RPA - P6

Non – Destructive Airport Pavement Testing Technology

Presented to: REDAC

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RPA P6 - Airport Pavement NDT Technology

Need

- The FAA predicts that the airline industry will grow from 731 million passengers in 2011 to 1.2 billion in 2032. Because of this, airport pavements will need to be evaluated faster and more efficiently; nondestructive airport pavement testing is the hub of airport pavement evaluation.

Research Goals

- Development of New Pavement Roughness Index for In-Service Airport Pavement
- Improve the NDT testing protocol and analysis method
- Develop more accurate structural analysis model
- Improve airport pavement structural inputs to FAA airport pavement programs.
- Evaluation of Alternative Profiling Technologies for Airport Pavement Acceptance

FY 2017 Accomplishments

- Submit alternative procedures for airport pavement smoothness acceptance.
- Research alternate airport pavement profiling methods and equipment at Cape May Airport.
- Research improved backcalculation methods as inputs to airport pavement thickness design.

Planned for FY 2018

- Draft New Pavement Roughness Index.
- Draft method for calculating runway/taxiway grades from longitudinal profiles.
- Support NAPTF and NAPMRC testing and utilize NDT technology to verify the observations of full scale testing.
- Characterize the pavement layer material with the emerging technologies.

FAA Pavement Structural Evaluation

- Low operational cost
- Short test duration
- Simulate a moving wheel load
- Measure pavement response-deflection basin
- Characterize pavement layer moduli
- Evaluate pavement structural capacity

Support NAPTF and NAPMRC

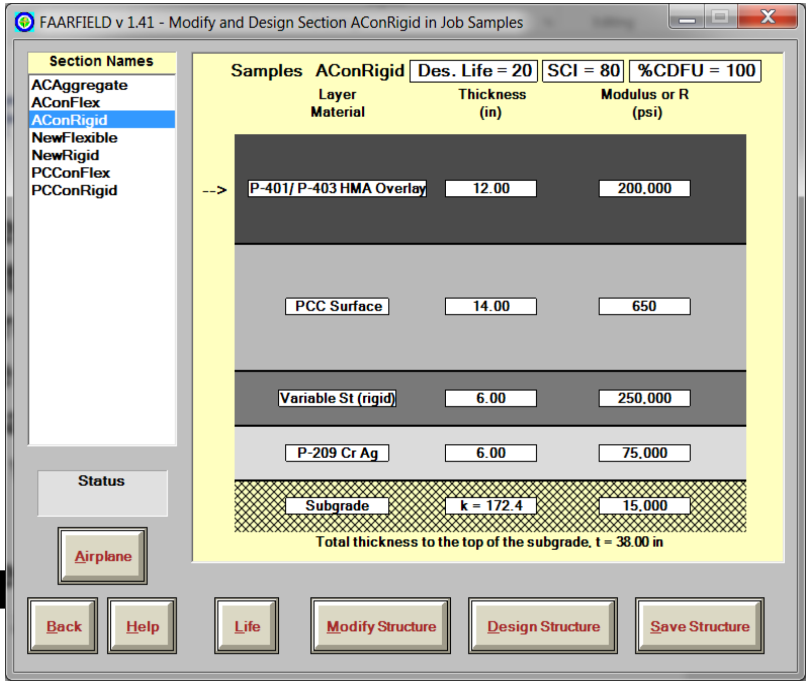
- **Nondestructively monitor the pavement mechanistic property changes under both traffic and environmental loading.**
- **Compare measured strain values against calculated values in order to better understand pavement material mechanistic properties.**
- **Assess the need for and designing the thickness of an overlay and enhance its performance under traffic loading.**
- **Provide the valuable pavement profiles through comparing stiffness of conventional and stabilized-base pavement on the same subgrade and similar pavements on different subgrades.**

Support Field Instrumentation

- **Field Instrumentation monitor the variations of pavement displacements, strains, stresses, and temperature due to the traffic and environmental loading.**
- **Better understanding of long-term pavement behavior under varied climatic and operating conditions, and improved characterization of paving materials.**
- **Develop improved material characterization through in-situ testing at airport construction projects.**
- **Current projects include Hartsfield-Jackson, LaGuardia, JFK, Newark, and Boston Airport.**

Support Inputs to FAARFIELD

- CBR has long been used as inputs for pavement design and is replaced by more advanced parameters, such as resilient modulus.
- Backcalculation provides simpler and economical technique for design inputs of FAARFIELD.
- Soil moisture contents and stress level are considered as the main reasons of causing discrepancies between CBR, laboratory modulus and backcalculated modulus.
- Develop relationship between in situ CBR, lab resilient modulus and backcalculated subgrade modulus.



