High Altitude Tactical Mapping with Applanix DSS

Presented By: Bruce Hogan
DSS Regional Sales Manager- Americas
bhogan@applanix.com

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Introduction of Topics

- Definition of Application Requirements/Concerns
- Rapid Response Market and Segmentation
- DSS Overview and Enabling Technologies for Tactical Mapping
- Workflow review
- Performance Results

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Emergency Response Activities for Operational Mapping

1) **Prevention**
   Involves the gathering of baseline data, identifying potential hazardous sites and assessing the availability of facilities and equipment necessary to assist in emergency response activities

2) **Preparedness**
   Involves monitoring the high-risk area in order to provide early warning of potential security risks or disasters

3) **Emergency Response**
   Specific incident involvement for the identification of the location, assessment of the occurrence, and short term monitoring of the event

4) **Recovery**
   Monitoring of the affected areas for damage assessment, change detection and environmental and social impact

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In-Field Data Collection Requirements for Operational Mapping

1) **Rapid Deployment of Reliable Equipment and Resources**
   Any equipment used in data collection must be easily portable, in most cases operated by one-person, and must minimize any risk of in-field downtime

2) **Data must be delivered to end-user in a timely fashion**
   Time to Collect and process data must be managed depending on the temporal requirements of data needs in the planning and assessment processes

3) **Data collection methodology must remain flexible to the situation**
   The collection of data must be reliable and allow for frequent coverage and allow for change detection over the area(s) affected

4) **Data Provisioning**
   Solution must address the rapid provisioning of data to first responders and planning teams

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Tactical Operational Airborne Mapping is a global opportunity segment that includes the following applications

- Military Ortho Map Reconnaissance
- Critical Infrastructure Mapping for Events
- Emergency Preparation
- Area Forensics
- Disaster Assessment
- Border Control Protection
- Tactical Field Ops Movement and Monitoring

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Applanix DSS Market Summary

DSS was first introduced by Applanix in 2004

Some Market Facts:

Today Applanix has over 100 DSS systems flying worldwide (combination of stand-alone and sensor fused platforms- ie lidar and multispectral)

~ 10% Of these systems have been deployed into Rapid Response and Military applications

Customers include: NOAA, NRL, Canadian DND (MCE) & RCMP

Systems will be deployed to Afghanistan and Iraq in 2008

DSS Updates and Milestones for 2007

- DSS Rapid Ortho Solution announced in March
- DSS 439 announced in June with deliveries starting in August
- Addition of POS Pac 5 workflow to DSS solution announced in September
- USGS Certification

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Current DSS Product Offerings

Solution Description	Target Market
DSS 422	Corridor (Low Altitude)
DSS 439	Small Area Ortho and Topographic Mapping, Corridor and Rapid Response
DSS 439 RapidOrtho	Rapid Response (Military, law enforcement and disaster management)
DSS 422 and 439 OEM	Sensor Fusion (ie Lidar)

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Digital Sensor System (DSS) 422/439

Designed as a turn-key, all-digital medium-format mapping solution:

Integrated POS AV Direct Georeferencing System

POSTrack Flight Management System (FMS) for Stand-Alone systems

True Color and CIR Digital Imager (39 or 22 Mega Pixels) with Yaw stabilized Azimuth mount

Ruggedized data logger and pressurized drive

Imagery and POS AV data post-processing software (POS Pac)

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What does all this terminology mean?

DSS is a true Metric Camera employing the advantage of Direct Georeferencing meaning that

Metric implies that the system is calibrated for interior orientation and remains STABLE over time

- **Principle Point**
- **Lens Distortion**
- **Focal Length** **+ Shock & Vibe and Pressure Tested= Mapping Grade Camera**

VS

Self Calibration method using AT to determine interior orientation using tie-points and Ground Control

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Applanix DSS 439
Design Features and Benefits

Feature	*Function*	*Benefit*
Compact and Lightweight system design	Allows for ease of deployment and installation of system	Enables system to be installed in small aircraft of opportunity to reduce flight costs
Tightly integrated modular hardware configuration	Stacked design enables in-field maintenance in most cases with “remove and replace” concept in mind	Complete yet flexible system. Reduces the risk of down-time in the field.
Rugged computer system architecture	Robust systems built specifically for computing and logging data in aircraft environment	Higher reliability than standard office computing equipment reduces operational costs
Embedded camera control firmware	Automatic control of camera, data logging and interface with POSTrack	Higher reliability than off-the-shelf consumer capture software reduces operational costs

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Applanix DSS 439
Value Added Technologies

Feature	*Function*	*Benefit*
Direct Georeferencing	Computes position of each pixel in orthophoto in local mapping frame using GPS and inertial sensors without need for Ground Control Points or aerialtriangulation	Saves processing time, increases reliability, and reduces cost by reducing number of ground control points required
TrueSpectrum Image Chain Analysis for colour and colour infra-red (CIR) imagery	Individual components of the entire imaging process are modeled in order to understand how changes or phenomenon at any point in the chain affects the image quality.	Seamless mosaics for a better product delivery for remote sensing and digital mapping applications

