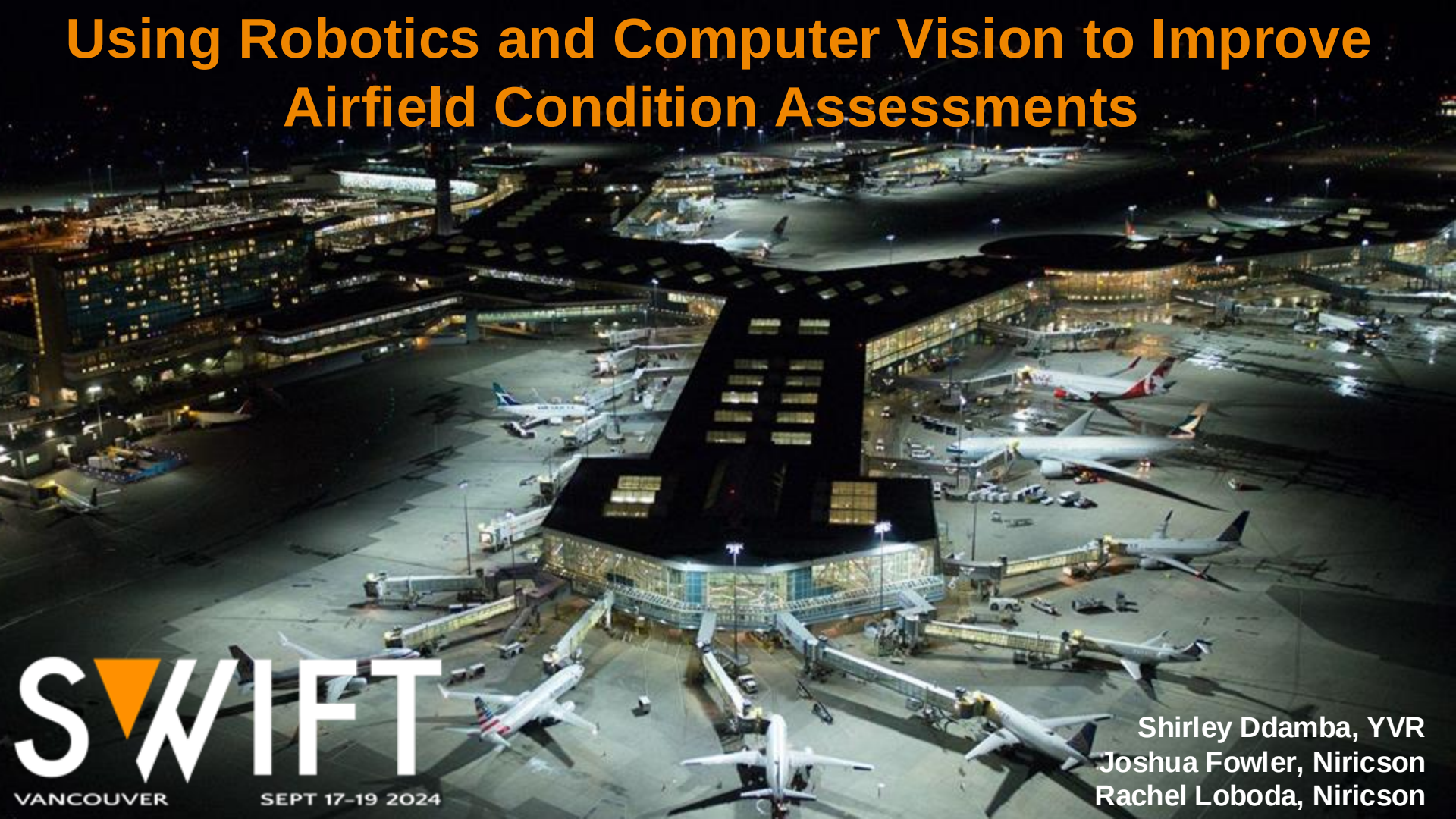
Using Robotics and Computer Vision to Improve Airfield Condition Assessments



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VANCOUVER SEPT 17–19 2024

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Vancouver International Airport YVR

- Vancouver International Airport (YVR) is an international airport located in Richmond, BC
- Vancouver International Airport is managed by the Vancouver Airport Authority
- YVR is the second busiest passenger airport in Canada
- Working with BC Innovate, YVR & Niricson