Google Earth View of Cape May Airport (WWD) Surveyor Data

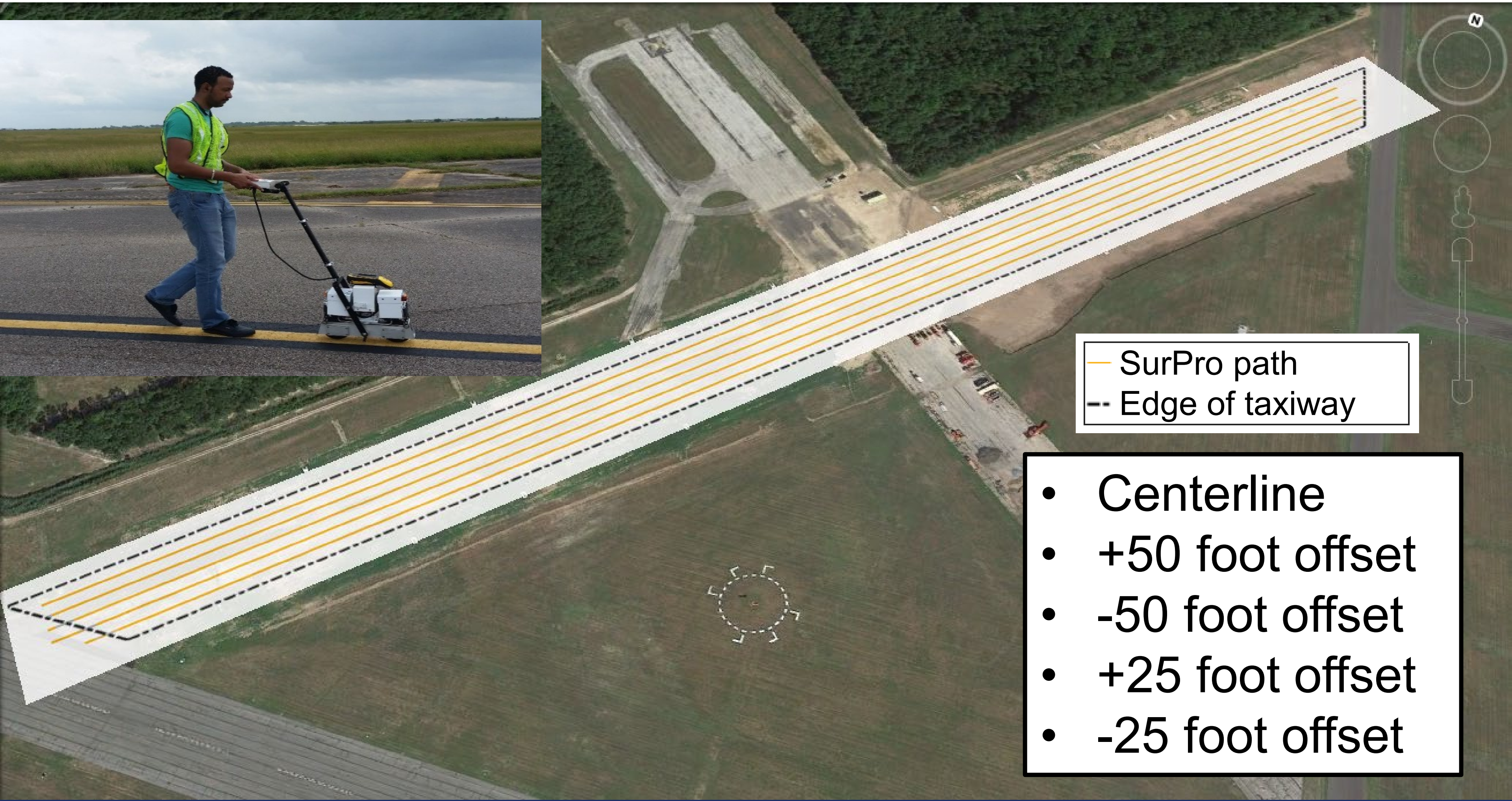
	Elevation	Station	Offset
9+0 50LT	16.31	9+0	L50
9+0 25LT	16.67	9+0	L25
9+0 CL	16.83	9+0	CL
9+50 50RT	16.62	9+50	R50
9+50 25RT	16.73	9+50	R25
9+50LT	16.82	9+50	CL
9+50 25LT	16.56	9+50	L25
9+50 50LT	16.27	9+50	L50
9+50 75LT	15.98	9+50	L75
10+0 75LT	16.04	10+0	L75
10+0 50LT	16.36	10+0	L50
10+50 25LT	16.56	10+50	L25
10+0 CL	16.84	10+0	CL
10+0 25RT	16.74	10+0	R25
10+0 50RT	16.5	10+0	R50
10+0 75RT	16.43	10+0	R75

