

A topographic map showing a river and a bridge. The map uses contour lines to indicate elevation, with colors ranging from green (low elevation) to brown (high elevation). The river is shown in blue and green, and the bridge is shown in white. The background of the slide is a faded aerial photograph of the same area.

Up and Under -

On Using Drones for Bridge Inspection

July 30, 2018

Gary Licquia

senseFly
Parrot Group

A Little About Me...

- 3+ years with senseFly products
- Background in GIS, Mapping, LiDAR
- BS – Florida State, MS – South Florida, MBA – Georgia State
- Sales Manager-US Central for Parrot Business Solutions



senseFly is a member of the Parrot Group

Parrot



PIX4D

AIRINOV

L'avenir de vos terres est dans le ciel






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MicaSense



-  Drones
-  Software
-  Sensors
-  Data management
-  Flight services

At senseFly...

we believe in using technology to make work safer and more efficient.



**Surveying &
Construction**



Mining & Aggregates

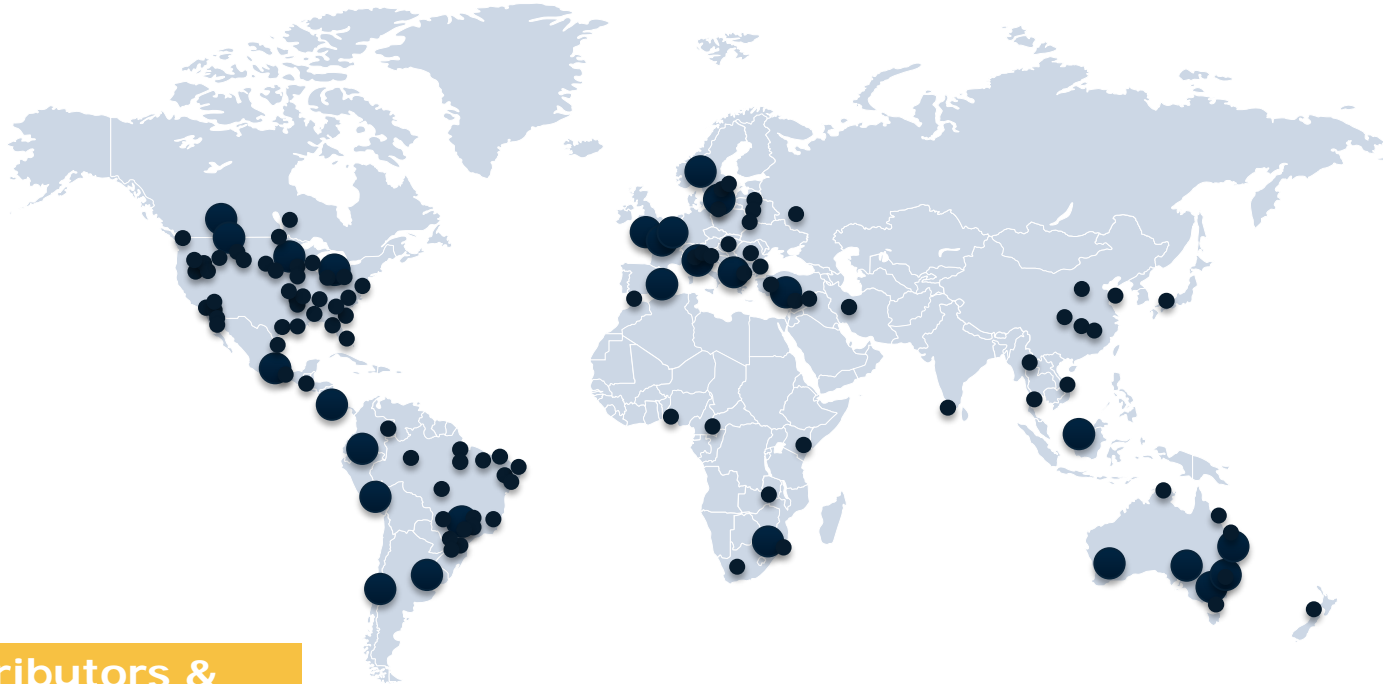


Agriculture



Inspection

We have global presence through our
distribution and service network



62 distributors &
200+ points of sale

Our fixed and rotary wing drones are adapted to the needs of multiple industries

eBee
senseFly



Aerial efficiency,
photogrammetric accuracy

eBee
senseFly



The professional
mapping drone

Wide payload
range



Our fixed and rotary wing drones are adapted to the needs of multiple industries

eBee
senseFly



The advanced agricultural drone

albris
senseFly



The close mapping & inspection drone

**Parrot
Sequoia**



**TripleView
Head**

Aging Infrastructure

- The U.S. has 614,387 bridges.
 - 40% are over 50 years old
- On average there were 188 million trips across a structurally deficient bridge each day in 2017.