Agenda

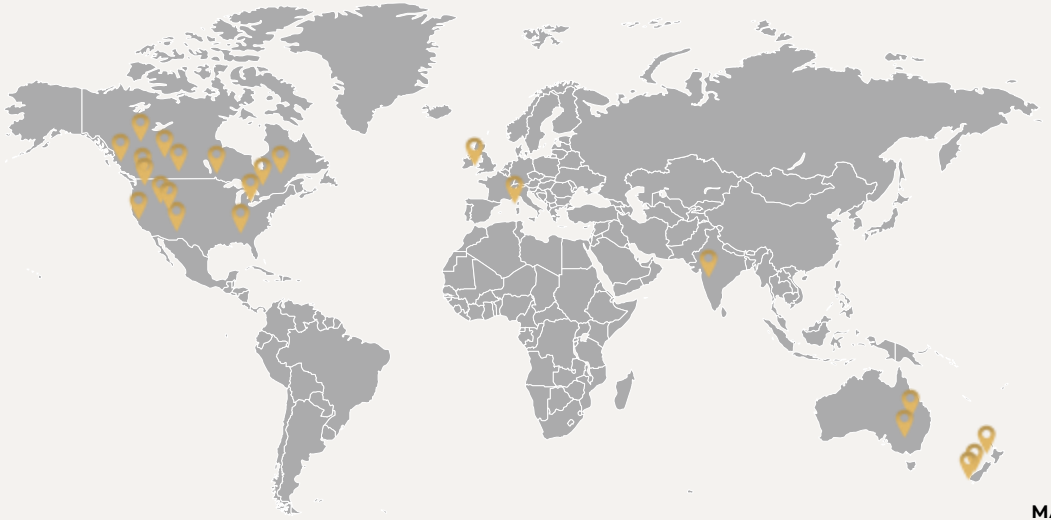
- Company Overview
- Niricson and YVR Project Overview
- Project Objectives and Scope of Work
- Data Collection Methodology & Challenges
- Comparisons to Alternative Methods
- Conclusion, Impacts & Takeaways

Niricson

Global Footprint
Actively Operate in 4 Continents

Major Clients:

Bangalore Airport, Montreal Airport, Pacific Gas and Electric, Ontario Power Generation, & BC Hydro



30+
Clients

100+
Projects

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01 **Automated Digital Defect Change Detection**

02 **Remote identification of Delamination**

03 **Built BY Civil Engineers FOR Civil Engineers**

Why Condition Assessments?

Aging Infrastructure
Airfield infrastructure is Rated a "D+" by ASCE

Weather Events, Freeze Thaw, Ocean Salts, Earthquake Damage, Flooding, Snow Removal
Increasing severe weather globally

Problems Forecasting Future Maintenance Costs and Capital Expenditures
Academics found that 90% of construction projects underestimated costs, which resulted in cost overruns of between 50% and 100%.

Challenges at YVR

- **Operations/Air Traffic is overloaded during daylight hours**
  - **Limitations of traditional hands-on inspections, particularly at night (limited surface coverage and subjective)**
  - **Time intensive**
  - **LCMS analysis times are long, relying on technical expertise for processing**
  - **Englobe prefers LCMS daytime use as it relies on video footage for Quality Control**

Objectives and Scope of Work

- **Main Objective: Evaluate a less impactful strategy for condition assessment on an active airfield**

- **Photogrammetric 3D and 2D Models of Airfield**

- **Develop distress maps, quantifying and mapping damage on an orthoimage using AI (All Visible on AUTOSPEX™ platform.)**

