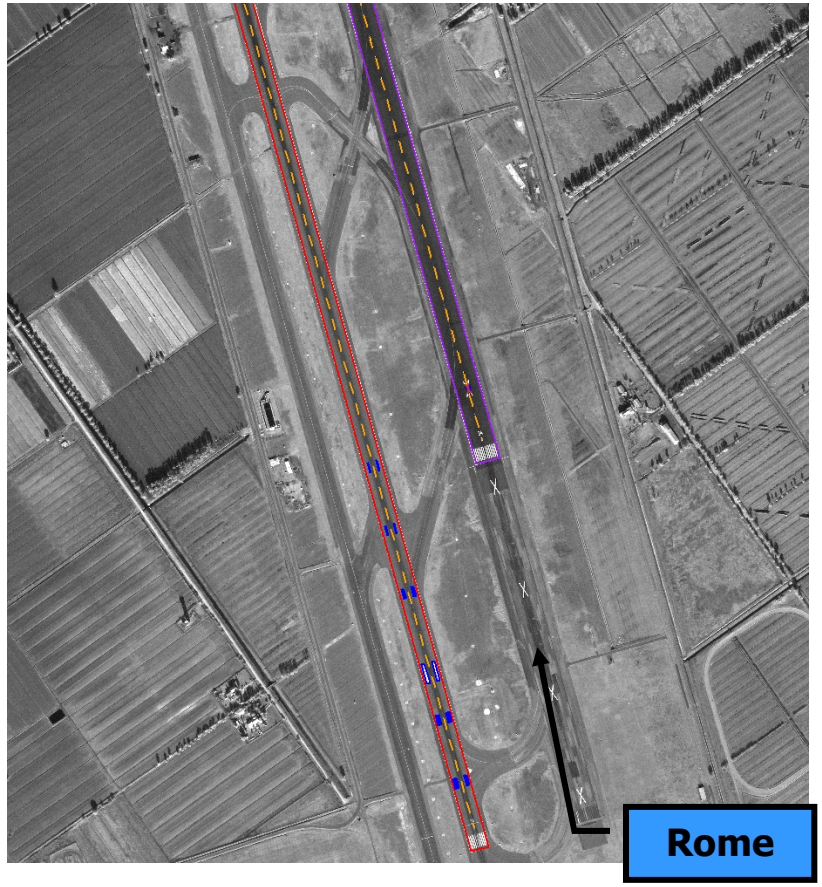
- Imagery Acquisition
- Ground Control
- Manual Vector Feature Extraction
- Automated Vector Feature Extraction
- Attribution
- Validation
- Publication to NGA/DoD/FAA

SPACE IMAGING®
Visual Information. Visible Results.

# (2) Monitor Airports for Changes

**Implement the following program:**

- **Collect temporary and permanent changes from AIS amendments or NOTAMS.**
- **Determine if we are looking for Known changes, or monitoring for missed changes**
- **Evaluate issues that affect airport:**
  - Age of Last Imagery.
  - Priority in Commercial aircraft movements, intersecting runways (LAHSO).
  - Construction Changes
  - NOTAM's issued.
  - TFR or other Homeland Security issues
- **Trigger new IKONOS acquisition!**



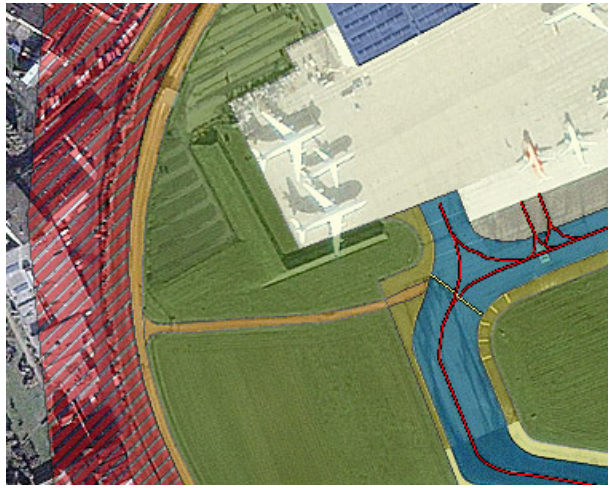


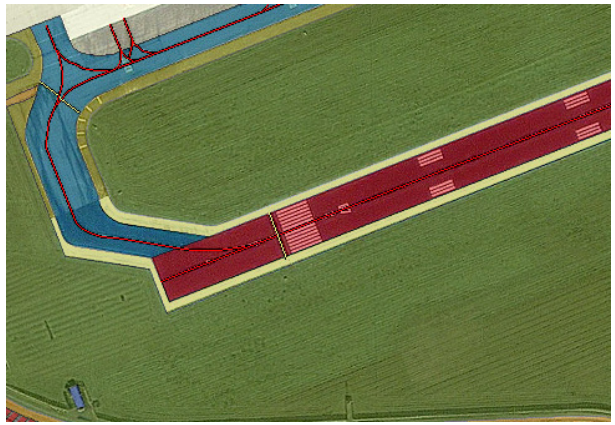

SPACE IMAGING®
Visual Information. Visible Results.

# (3) Update AMDB's

Implement the following program:

- Rectify new imagery to Ground Control.
- Update AMDB as required.
- Perform all needed DO-200A tasks.
  - Audit trail back to satellite image.
  - Change History of AMDB.
  - Edit and Validation Process.
  - Posting to "output" queue.
- New AMDB issued!