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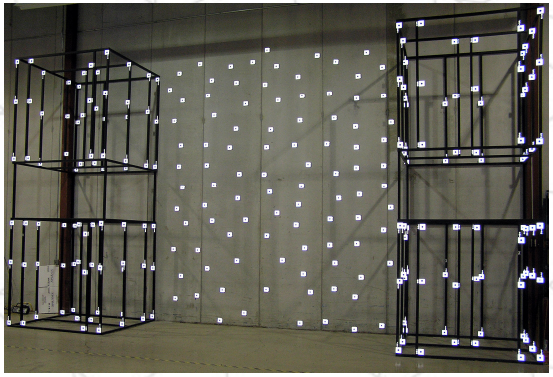
New engineering test labs, manufacturing facilities, and increased aircraft calibration capacities have been introduced at Applanix

Applanix Camera Manufacturing Lab

Precision CNC Machine



Terrestrial Camera Calibration Cage

Reasons:

- Improve overall quality and re-duce re-work time via improved tooling
- Shorten manufacturing time via improved tooling
- Shorten turn-around times on re-calibrations for the yearly maintenance

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Applanix DSS that has been certified by the USGS

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
National Center for Earth Resources Observation and Science
Sioux Falls, South Dakota 57198

September 4, 2007

Subject: Successful Completion of the USGS Manufacturer Certification Process for Applanix Digital Sensor System (DSS) 422 and DSS 439

The United States Geological Survey (USGS) certifies that the Digital Sensor System (DSS) 422 and 439 manufactured by the Applanix Corporation, of Richmond Hills, Ontario, Canada meets the claims of the manufacturer and is capable of providing quality, consistent image data to support civil government mapping and ortho-photography product development.

The USGS provides this certificate to Applanix Corporation for successful completion of the USGS Manufacturer Certification process which included presenting and providing all appropriate information to address the certification requirements as defined in the USGS Plan for Quality Assurance of Digital Aerial Imagery and the USGS Manufacturer's Certification Checklist.

This certification is valid for Applanix DSS 422 and DSS 439 sensor types evaluated by the USGS. Any design changes that change the effective output of the system will require additional evaluation and re-certification if necessary. This certification joins the certification previously provided to Applanix for their DSS 322 sensor type.

To discuss manufacturer certification, please contact the manufacturer, or the USGS certification team via the following web mail link - http://calval.cr.usgs.gov/.

Gregory L. Stensaas
USGS Manufacturer Certification Team Lead
Remote Sensing Technologies Project Manager
Geography Discipline

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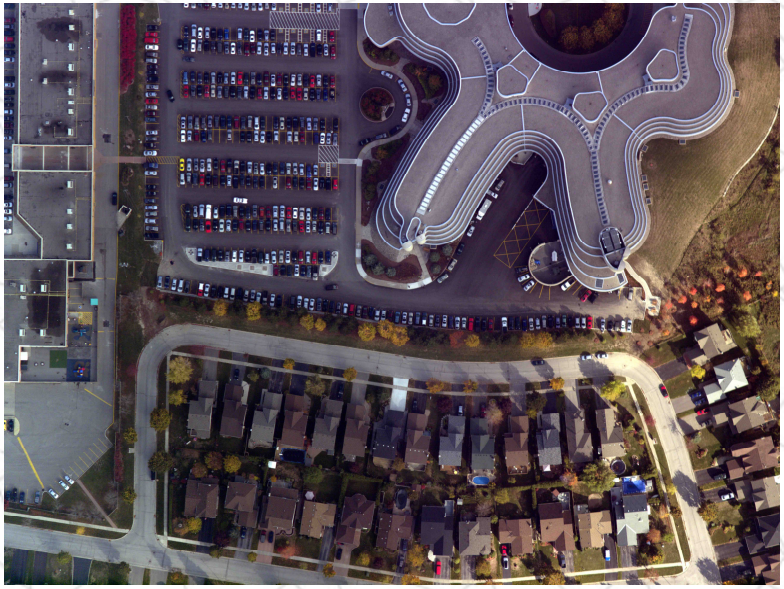
Longer Focal Length Lens

- **Applanix has successfully tested longer focal length 250mm option for DSS**
- **Fast turn around of data, high accuracy of geo-coding, high-resolution of imagery proved to be invaluable vs satellite imagery for Recon type assessment**
  - Net result => Can produce high res Geo referenced imagery from higher altitudes for recon mapping applications