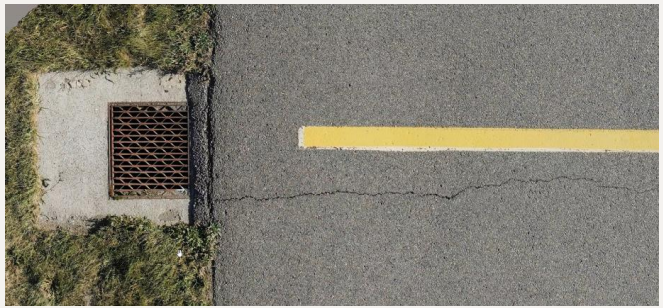
Workflow Overview

Data Collection Protocol

Cloud AI Platform

Step 1

Data Collection



Step 2

Data Pre-Processing

Step 3

Data Processing

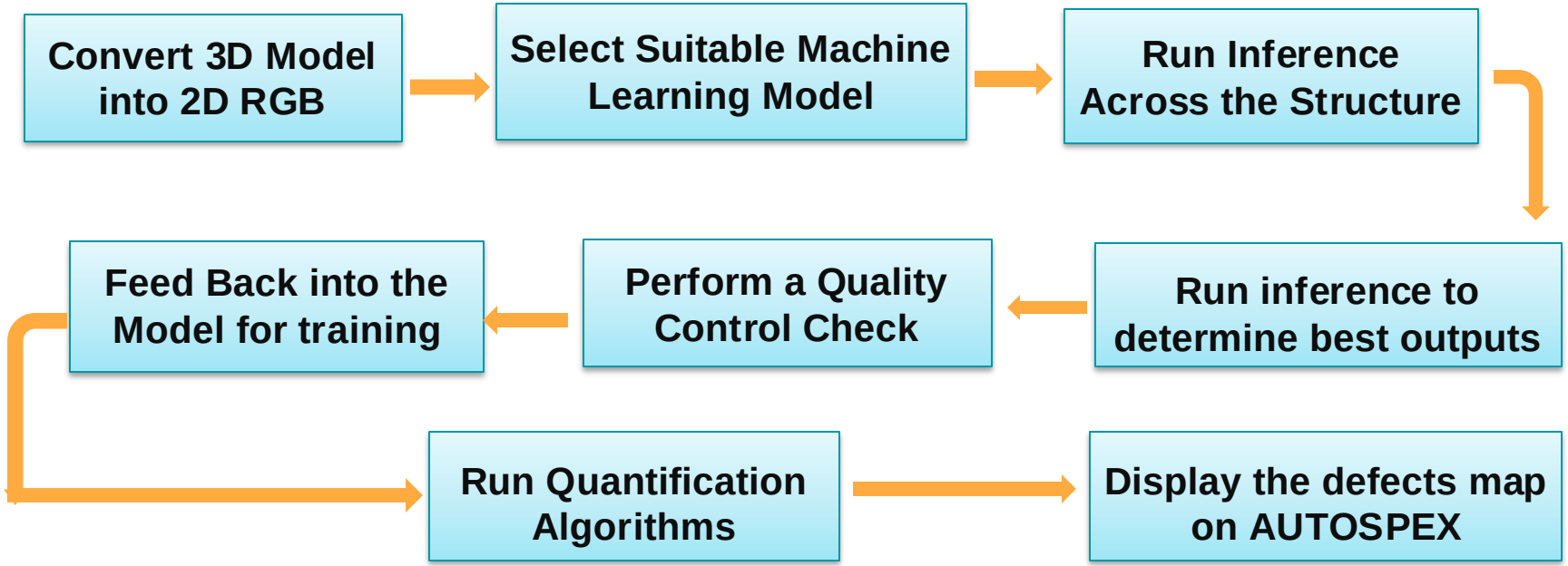
Step 4

Quality Checks

Step 5

Upload & Analytics