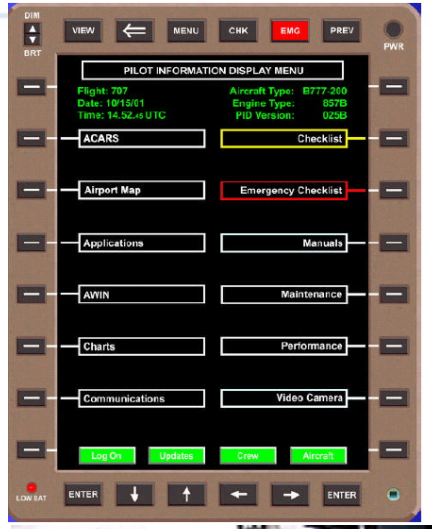


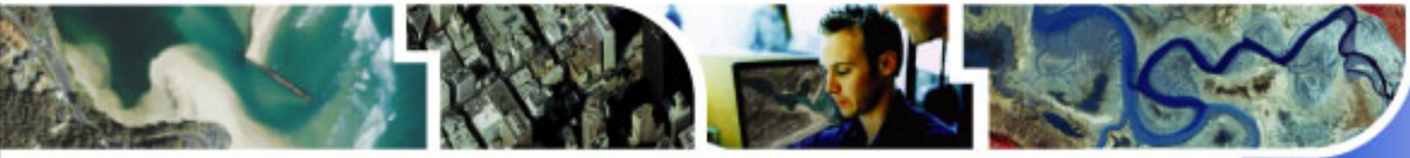
SPACE IMAGING®
Visual Information. Visible Results.

# (4) Advise all Users

Using new/updated AMDB, we:

- Update Static data for next AIS/AIP amendment to NGA/FAA/DoD standards.
- Update Textual NOTAM info
- Update Graphical NOTAM info
- Realtime Data Feeds
  - NGA/DoD
  - Military & Civil CNS/ATM authorities
  - Military & Commercial Dispatchers
  - Datalink – ADS-B transmission
  - Homeland Security/TSA
- <u>Users Advised!</u>

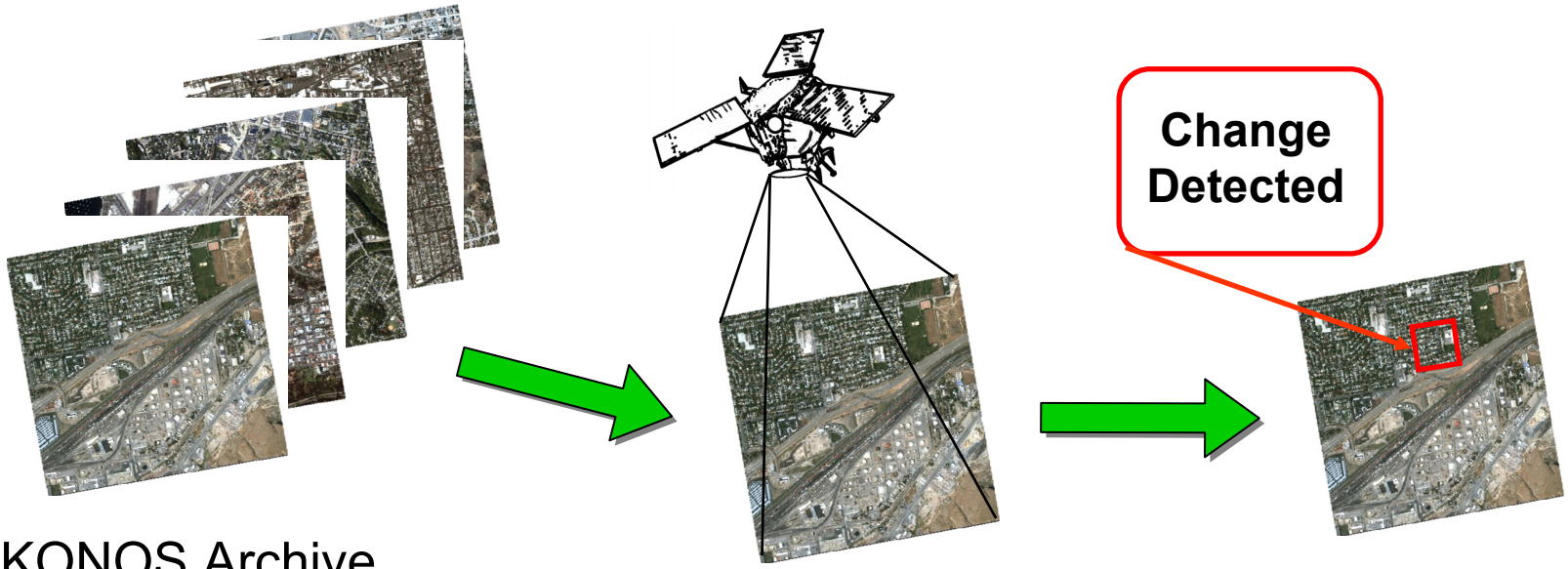




SPACE IMAGING®
Visual Information. Visible Results.

# Automated Feature Extraction: AMDB

Leveraging our extensive archive of IKONOS images, provide notification when newly acquired imagery exhibits changes of interest.