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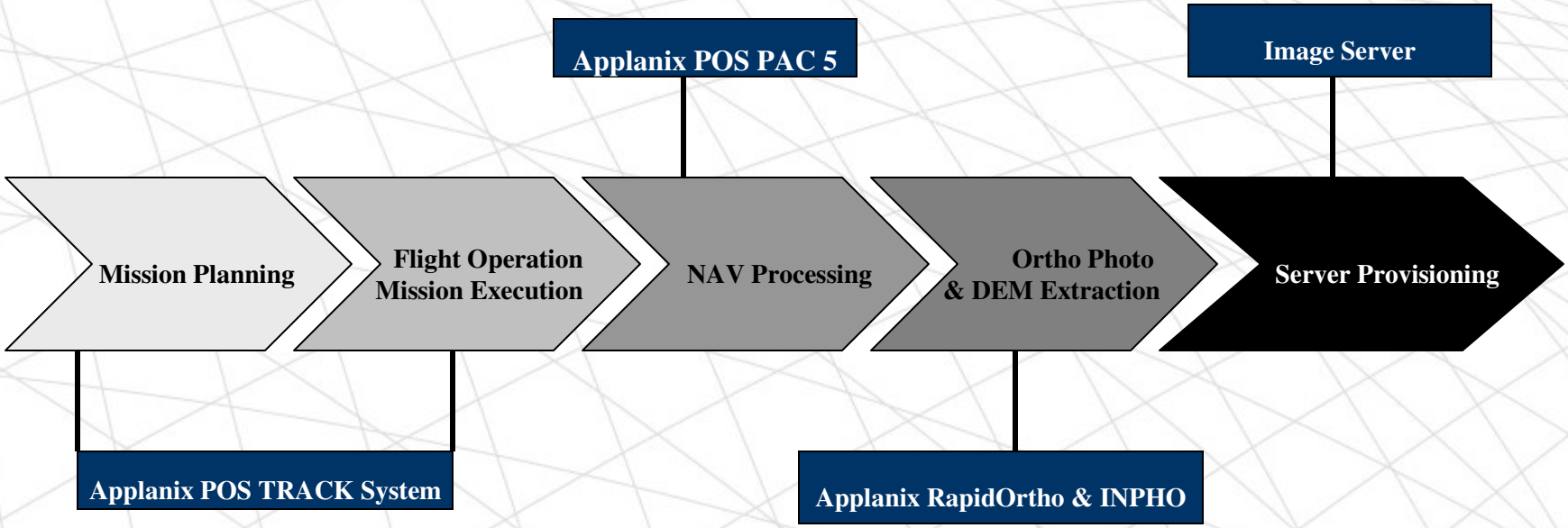
DSS Workflow Overview



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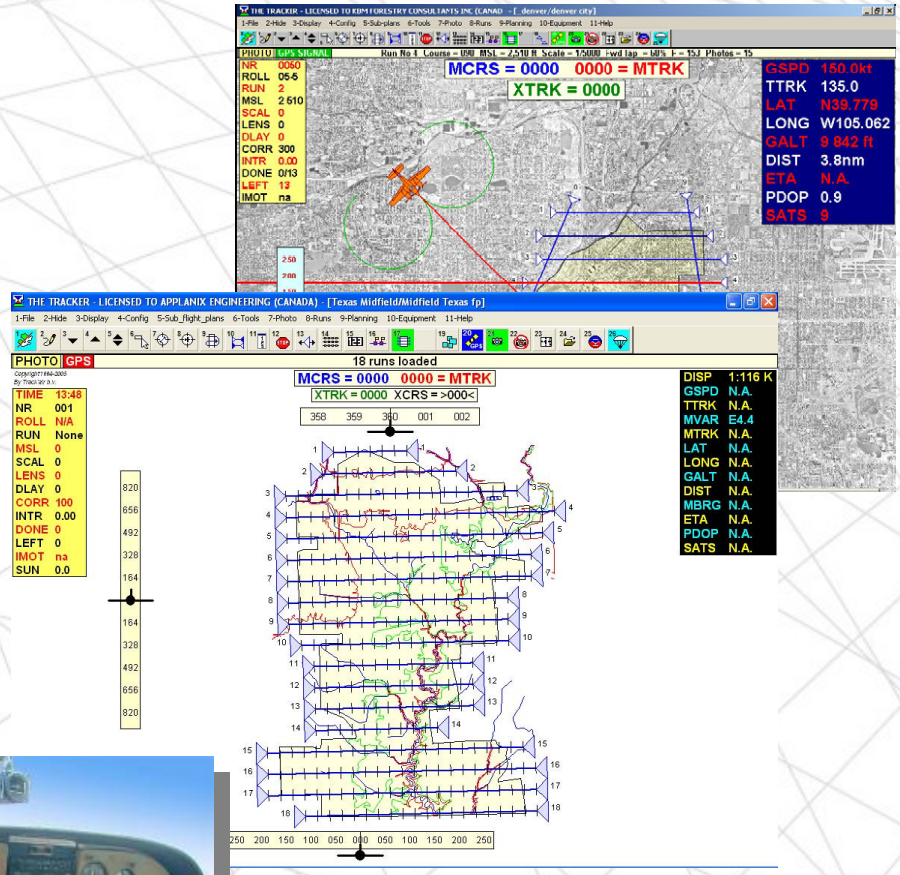
Mission Planning

TrackAir Flight Planning and Operation Software

Modules allow for:

- Inputs Area of Interest
- Flight Planning
- Operation
- Database Management



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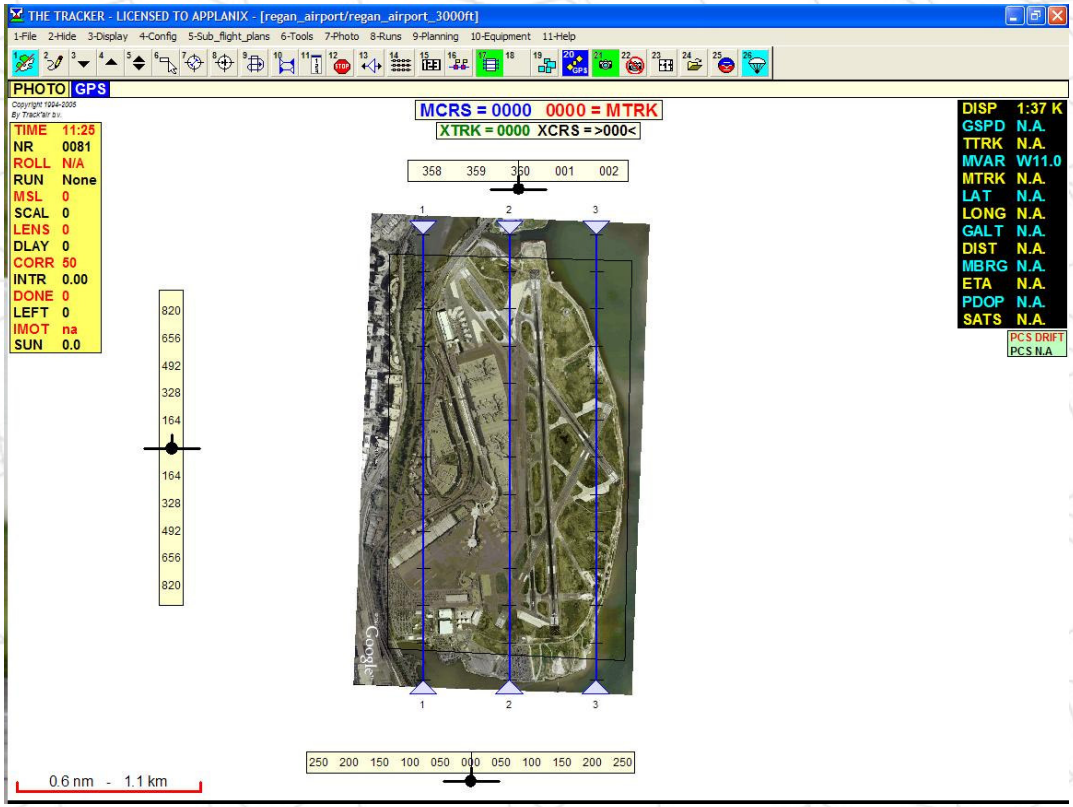
Flight Plan- Regan Airport



Project name: regan_airport

Date: 2/11/2008 11:45:36 AM

Camera: Applanix DSS_439 60mm

Selected lens: 60 mm
Forward overlap: 60.0%
Lateral overlap: 30.0%
Flying height agl: 3000 feet

TOTAL QUANTITIES

Totals for runs + strips
Total lines: 3
Total photos : 39
Total models: 36
Total length (km): 8 km
Total length (nm): 4 nm

Surface area: 3 km2

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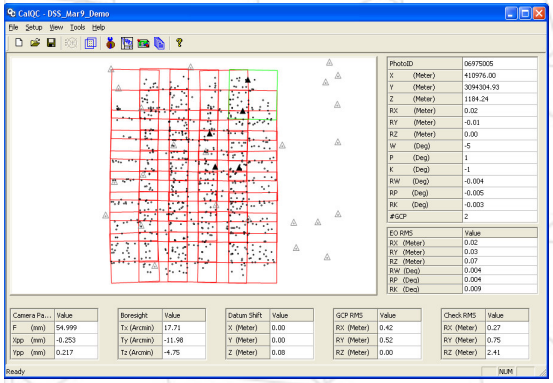
DSS Workflow

- **MissionView (DSS Tools)**
  - Previews and manages raw data from system, copies data from and cleans DSS Mission drives
- **POSPac AIR**
  - Differential GNSS Aided Inertial post-processing
- **ImageView (DSS Tools)**
  - Develops raw images using the digital back camera calibration and image correction files to produce full resolution or sub-sampled image files (TIFF etc)
- **Photogrammetry Tools: POSEO, CalQC, ATG, STG**
  - Generates Exterior Orientation for each image
  - Camera/IMU boresight calibration, camera interior geometry calibration and quality control
- **<u>Final Product:</u>**
- **QA/QC'd Exterior Orientation Data**
- **Digital Images ready for mapping process**