Point Elevation Comparison

	Location Centerline	Rod and Level Survey Elevation	Surpro Elevation	SurPro +16.83	%Error (Rod and Level True Elevation)	% Difference
1						
2	0	16.83	0	16.83	0.00	0.00
3	50	16.82	0.0084	16.83	0.06	0.01
4	100	16.84	0.0343	16.86	0.12	0.03
5	150	16.83	0.0192	16.84	0.06	0.01
6	200	16.78	-0.0291	16.80	0.12	0.03
7	250	16.8	-0.0133	16.81	0.06	0.01
8	300	16.72	-0.0941	16.73	0.06	0.01
9	350	16.7	-0.1089	16.72	0.12	0.03
10	450	16.58	-0.172	16.65	0.42	0.11
11	500	16.53	-0.2262	16.60	0.42	0.11
12	550	16.47	-0.249	16.58	0.67	0.17
13	550	16.47	-0.3215	16.50	0.18	0.05
14	600	16.41	-0.3723	16.45	0.24	0.06
15	650	16.47	-0.3021	16.52	0.30	0.08
16	700	16.51	-0.2677	16.56	0.30	0.08
17	750	16.54	-0.2475	16.58	0.24	0.06
18	800	16.54	-0.2346	16.59	0.30	0.08
19	850	16.56	-0.2186	16.61	0.30	0.08
20	900	16.6	-0.1895	16.64	0.24	0.06
21	950	16.61	-0.1676	16.66	0.30	0.08
22	1000	16.6	-0.173	16.65	0.30	0.08
23						
24						
25	2400	15.74	-0.9828	15.84	0.64	0.16
26	2450	15.73	-1.001	15.82	0.57	0.14
27	2500	15.7	-1.0856	15.74	0.25	0.06
28	2550	15.68	-1.1513	15.67	-0.06	-0.02