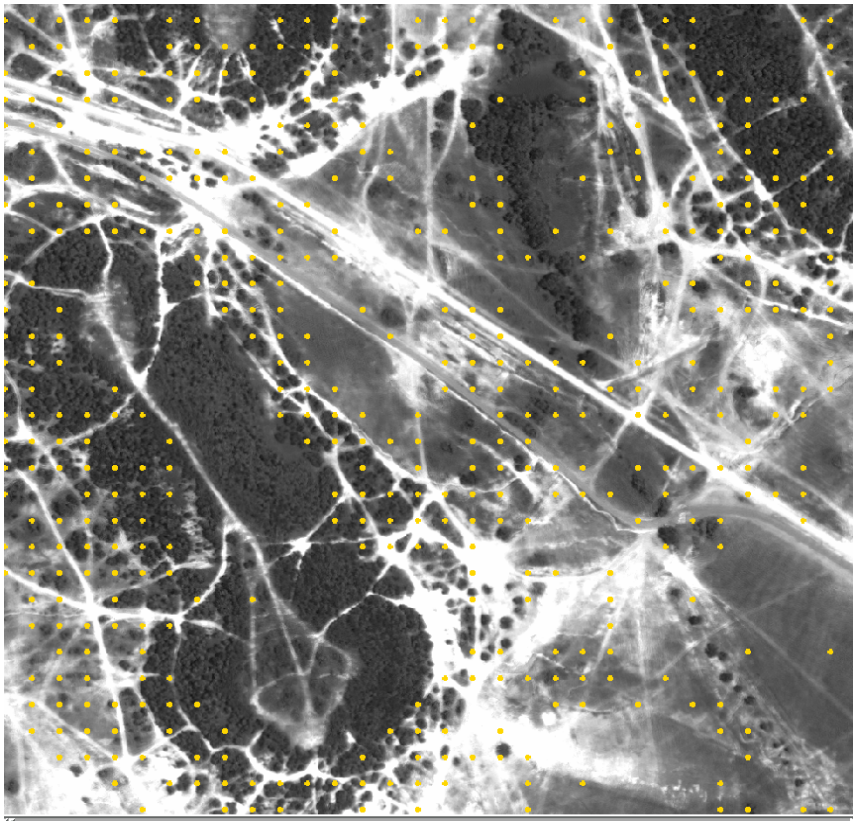

IKONOS Archive

Automation allows us to filter the imagery for significant change as it is acquired.

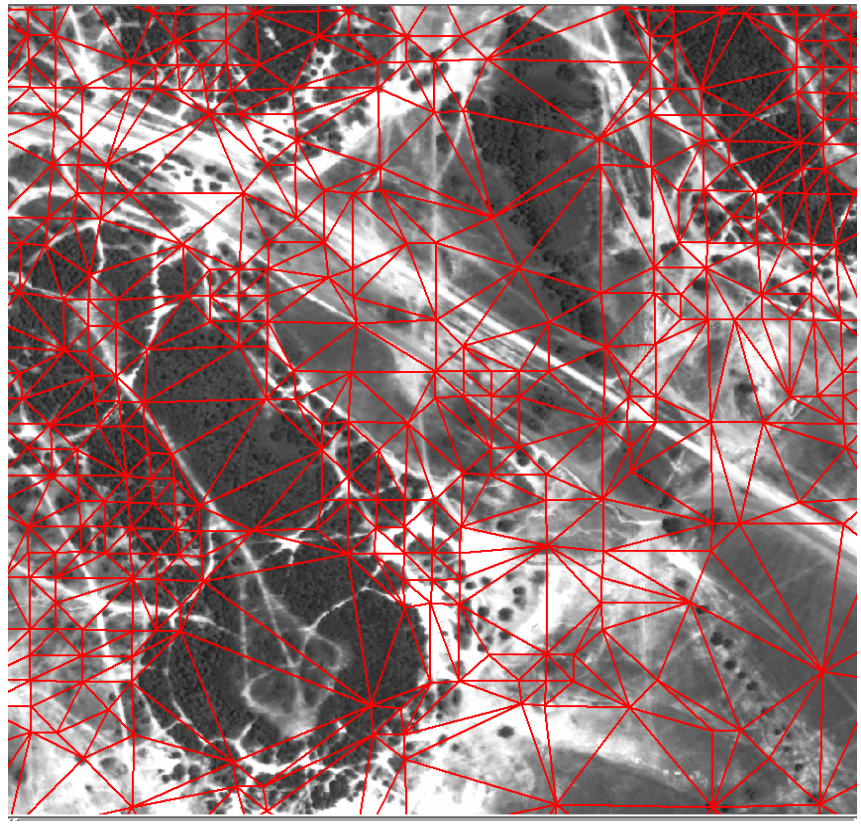


SPACE IMAGING®
Visual Information. Visible Results.