Machine Learning for Pattern Recognition



Data Collection Methodology

Data Collection Methodology

Data Collection Challenges | YVR

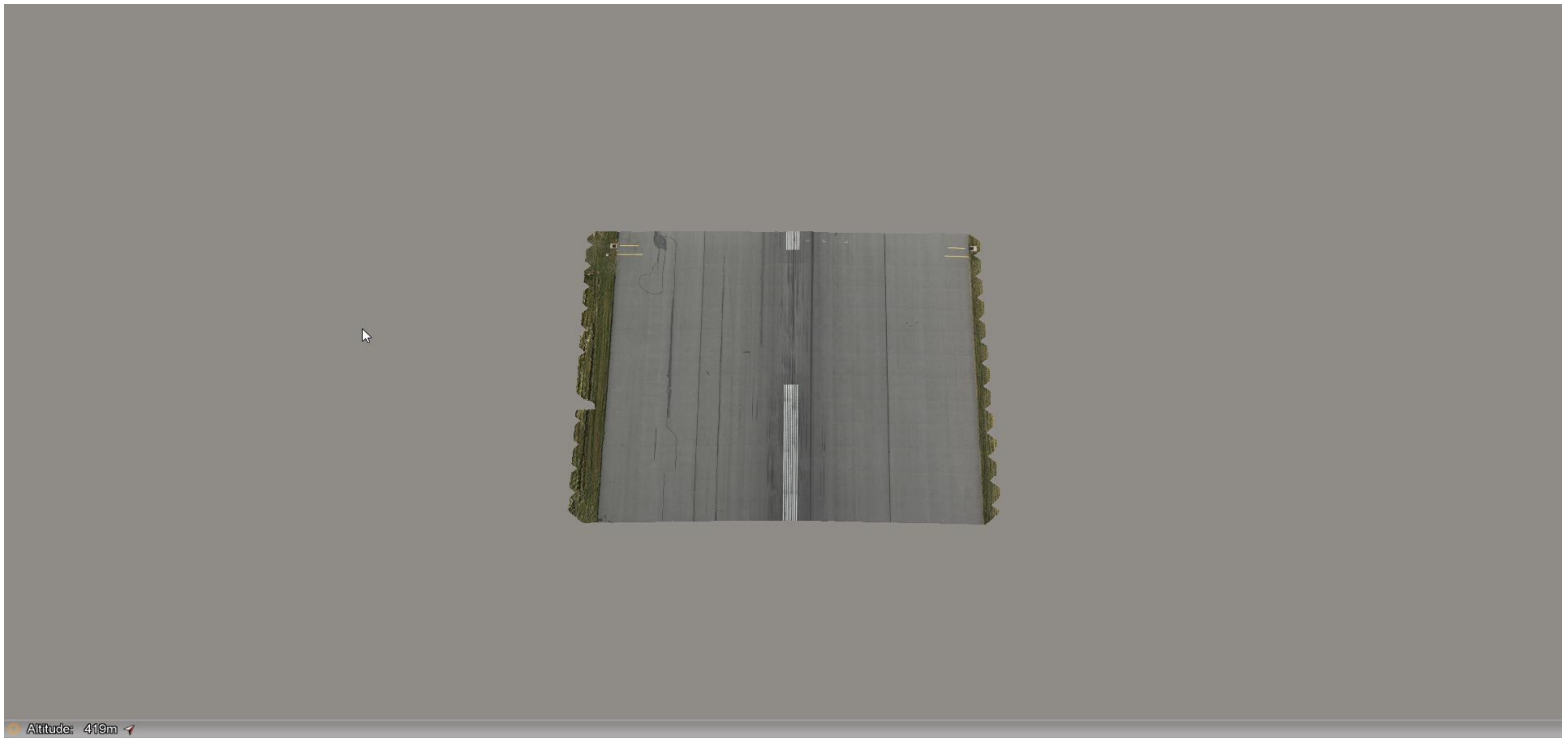
Operational Hurdles for Drones in the Airside Spaces
- NavCan moved traffic due to winds and Stated drones were not allowed to fly