Contour Plot Produced from Survey Data

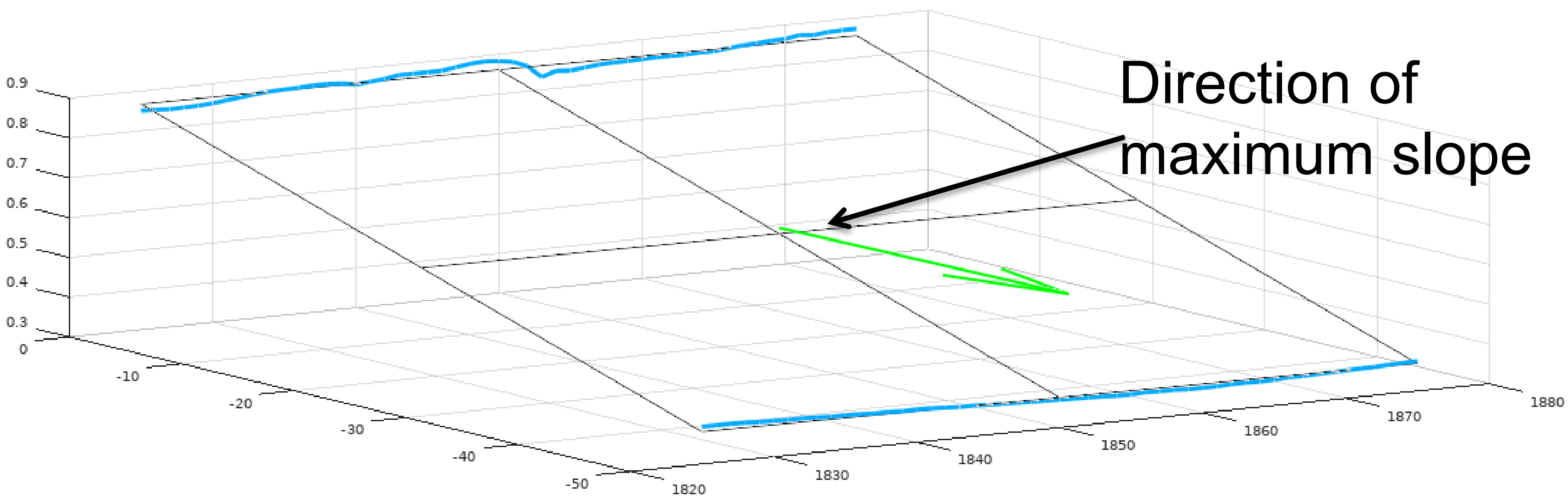
Chosen SurPro Data for Analysis



- Centerline
- +50 foot offset
- -50 foot offset
- +25 foot offset
- -25 foot offset

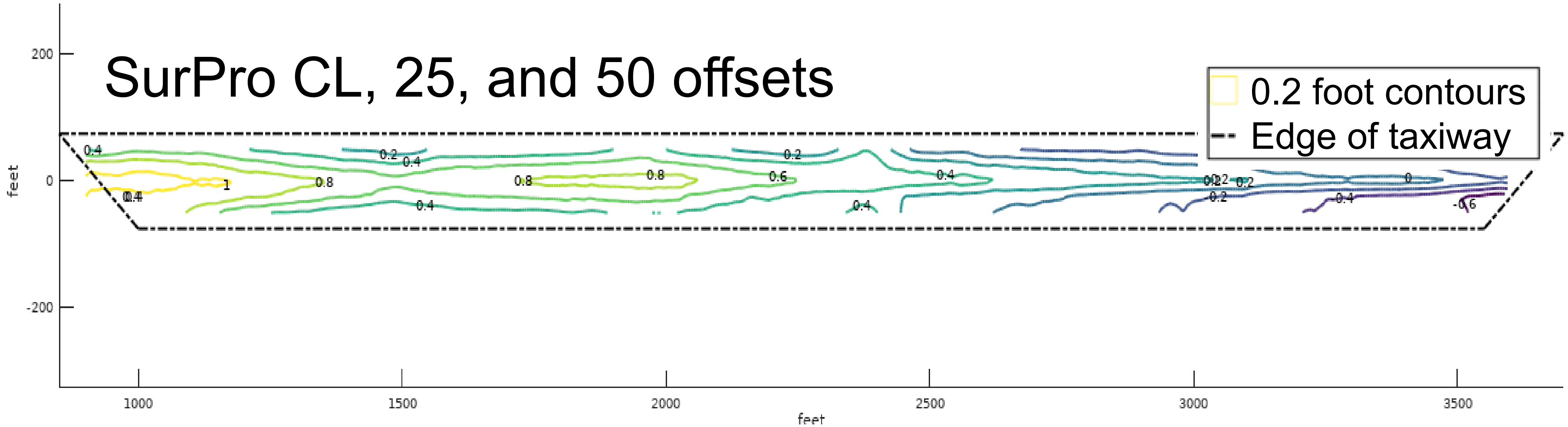
Maximum Slope Direction Solving Method

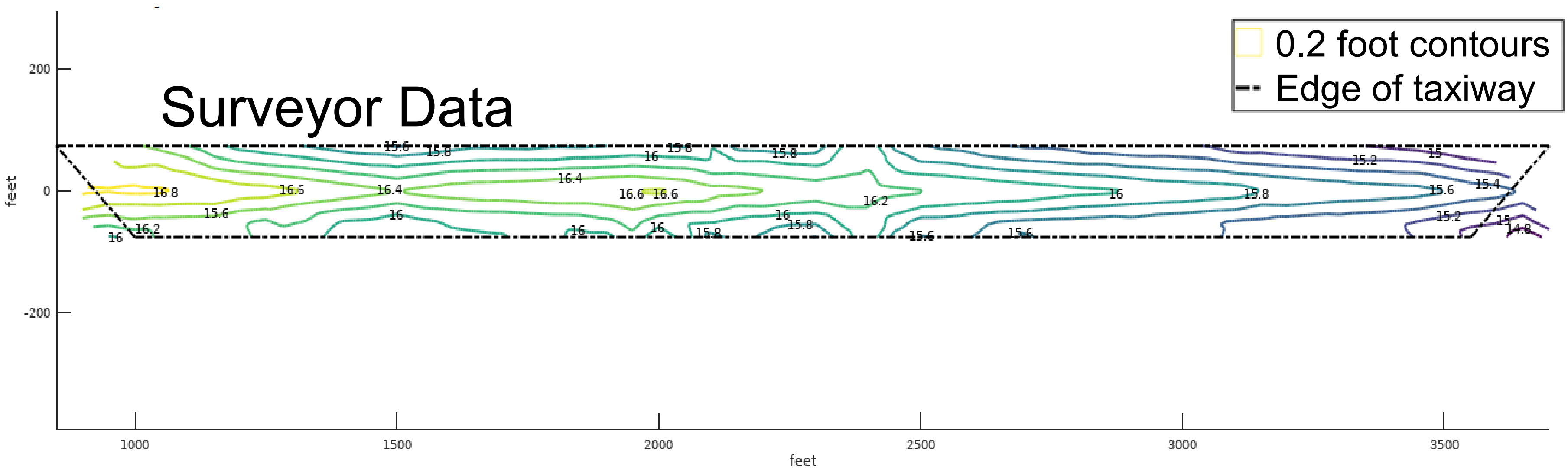
- **Using the equation of the plane found by “affine_fit” the maximum slope is found.**