# First, Image Registration…



Automatic tiepointing

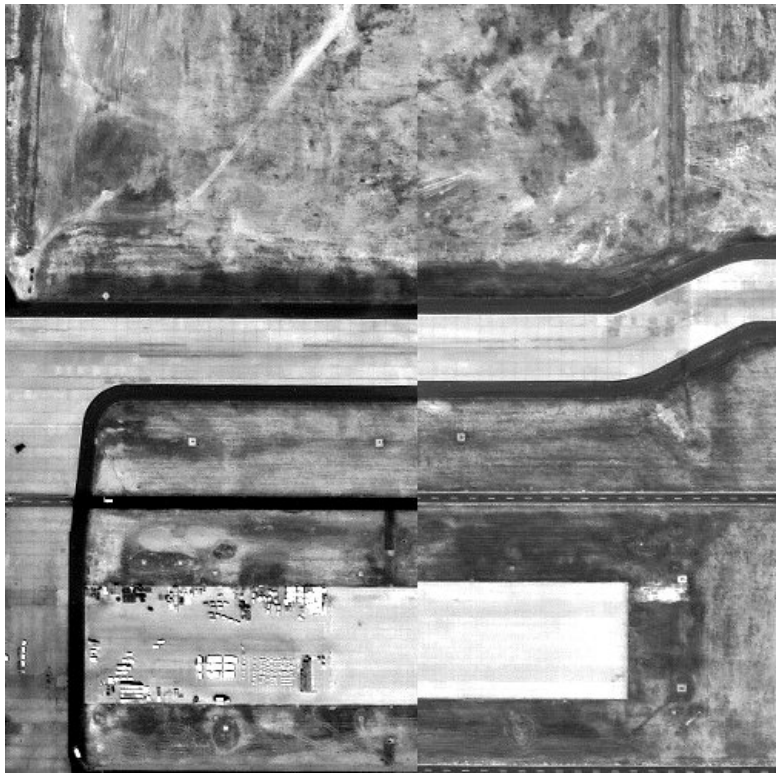


Locally varying image warp



SPACE IMAGING®
Visual Information. Visible Results.

# Next, Autowarping of adjacent tiles…



Before

After

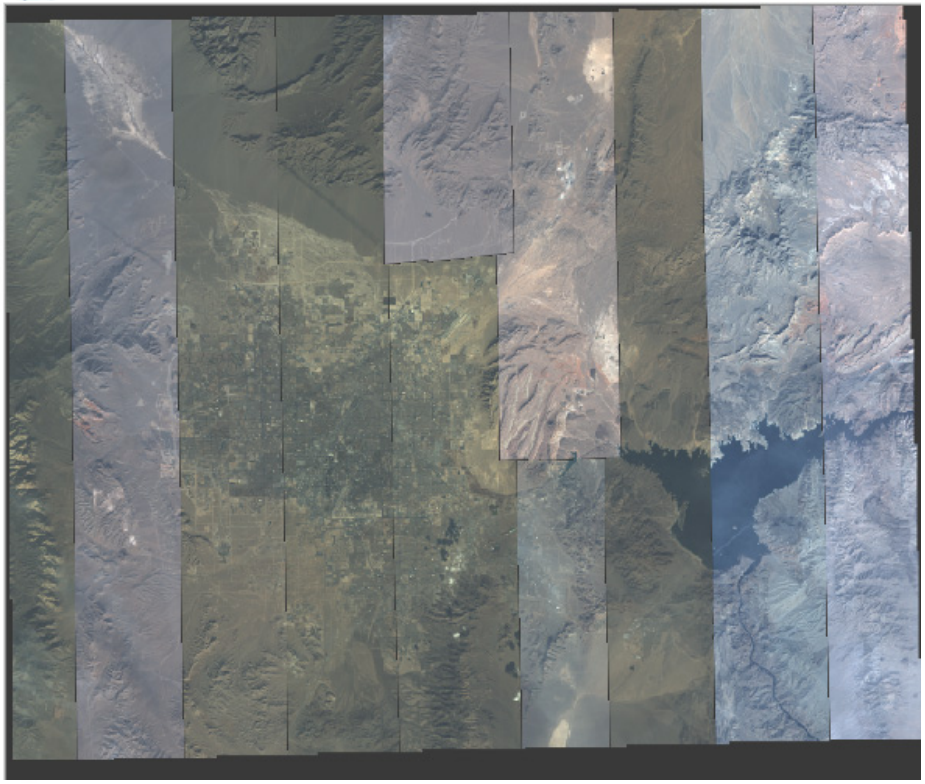


SPACE IMAGING®
Visual Information. Visible Results.