Low Traffic time periods at YVR are limited

Requirement for High Resolution Imagery in the Dark
- Toggle different lumens/lighting to eliminate dark spots, power source for lighting

User Friendly, Stable Device that Can be Operated by Airport Staff

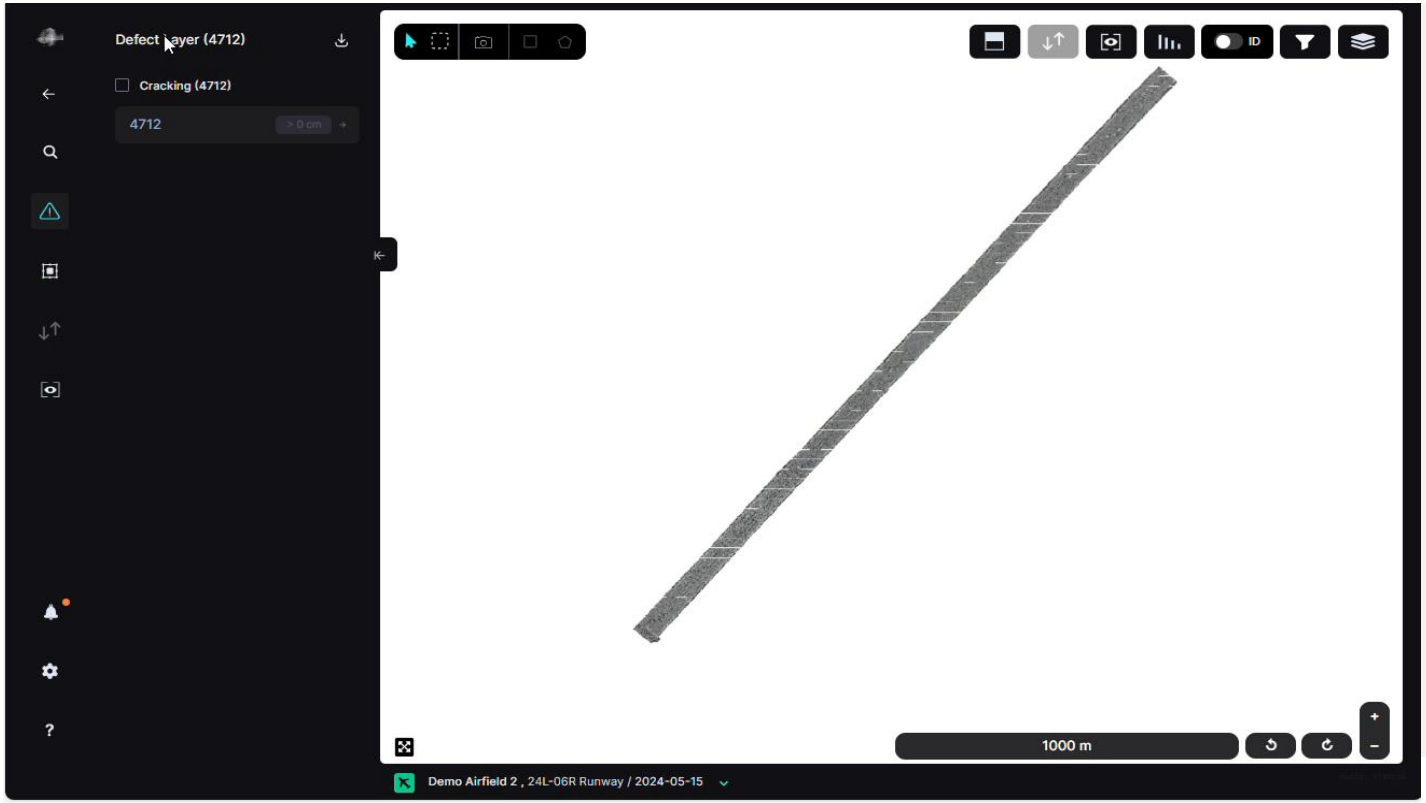
Digital Asset Management



Mapping Defects

Automated Defect Mapping Generated Through AI Technology

Digital Asset Management



Coverage of Entire Surface

Geospatial Sample Areas

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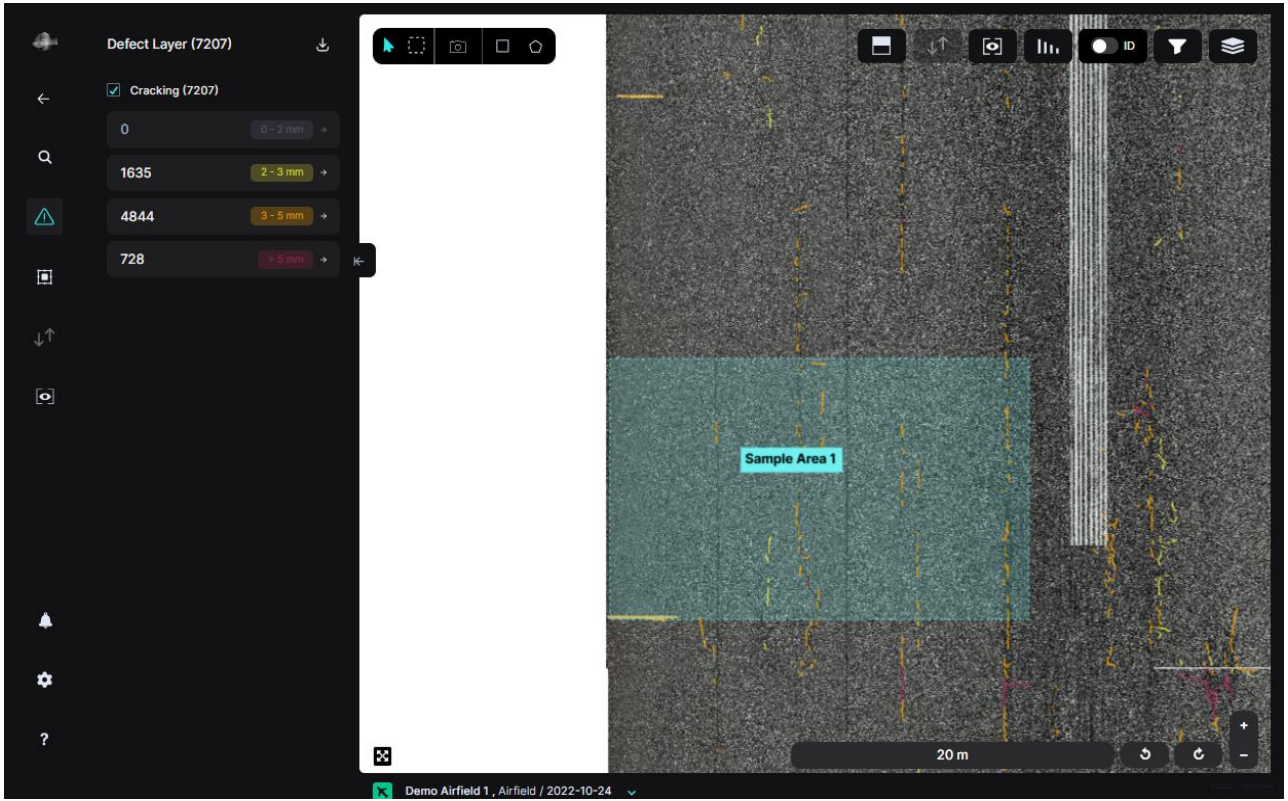

Sample areas & locations can be created on the maps, which aggregate defects within the selected area