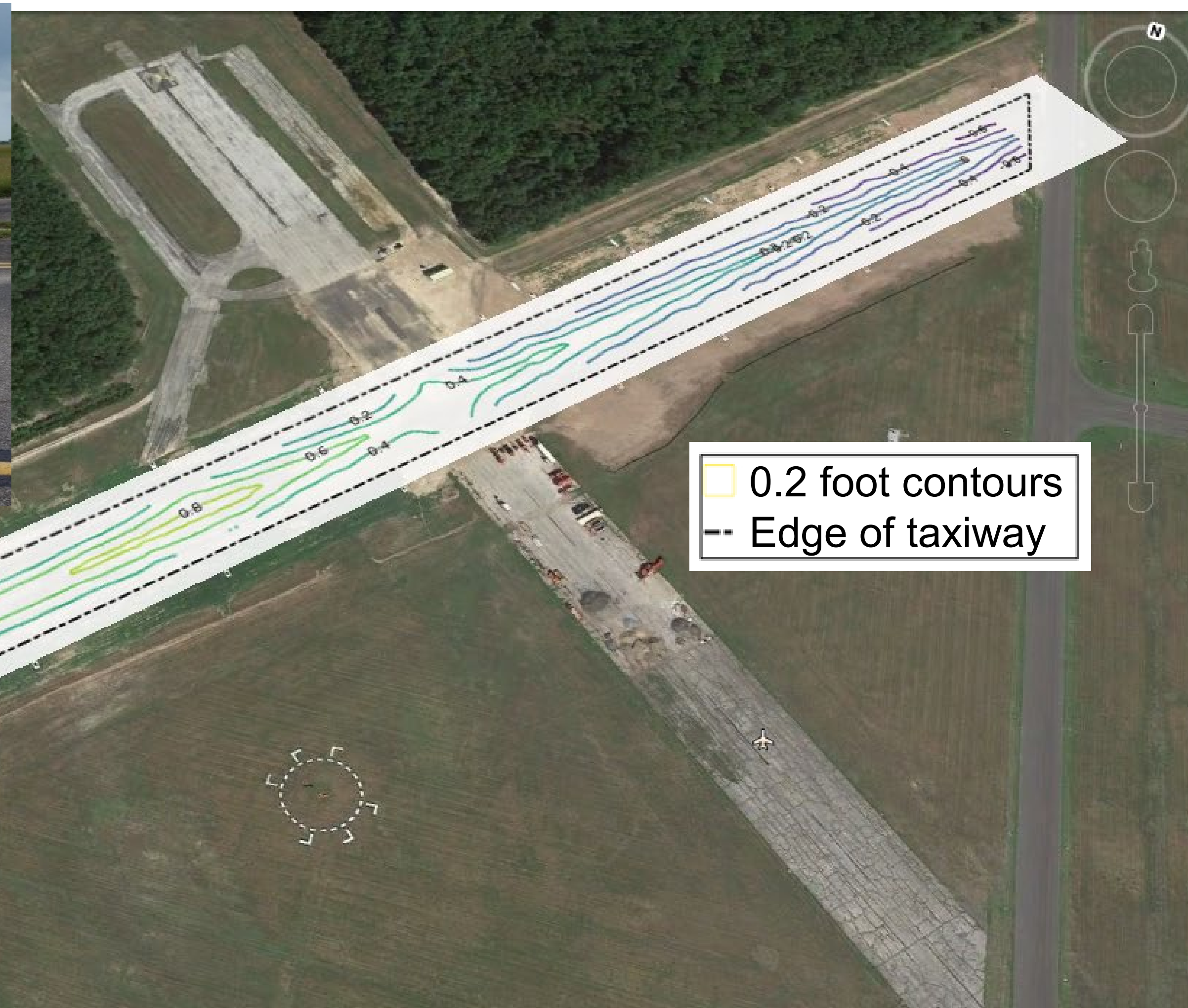
Reference:
https://www.mathworks.com/matlabcentral/fileexchange/43305-plane-fit