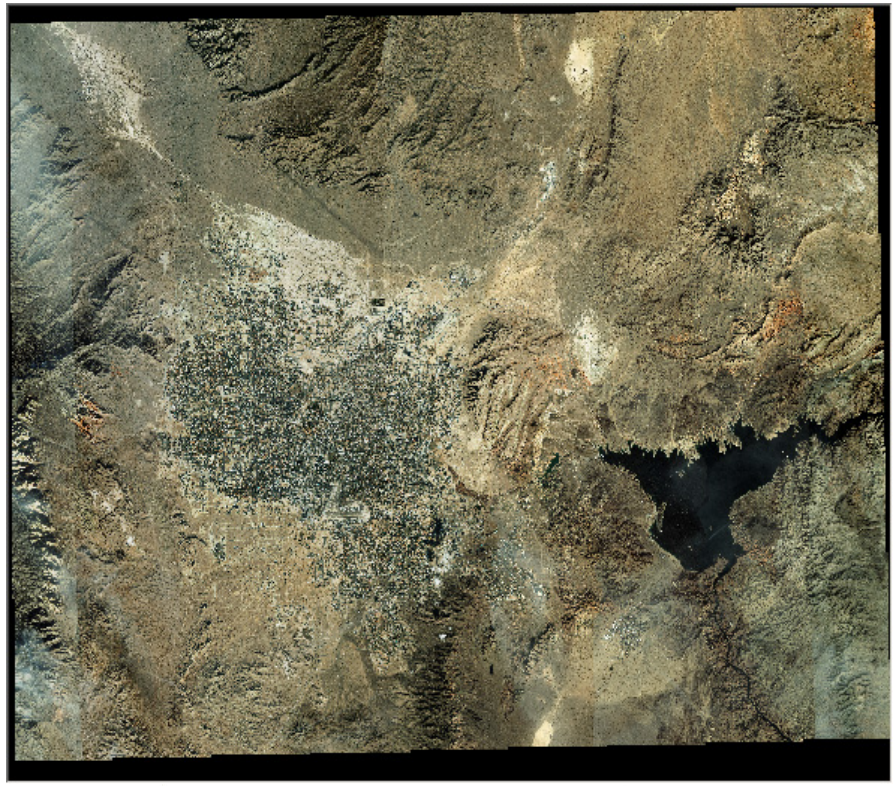
# Last step - GlobalBalance

Automatically compute and apply the optimum color balance over all the components of a mosaic

Las Vegas, Nevada



IKONOS one meter color



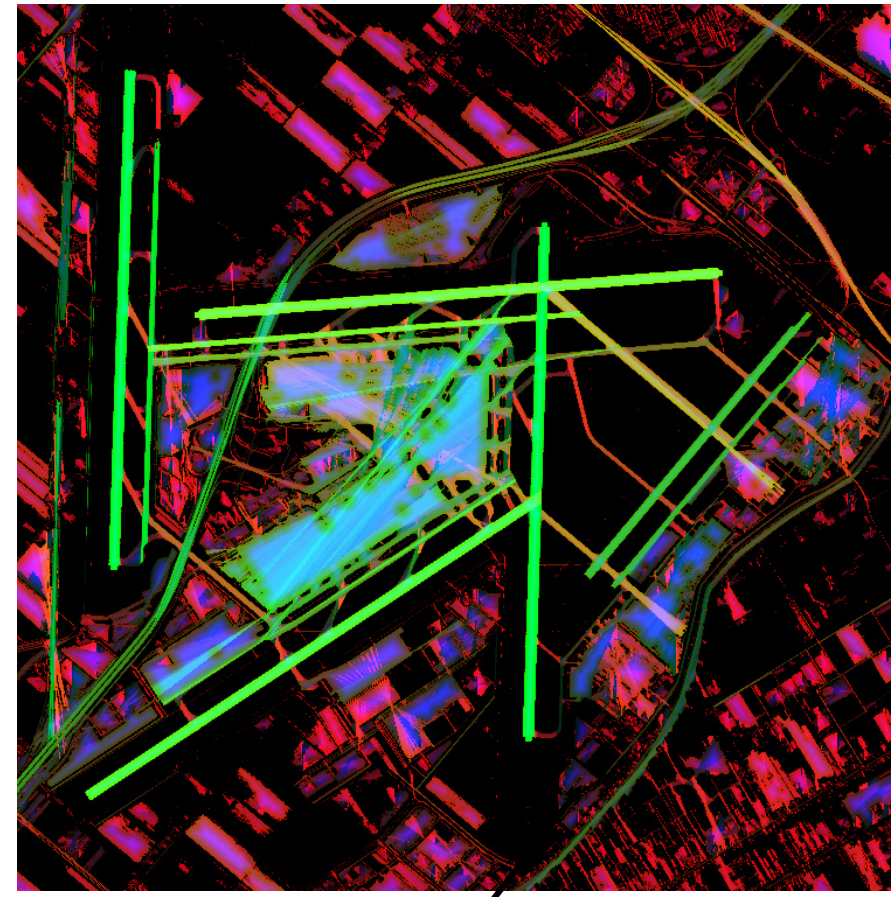


SPACE IMAGING®
Visual Information. Visible Results.

# Now, extract Airport Features:

- Evolution of capabilities:
- Detect Airport

Conduct materials mapping using IKONOS Multispectral Sensors, to segregate pavement from non-pavement areas with chose Imagery tile.



Amsterdam

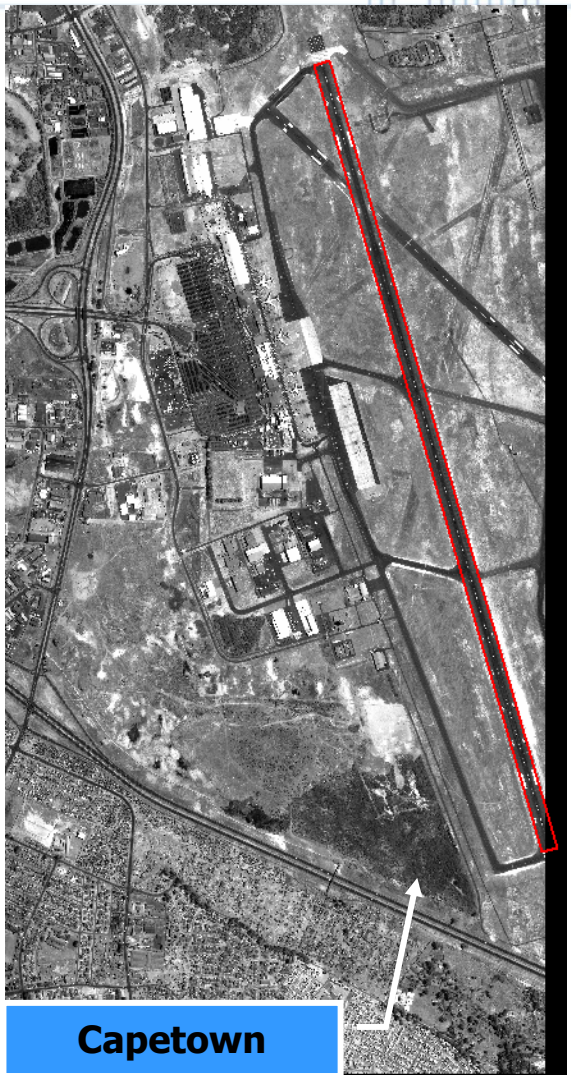


SPACE IMAGING®
Visual Information. Visible Results.