Geospatial Defect Mapping

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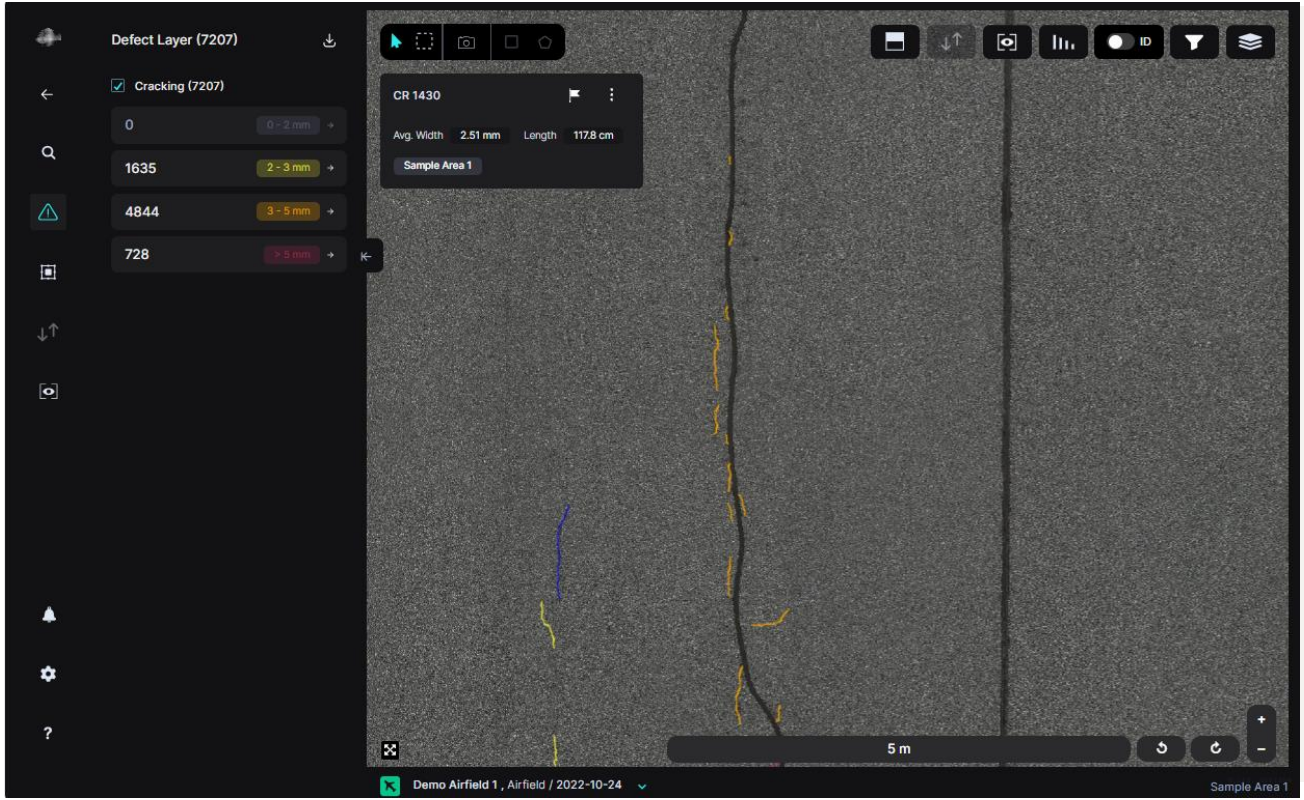

Defects are Associated with the locations that are defined in the software

Geospatial Defect Severity

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Defects can be labeled as high/medium/low severity

Defects can be labeled by ‘type’ on the platform

Automated PCI Inputs

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A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
Asset Nan	Survey Date	Created At	Updated At	Defect Typ	Defect Id	X	Y	Avg Width Mm	Length Cm	Area Cm S	Avg Width	Length Fee	Area Feet	Flagged	Flagged By	Flagged At	Location	Priority	Severity	Focus Area
Demo Airf	10/24/2022	1/15/2024 0:02	3/21/2024 18:37	Cracking	CR 5625	43.67197	-79.6499	12.09	460.1144		[illegible]	[illegible]		Yes	Admin	3/21/2024 18:3				
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 6465	43.67177	-79.6494	3.5	46.1726		0.14	1.5149		No			Zone D			
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 2823	43.67515	-79.6497	3.77	13.0417		[illegible]	[illegible]		No			Zone X			
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 12	43.6803	-79.6492	5.04	133.5904		0.2	4.3829		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 32	43.68024	-79.6494	4.21	20.7735		0.17	0.6816		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 686	43.67876	-79.6493	5.61	41.6882		0.22	1.3678		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 114	43.68001	-79.6493	4.13	36.8271		0.16	1.2083		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 6948	43.67113	-79.6493	6.21	40.3726		0.24	1.3246		No			Zone E			
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 16	43.68029	-79.6492	4.51	128.6745		0.18	4.2217		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 61	43.68017	-79.6491	4.23	11.5269		0.17	0.3782		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 6946	43.67113	-79.6493	6.25	54.8935		0.25	1.801		No			Zone E			
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 3917	43.67417	-79.6501	2.63	50.9878		0.1	1.6729		No			Zone G,Zone X			
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 3928	43.67415	-79.6498	2.84	13.071		0.11	0.4289		No			Zone G,Zone X			
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 6972	43.68027	-79.6498	3.54	48.215		0.14	1.5819		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 6984	43.68027	-79.6497	2.13	35.3812		0.08	1.1608		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 3938	43.67414	-79.6498	3.2	45.8214		0.13	1.5034		No			Zone G,Zone X			
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 539	43.67874	-79.65	4.43	19.3895		0.17	0.6362		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 530	43.67902	-79.6499	4.21	87.8169		0.17	2.8812		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 518	43.67907	-79.6497	4.35	36.1904		0.17	1.1874		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 1185	43.67732	-79.6497	2.67	35.4211		0.11	1.1622		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 554	43.67895	-79.6497	4.07	84.3409		0.16	2.7671		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 2517	43.67542	-79.65	2.57	15.3904		0.1	0.505		No			Zone X			
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 618	43.67493	-79.6498	4.11	9.3396		0.16	0.3065		No			Zone X			
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 757	43.67838	-79.6497	4.39	14.4906		0.17	0.4755		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 715	43.6785	-79.65	4.28	27.7329		[illegible]	[illegible]		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 721	43.67848	-79.6497	4.21	29.6898		0.17	0.9741		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 7074	43.67988	-79.6499	3.42	64.6147		[illegible]	[illegible]		No			Sample Area A			
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 4033	43.67399	-79.6498	4.15	21.5768		0.16	0.7079		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 819	43.67833	-79.6496	4.28	27.5559		0.17	0.9041		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 4039	43.67398	-79.65	4.25	11.9388		0.17	0.3917		No			Zone A			
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 5809	43.67216	-79.6497	2.98	22.1568		0.12	0.727		No			Zone D			
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 847	43.67823	-79.65	4.26	38.039		0.17	1.248		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 855	43.67818	-79.65	5.72	51.9537		0.23	1.7046		No						
Demo Airf	10/24/2022	1/15/2024 0:02	1/15/2024 0:02	Cracking	CR 1111	43.67748	-79.6498	3.64	27.5917		0.14	0.9053		No						FA01