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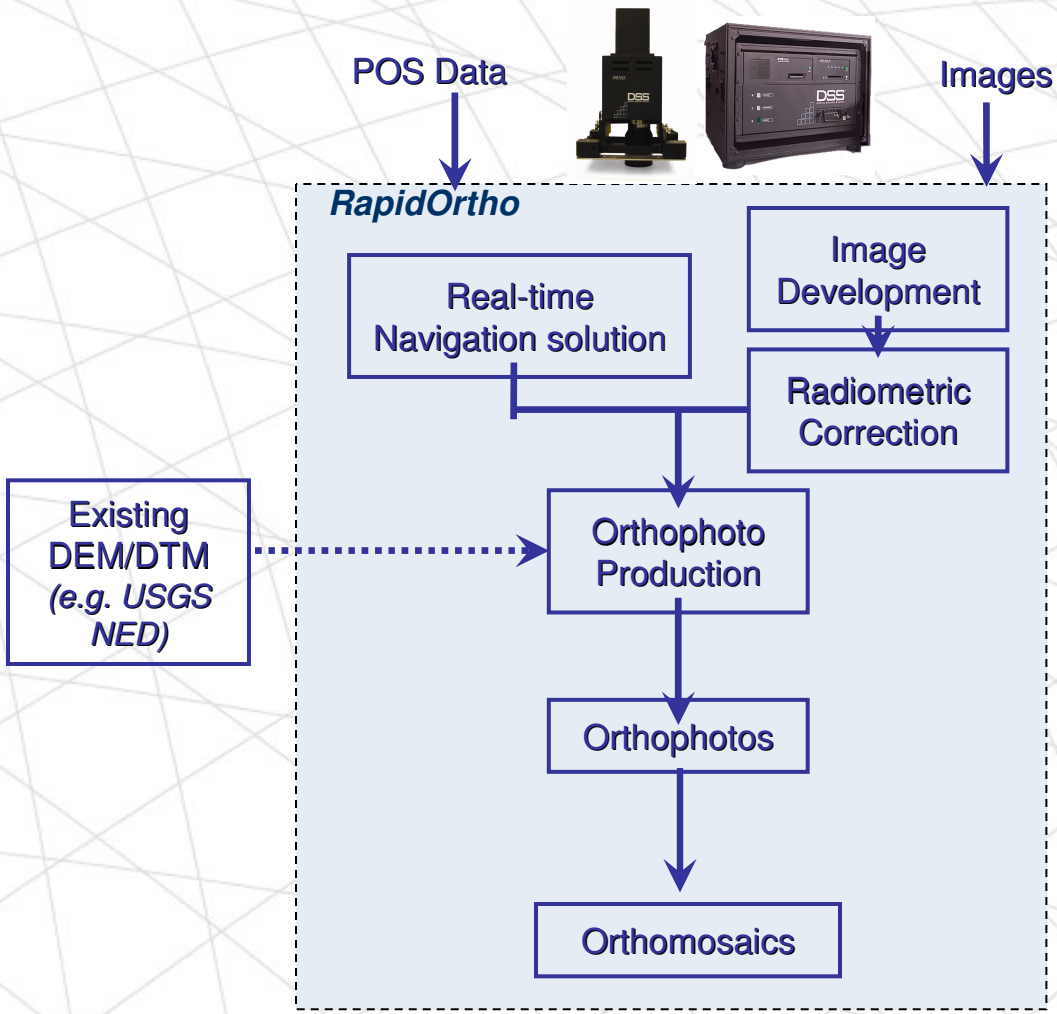
RapidOrtho™



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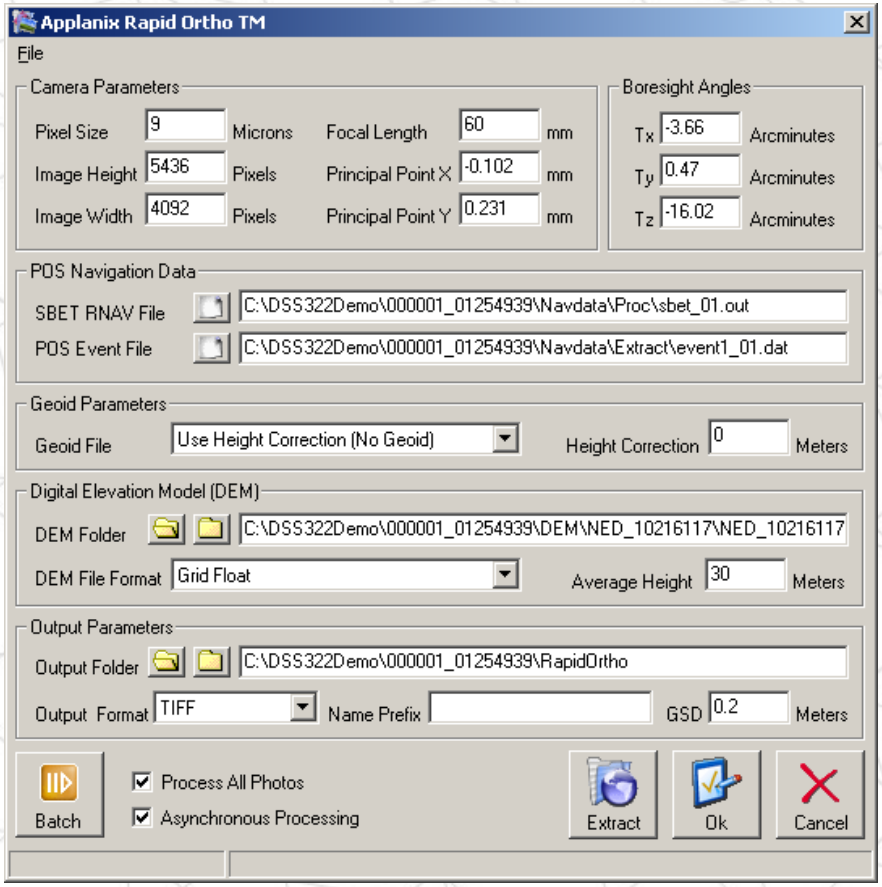
Rapid Ortho Processing

- **Single Interface Environment**
  - Combine Image Development and Orthophoto generation



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RapidOrtho- Rapid Location

- More focused on small isolated areas for first responders requirement immediate evaluation of imagery

- Locating areas of interest

Results:

Individual Orthophoto generation <u>within 25 seconds</u> (Dual Processor or better)
Accuracy of <1m RMS

60% endlap, 30% sidelap:
36 km^2 Orthomosaic at 20 cm GSD <u>within 4 hours</u>, in 9 orthomosaic tiles.
Accuracy of < 1 m RMS

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Hurricane Katrina Disaster Assessment