*Infrastructurereportcard.org

Aging Infrastructure





Traditional Inspection Methods



Traditional Inspection Methods



Challenges from Traditional Methods

- Dangerous
- Costly
- Disruptive
- Time-Consuming



Practicality of UAV Inspection

- Comparatively low cost
- Fast
- Safe
- Low-Impact on traffic



Specifications for UAV Inspection Platforms

- Capable of looking up
- Operate without GPS
- Proximity detection
- Multiple sensors



With the albris we offer a professional grade inspection drone

albris
senseFly



- Close object operation
- Advanced situational awareness
- Automatic, interactive & manual flight modes
- Look up/forward/down
- 1 flight, 3 types of imagery
- 38 MP RGB still, HD video & thermal



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MnDOT Project Scope

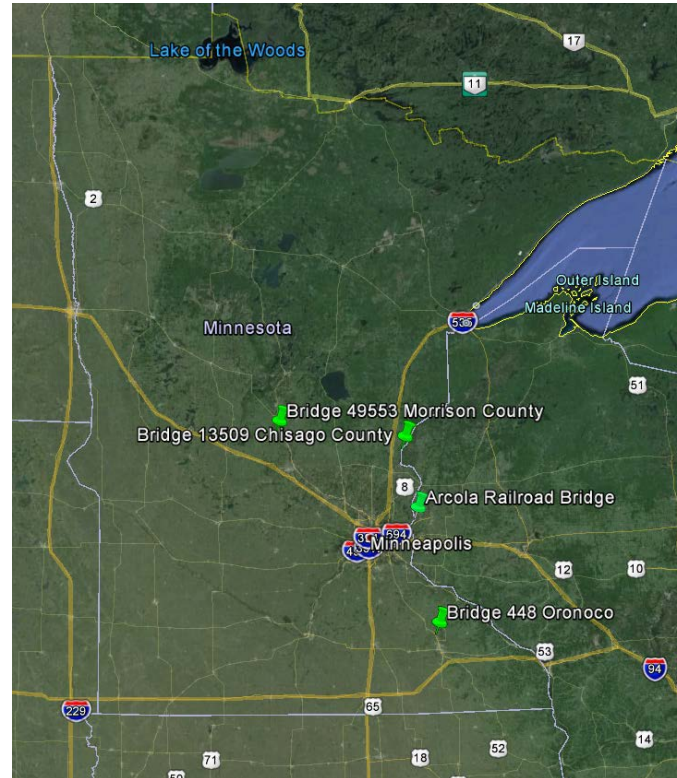
- Develop a field demonstration of UAVs for bridge inspection
- Evaluate the technology's effectiveness and safety implications for routine bridge inspections and interim or special inspections.



MnDOT Project Scope

Bridge Selection Criteria

- Rural vs. Urban
- Variety of Bridge Sizes
- Variety of Bridge Types
- Bridge Location
- Bridge Owner
- Cooperation
- Limit Public Contact



MnDOT - Phase 1

- Evaluating the safety and effectiveness of UAV technology to produce an initial research report.



MnDOT - Phase 1

Bridge 49553 –Morrison County Pedestrian Bridge

- Large Steel Truss
- Difficult to access with UBIV
- Great detail in images
- Pack rust visible
- Concrete deterioration visible



MnDOT - Phase 1

Bridge Element Comparison

Table 5-3 Bridge 49553 Inspection Element Table

Bridge Element	Condition State	Previous Inspection Note	Discernable from UAV Video/Photo/IR Image
31 Timber Deck	8450 FT^2 CS 2	Constructed 13' wide x 4" thick x 650' treated timber deck and replaced 33 RR ties. Also placed 2" treated timber wear course.	Yes
407 Bituminous Approach	2 EA CS 1	Paved 2" bituminous in November, 2006. 8/28/13 - West approach failure repaired by MCHD. Good condition. Erosion on East approach repaired w/ quarry run riprap.	Yes
334 Metal Rail Coated	1299 FT CS 1	Placed 1,300' of coated chain link fence in November, 2006. 8/27/12 - Missing (1) end cap on East end.	Yes
117 Timber Stringer	3251 FT CS 1	Constructed 5- 4"x 8" treated timber stringers.	Yes, partially
131 Painted Stl Deck Truss	351 FT CS 2 299 FT CS 2	10/4/04 - All steel corroding & in need of rehab.	Yes
311 Expansion Bearing	1 EA CS 1 8 EA CS 2 1 EA CS 3	10/11/05 - Bearings show movement is possible. Significant corrosion is present, but bearings appear functional. 8/27/12 - Extensive crack in lower portion of bearing on South bearing on East abutment. 8/28/13 - Changed quantity to	Yes