# AFE: Runway Vectorization

- Evolution of capabilities:
- Detect Airport
- Detect Runway Polygon

Understand characteristics of runway polygon and detect using pattern recognition routines.



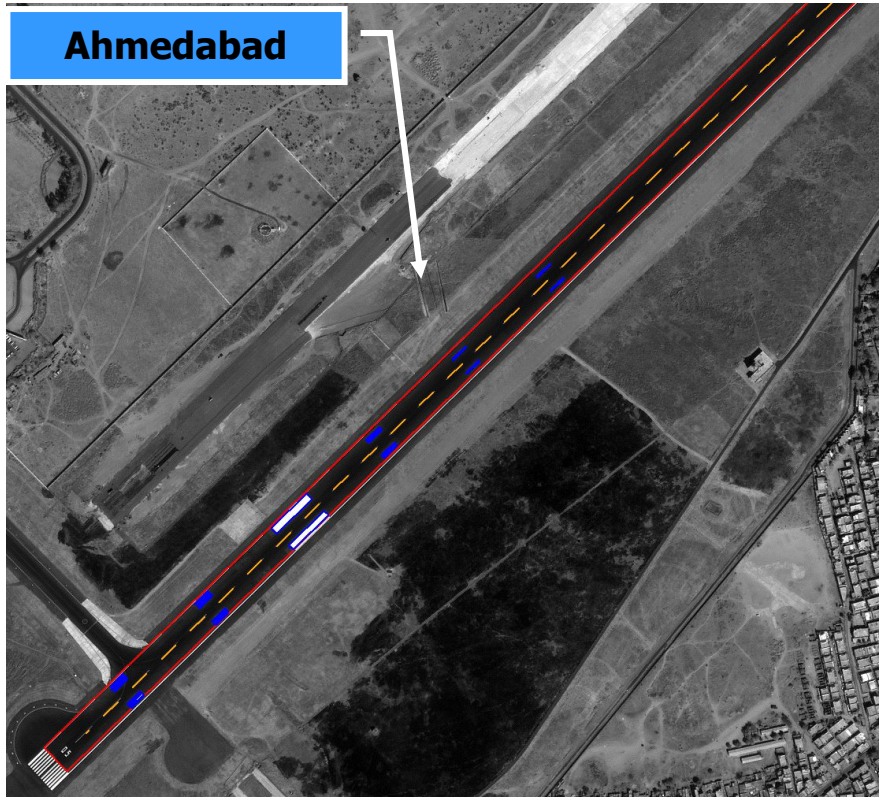



SPACE IMAGING®
Visual Information. Visible Results.

# AFE: Runway Vectorization

- Evolution of capabilities:
- Detect Airport
- Detect Runway Polygon
- Detect Runway Markings

Understand patterns to be located within runway polygon.



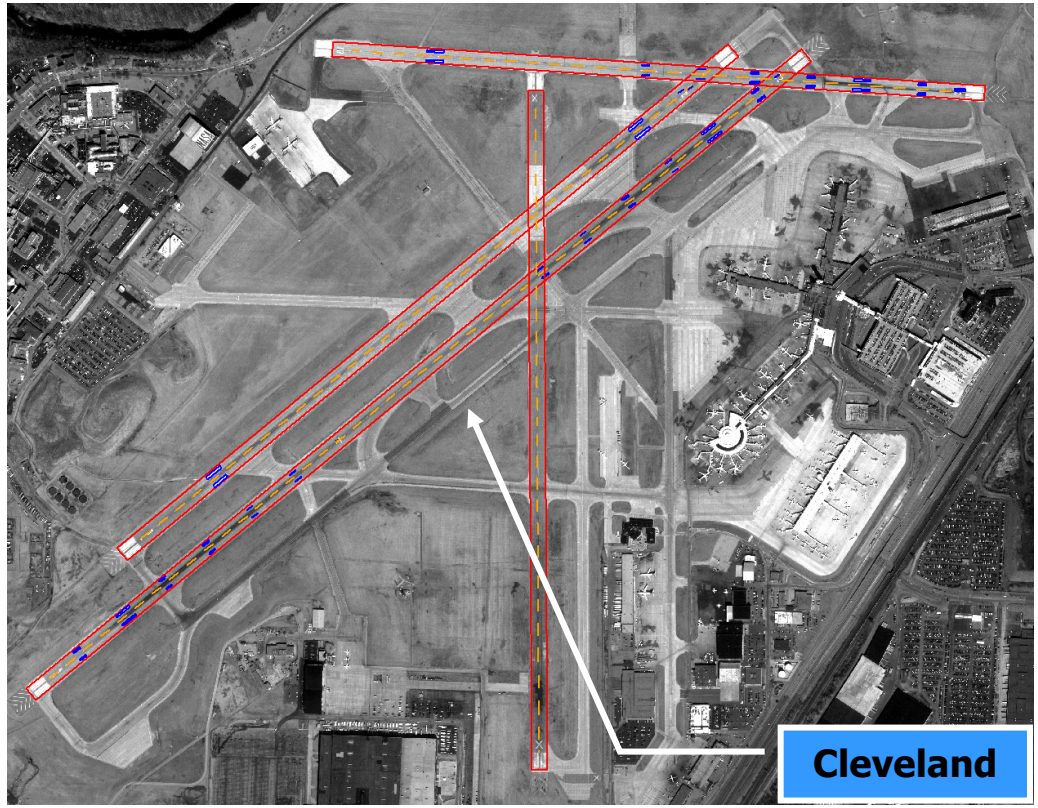



SPACE IMAGING®
Visual Information. Visible Results.