Comparison Between SurPro And Survey Contours



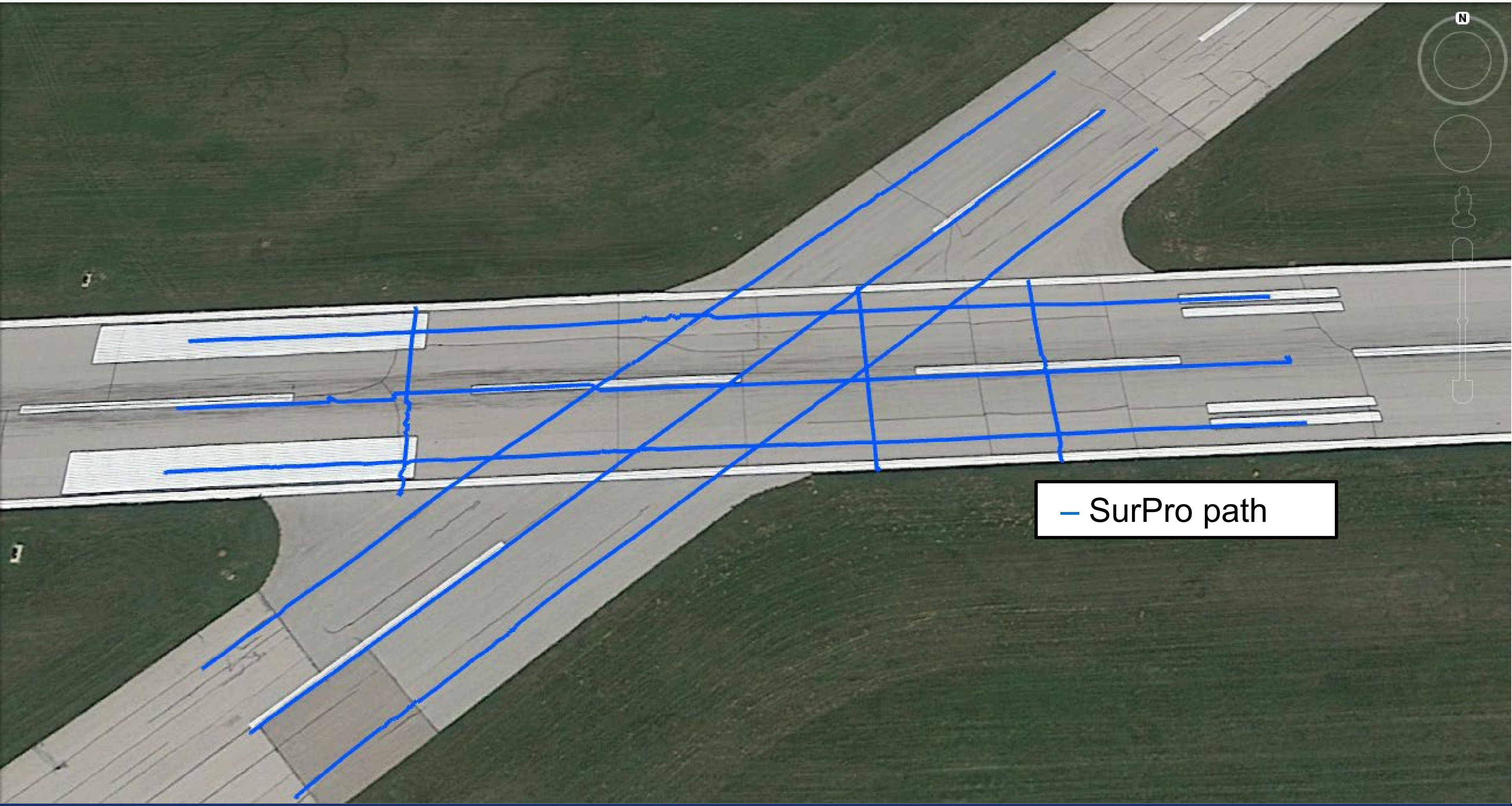


Contour Plot Determined from SurPro data