- 11 Days of Data Collection
- Over 8000 Images Collected
- Images Processed within 24-48 Hours of collection

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Border / Coastal Monitoring

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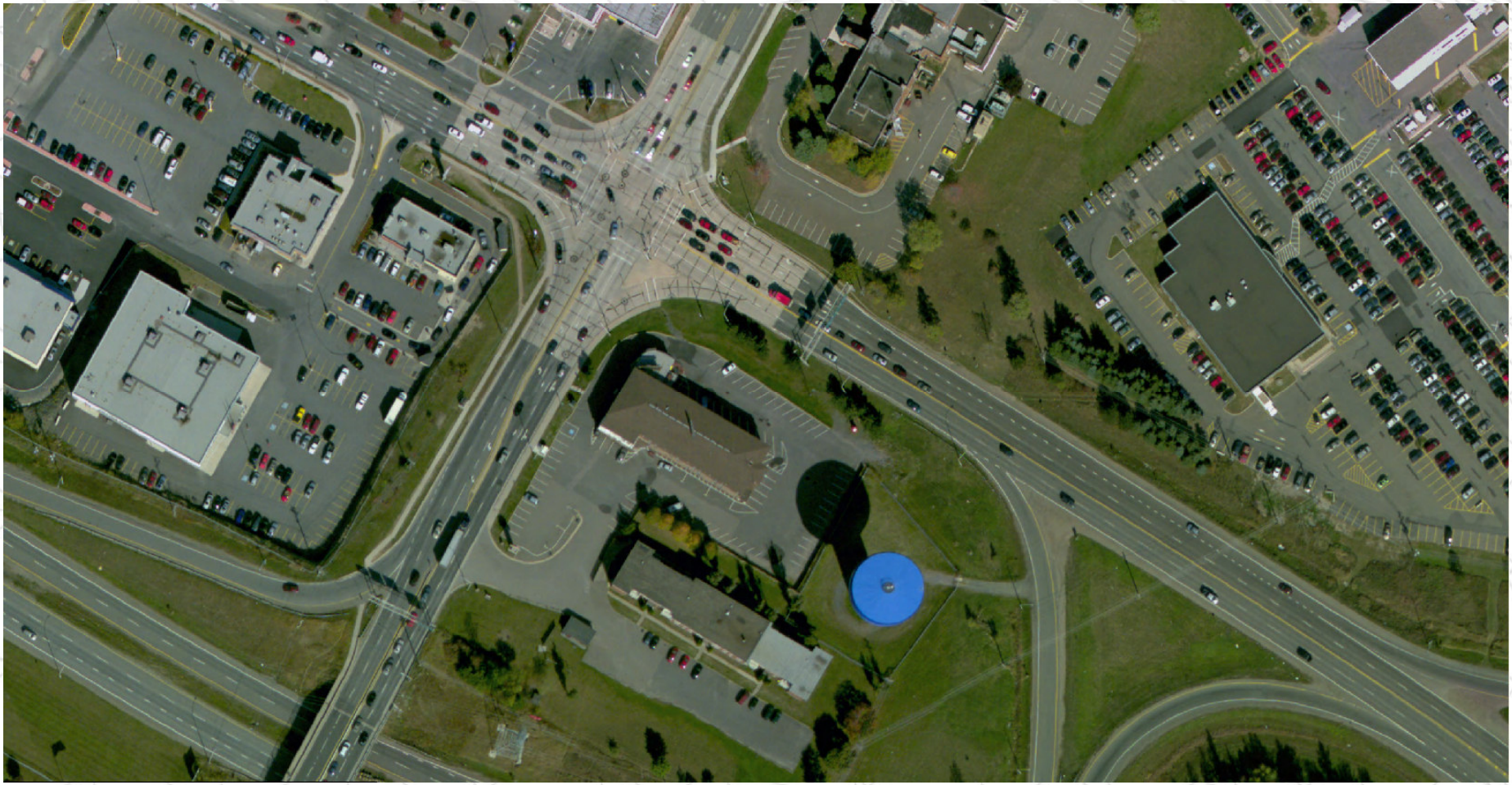
Emergency Preparedness for City and Towns