MnDOT - Phase 1



MnDOT - Phase 1

Arcola Railroad Bridge

- Large Complex Bridge
- Normally inspected using rope access
- National Park Service Permission
- Difficult to access





Arcola Bridge Image Detail

MnDOT – Phase 2

- Cost comparison with UBIVs, traffic control
- Explore inspection specific technology including the senseFly albris
- Compile a best practices document
- Deck surveys with zoom camera
- Culvert and Box Girder Inspection
- IR Deck Delamination Assessment at Dawn
- Paint Assessment

MnDOT – Phase 2

Blatnik Bridge Inspection

- Largest Bridge in Minnesota
- Crosses Duluth Harbor adjacent to Lake Superior
- Challenging wind and weather



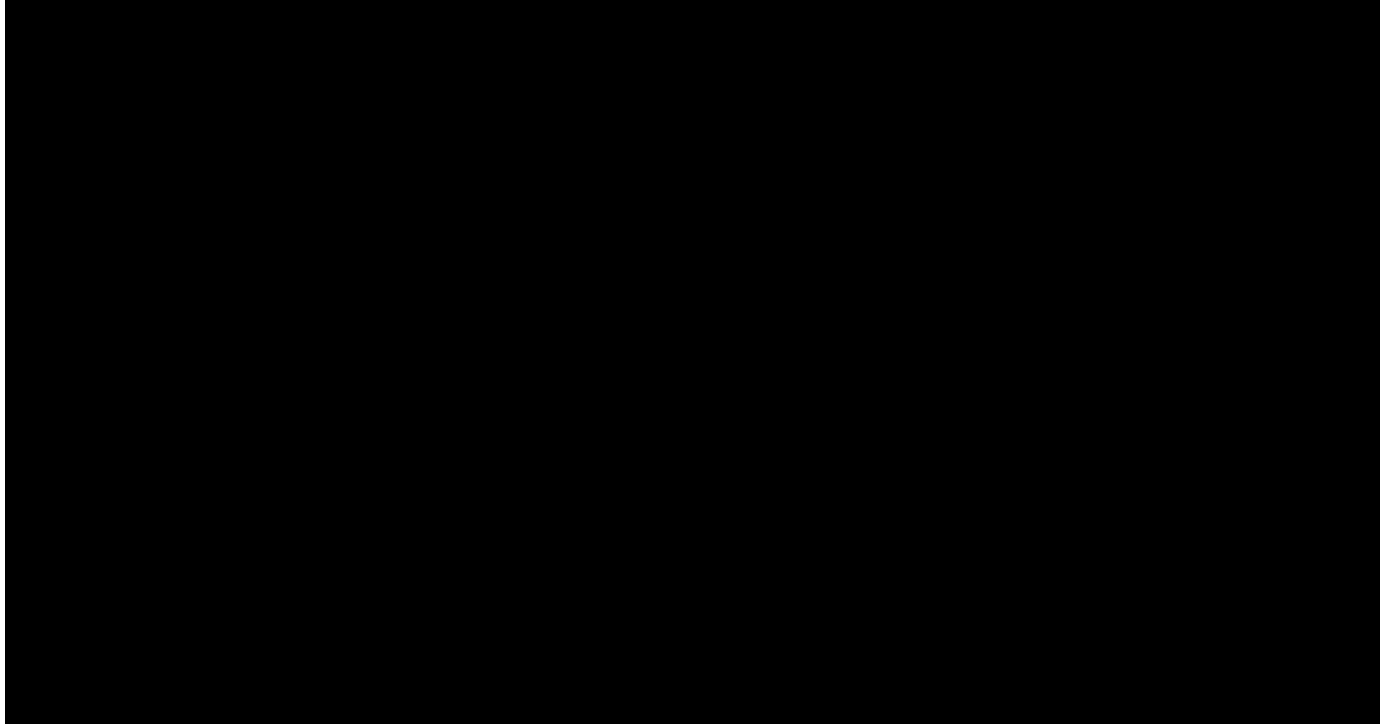
MnDOT - Phase 2

Nielsville Bridge 5767

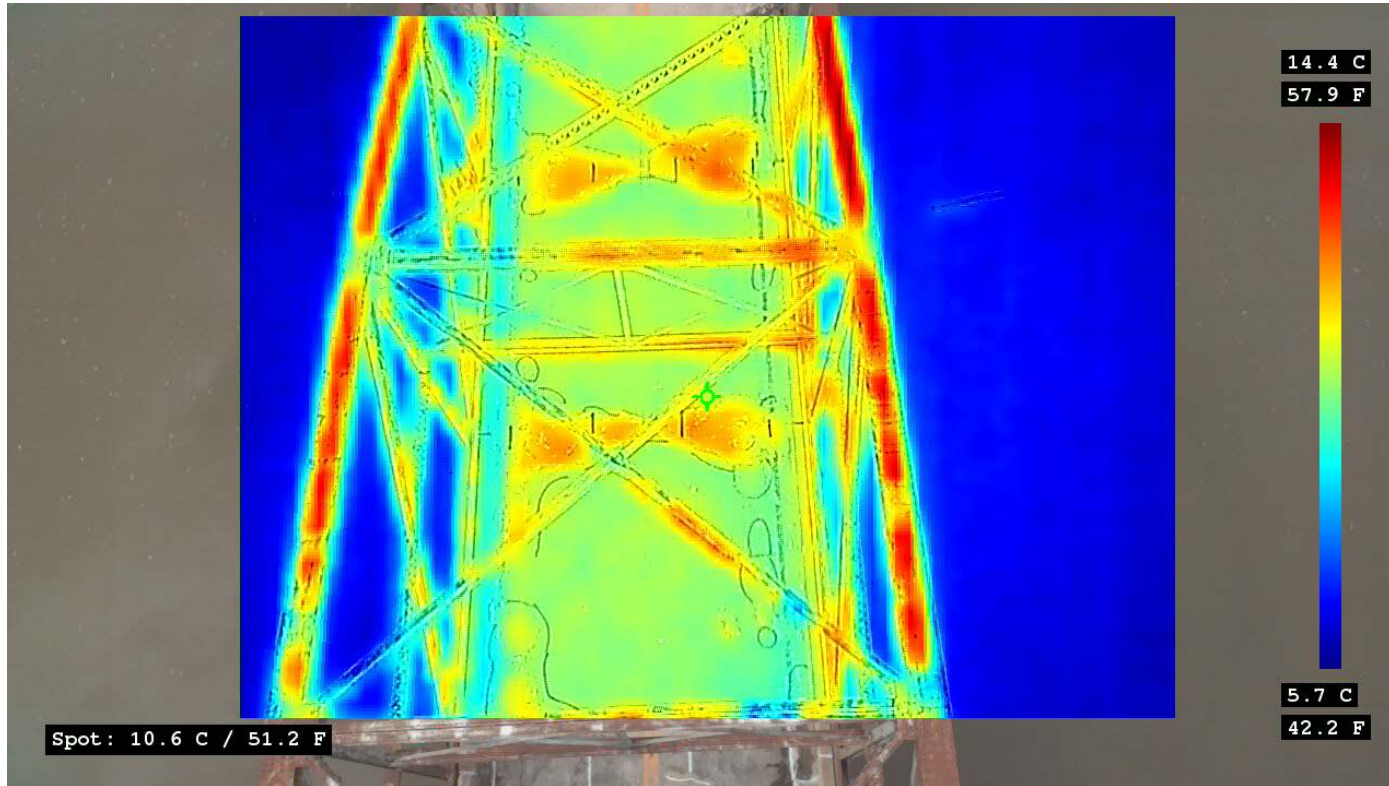
- Infrared Imaging
- Thermal Camera results were similar to high end FLIR cameras
- Drone has the ability to map chain drag markings for quantities in CAD