# AFE: Runway Vectorization

- Evolution of capabilities:
- Detect Airport
- Detect Runway Polygon
- Detect Runway Markings
- Intersecting Runways

Need to “train” artificial intelligence routines to understand concept of intersecting runways, and of how to acquire that.



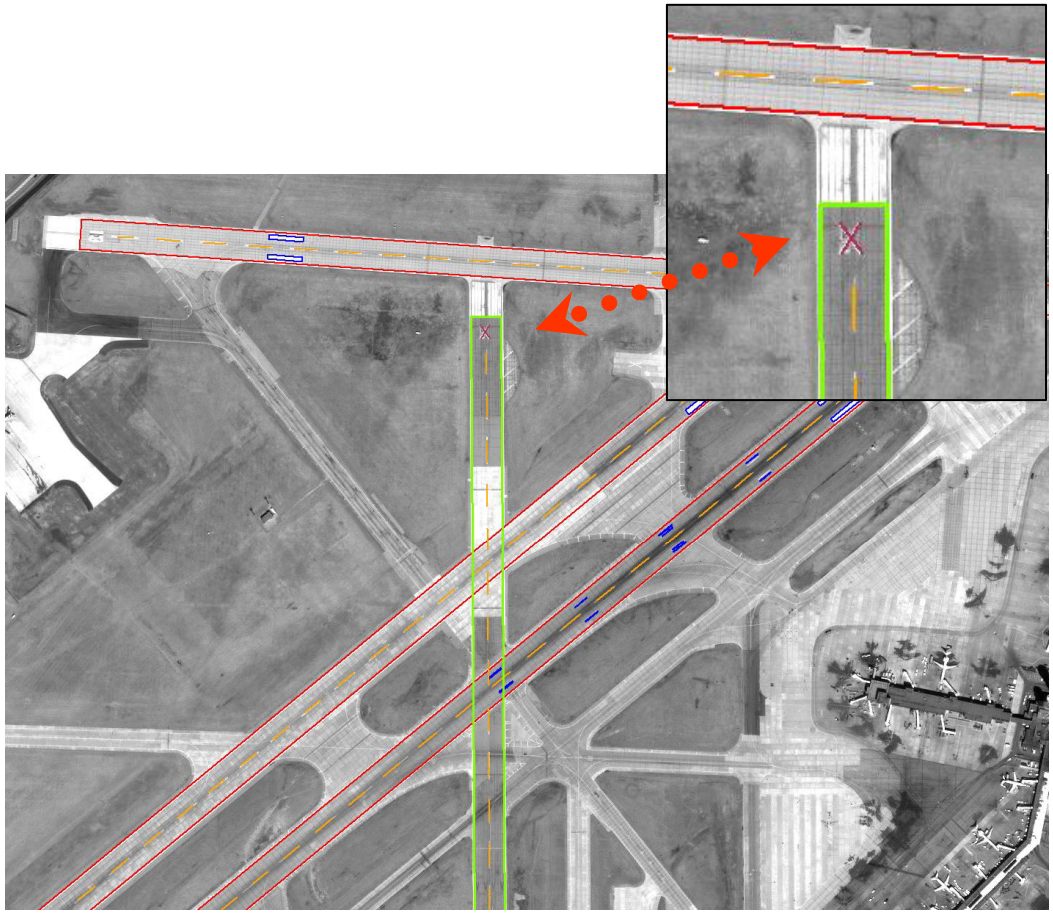



SPACE IMAGING®
Visual Information. Visible Results.

# AFE: Runway Vectorization

- Evolution of capabilities:
- Detect Airport
- Detect Runway Polygon
- Detect Runway Markings
- Detect Intersecting Runways.
- Detect Closed Runways.