Digital Surface Profile

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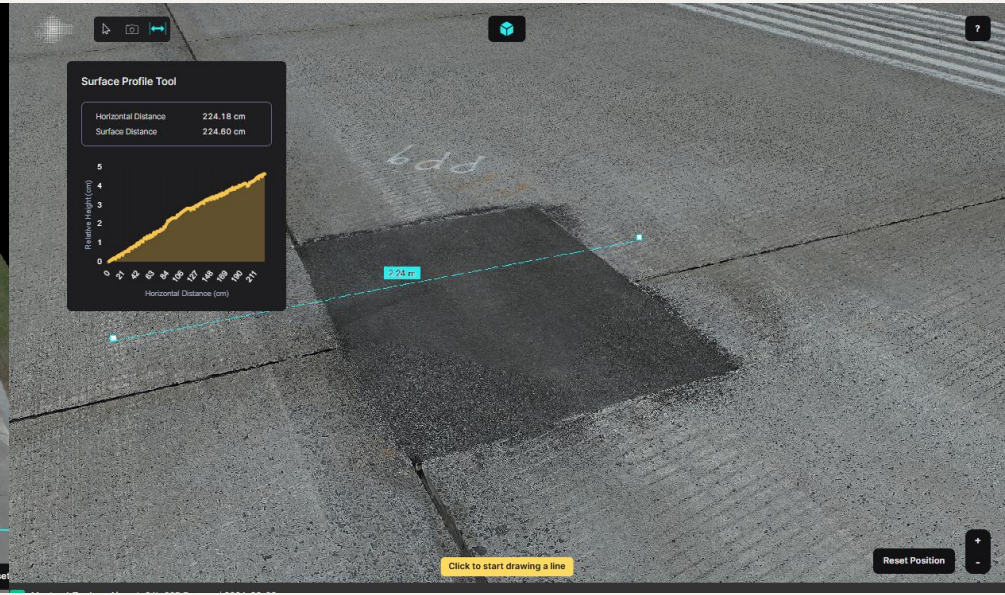
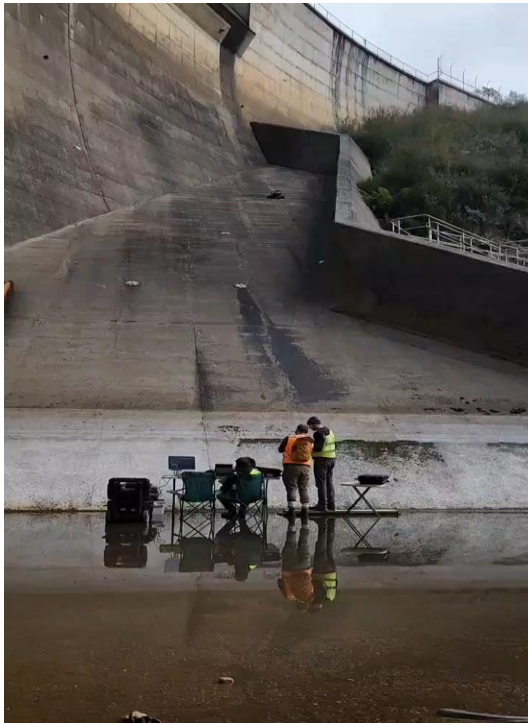