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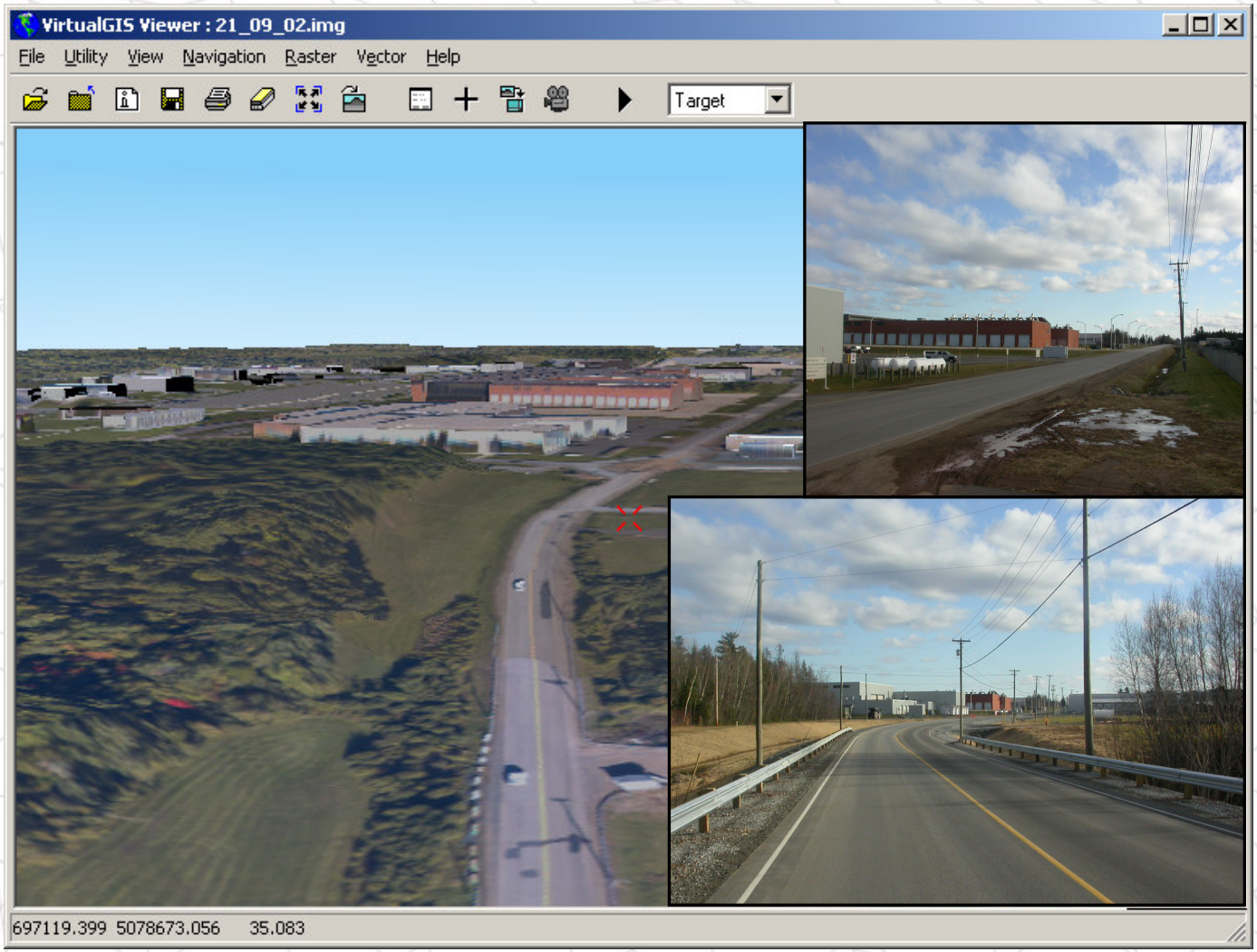
Visualization – Overlapping Images allow for 3D Collection



Proposed 3D Area Of Operation…

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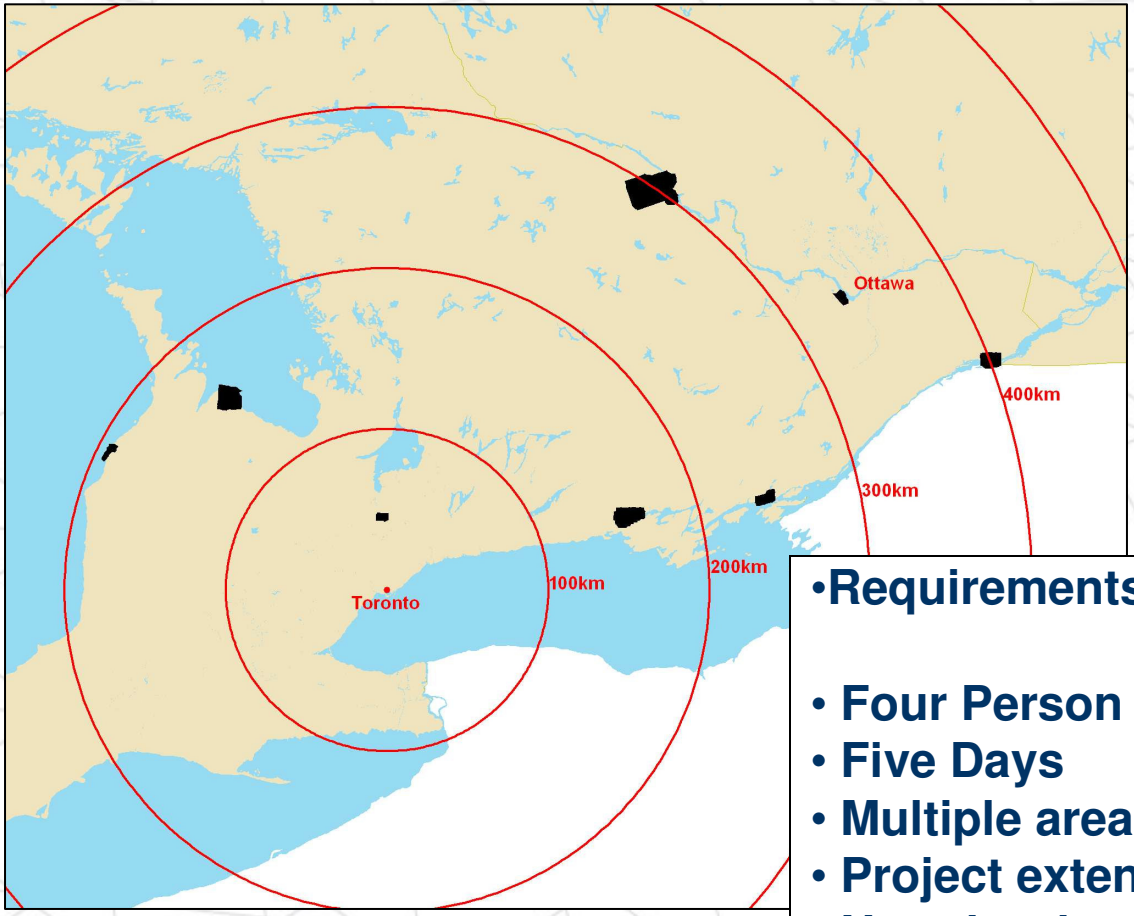
Rapid Response: Assessing Needs