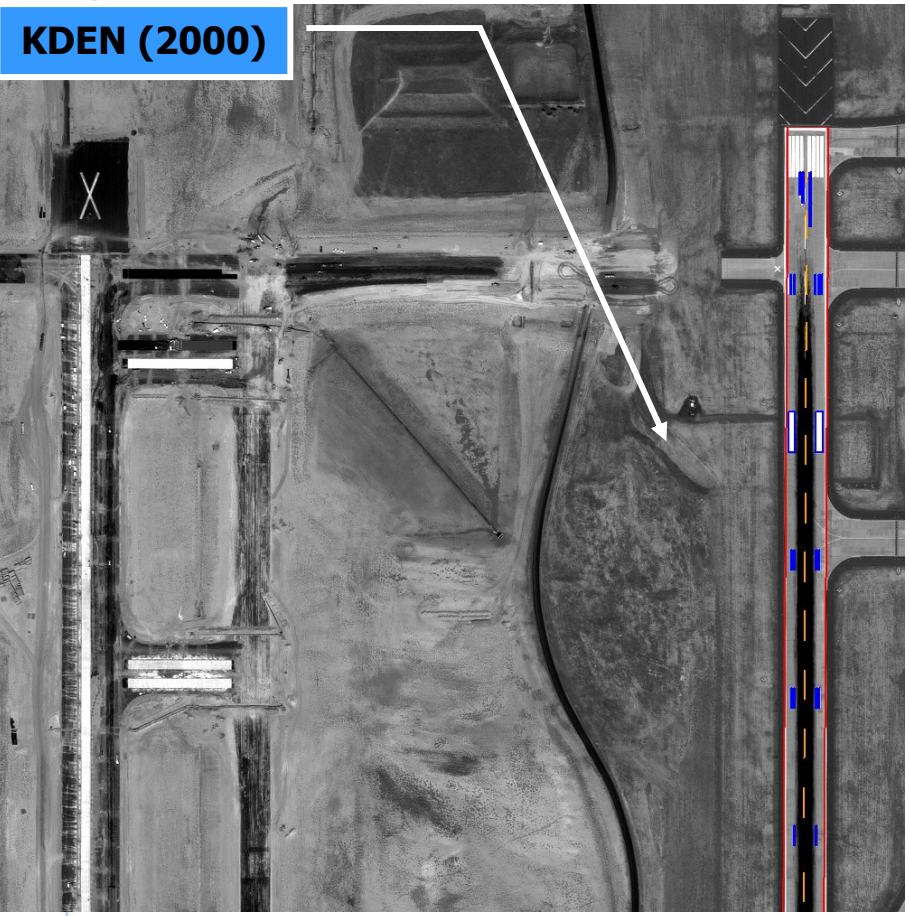
Understand notion of patterns that represent closure – either detection of "X" or the detection of threshold changes.

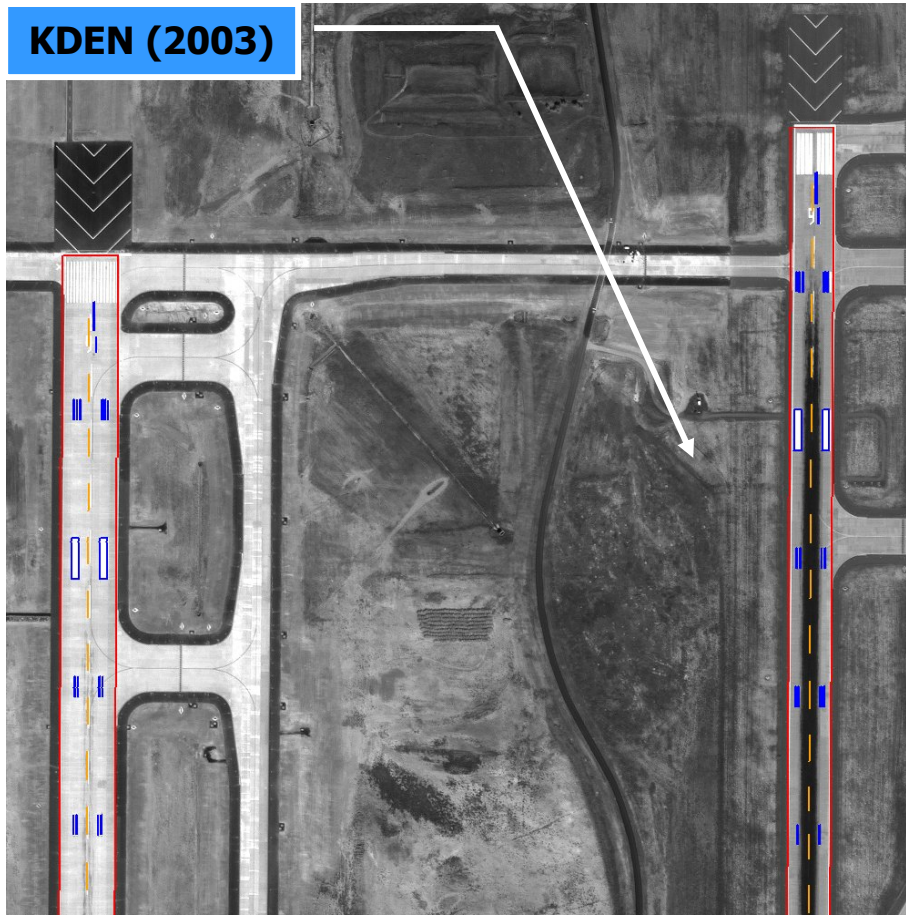




SPACE IMAGING®
Visual Information. Visible Results.

# Runway Vector Change Detection






SPACE IMAGING®
Visual Information. Visible Results.

# Runway Threshold Change Detection

Before

After

- Runway extensions show up automatically



SPACE IMAGING®
Visual Information. Visible Results.

# Airport Environment: Building Changes

Demolished Buildings

New Building



SPACE IMAGING®
Visual Information. Visible Results.

# Questions?

Contact us at:

- Dejan Damjanovic (303) 254-2323
  Air & Marine Transportation Domain Manager
  ddamjanovic@spaceimaging.com

- http://www.faa.gov/safeflight21/
- www.rtca.org
- www.eurocae.org
- http://www.bts.gov/programs/geographic_information_services/geospatial_onestop/index.html

SPACE IMAGING®
Visual Information. Visible Results.