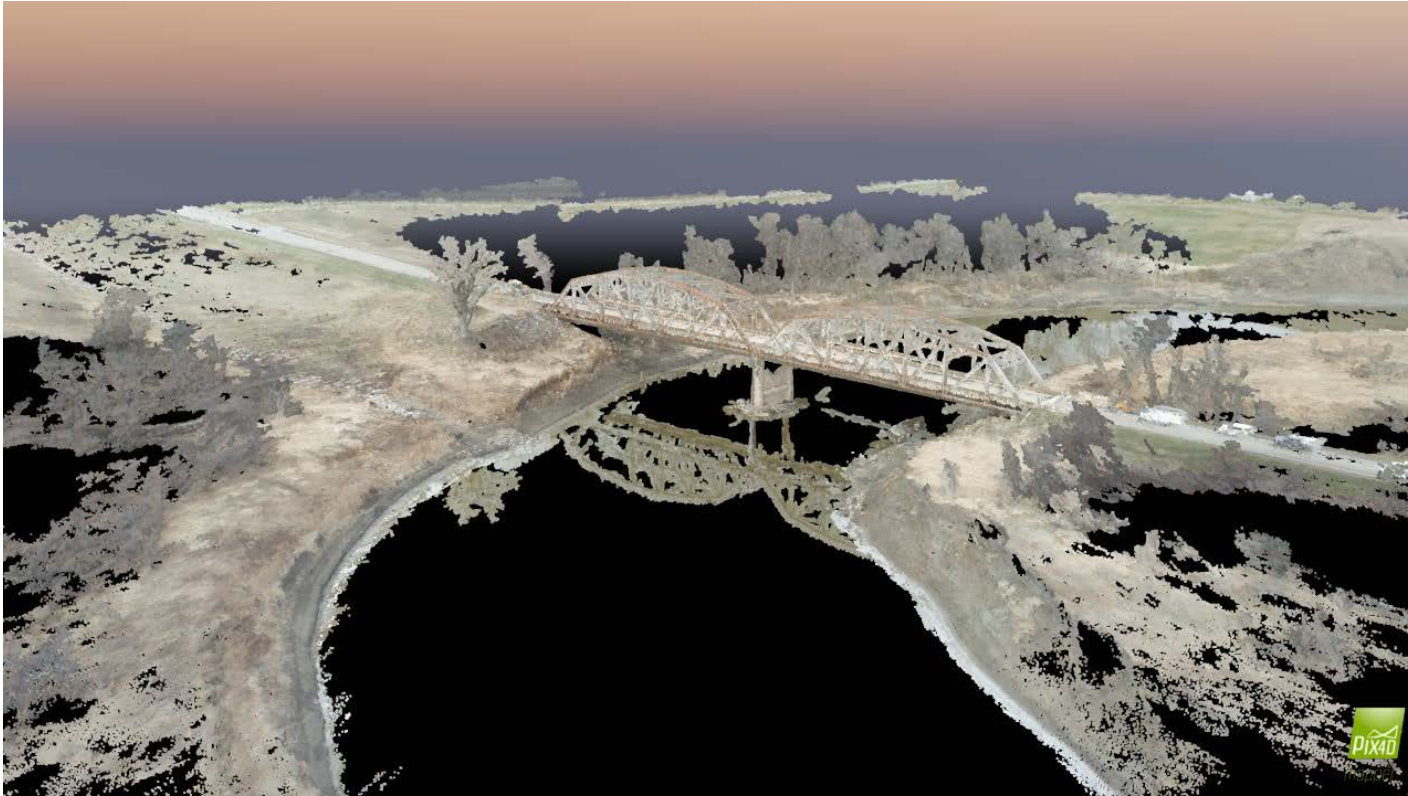
Minnesota Department of Transportation Project



Nielsville Bridge – Thermal Infrared Imagery



Nielsville Bridge – 3D Point Cloud



MnDOT Project – Best Practices

The National Bridge Inspection Standard (NBIS) requires that a properly trained and certified inspector be present and lead the inspection in order to ensure the safety of the traveling public.



MnDOT Project – Best Practices

To meet standards, live video feed and photos were streamed to a TV and reviewed immediately by a certified inspector.





Inspection is about doing it live, being involved, rather than later in the office. The more interactive, the better quality the inspection.

Jennifer Zink, State Bridge Inspection Engineer, MnDOT



MnDOT Project – Benefits of UAS Inspection

- Both infrared and 3D modeling detail of bridges
- Effectively identify concrete delamination
- Gather topographic mapping detail and efficiently map riverbank conditions upstream and downstream, from the bridge site.

MnDOT Project – Benefits of UAS Inspection

Blatnik Bridge Inspection

Snooper Truck

Days On Site	Cost	Safety and Convenience
8	\$59,000	✗

UAV

Days On Site	Cost	Safety and Convenience
5	\$20,000	✓

66% Savings!



The inspection detail that UAS provide effectively replicates some of the detail learned through the use of snoopers, **without the traffic control requirements**, and at **significantly lower cost** in terms of equipment and traffic control needs

Jennifer Zink, State Bridge Inspection Engineer, MnDOT



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A topographic map background with a river and forest. The map features contour lines in shades of brown and orange, indicating elevation. A river flows through the center, with a forested area on the left. The overall color palette is warm and natural.

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