•Requirements:

- Four Person Team
- Five Days
- Multiple areas within 400km radius
- Project extents between 10 – 450km2
- No prior data (DEM)
- Orthomosaics ready ~6 – 12hrs after flight

•Mission Successful Using

•Applanix DSS

Summary:
Digital Sensor System

- **Completely Integrated Digital Mapping System**
  - Low cost design, accurate, easy to install, *&* completely portable
  - Ruggedized & fully supported system with a clear upgrade path as new technology develops
  - "Turn-key", integrated digital imager, direct georeferencing navigation & mission management systems

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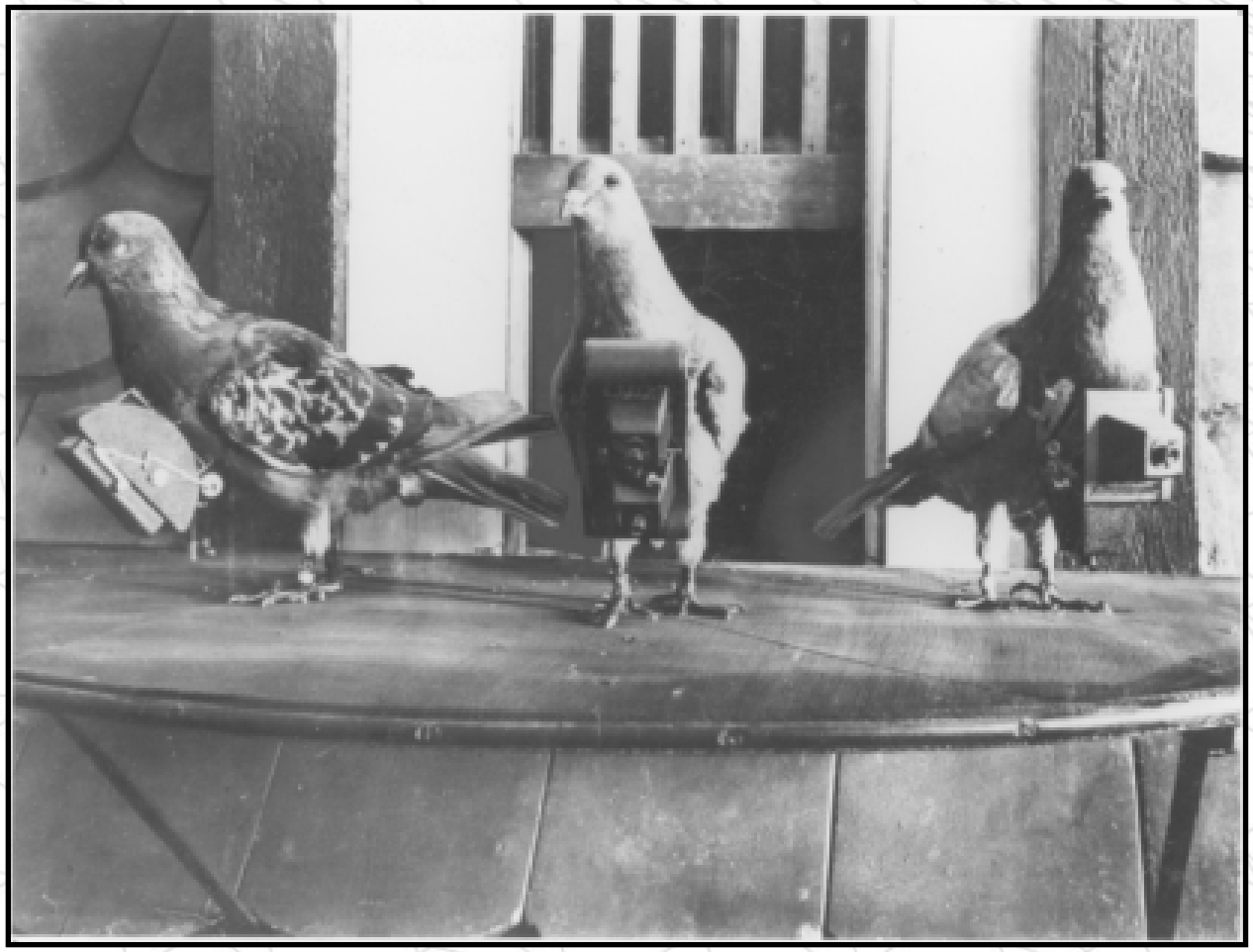

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