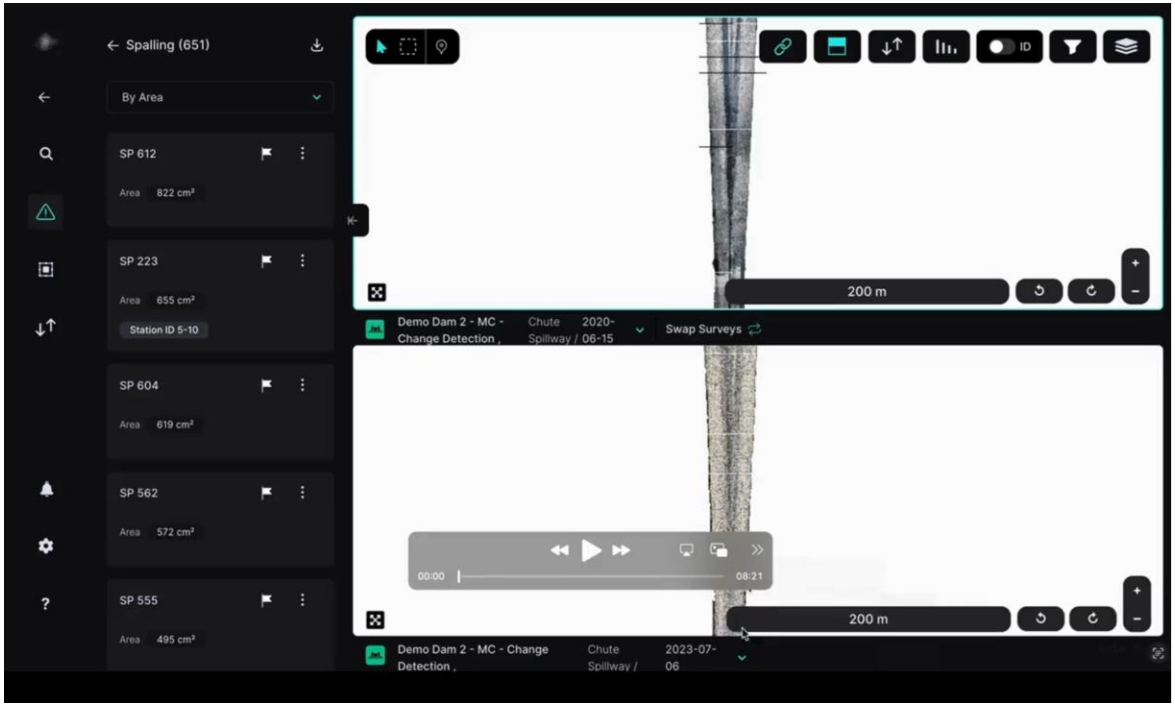
Data Collection
Concrete Soundings for PCC



- **Not all spalls are visual, some PCC airfields do soundings to identify delamination**
- **By detecting delamination before the concrete spalls, we can be proactive with maintenance**

Planning Future Maintenance

1) Use quantities to plan and budget for annual/periodic maintenance
2) Repeat survey to understand the condition trendline
3) Understand the effectiveness of repair work
4) For new construction, use the scan to track deterioration during warranty period



Impact on Cost, Time Saving, ROI

- **Traditional hands-on inspections require longer operational shutdowns**
- **Work completed with 0% operational impact to flight traffic**
- **Repeatable, standardized method which can track visual and non-visual defects as a baseline**

Impact on Cost, Time Saving, ROI

- **Average Airport earns $10,000 per Aircraft in Revenue. On the low side, YVR can complete 50-60 movements per hour with two runways. Cost: $250,000 per Hour per Runway**
- **Cost of Traditional Inspections: Missing Defects Leading to Inefficient Repairs**
- **Cost of Inaction: Potential Emergency Pavement Situations**

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Comparison to Traditional Methods

	Photogrammetry	LCMS	Manual
Collection Speed	Fast	Fast	Slower
Processing Speed	Fast	Slower	Fast
Coverage	100%	100%	25%
Nighttime	Yes	Partially	Limited
Objective	Yes	Yes	No
Sounding	Yes	No	No

Conclusions, Impacts & Takeaways

- **Automated tracking of changes and deterioration, automatically mapped and quantified out.**
- **Raveling and Weathering are challenging for asphalt. All concrete distresses for PCC can be recognized.**
- **Rain, Snow remains an issue.**

Conclusions, Impacts & Takeaways

- **Accurate maintenance estimates for repair quantities & asset planning.**
- **Rover can be automated for collection on-demand. This is the "Roomba Vacuum Cleaner" for Pavement.**


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Questions?