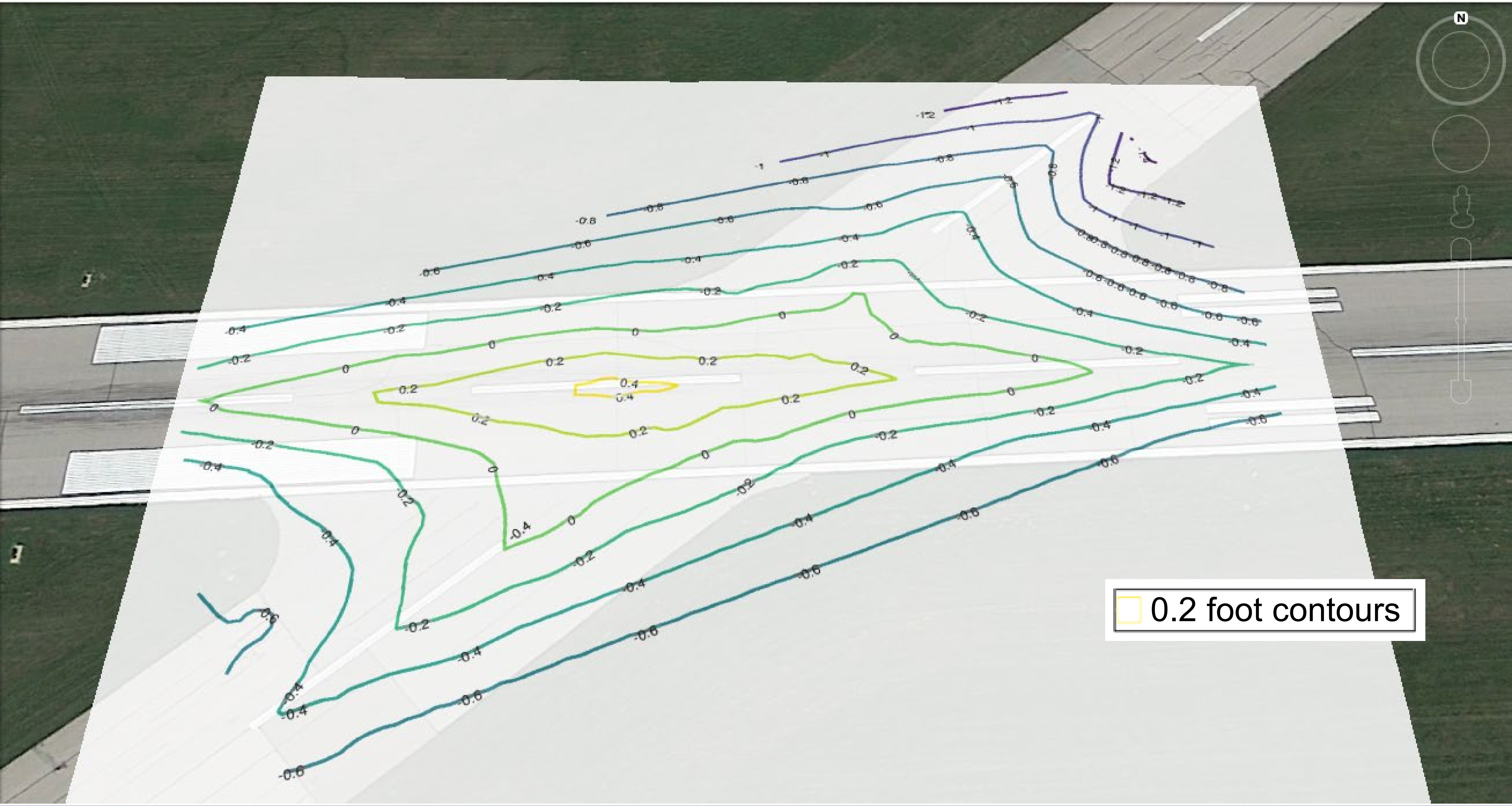


Cape May Maximum Slope Direction for 50 x 50 ft. Sections

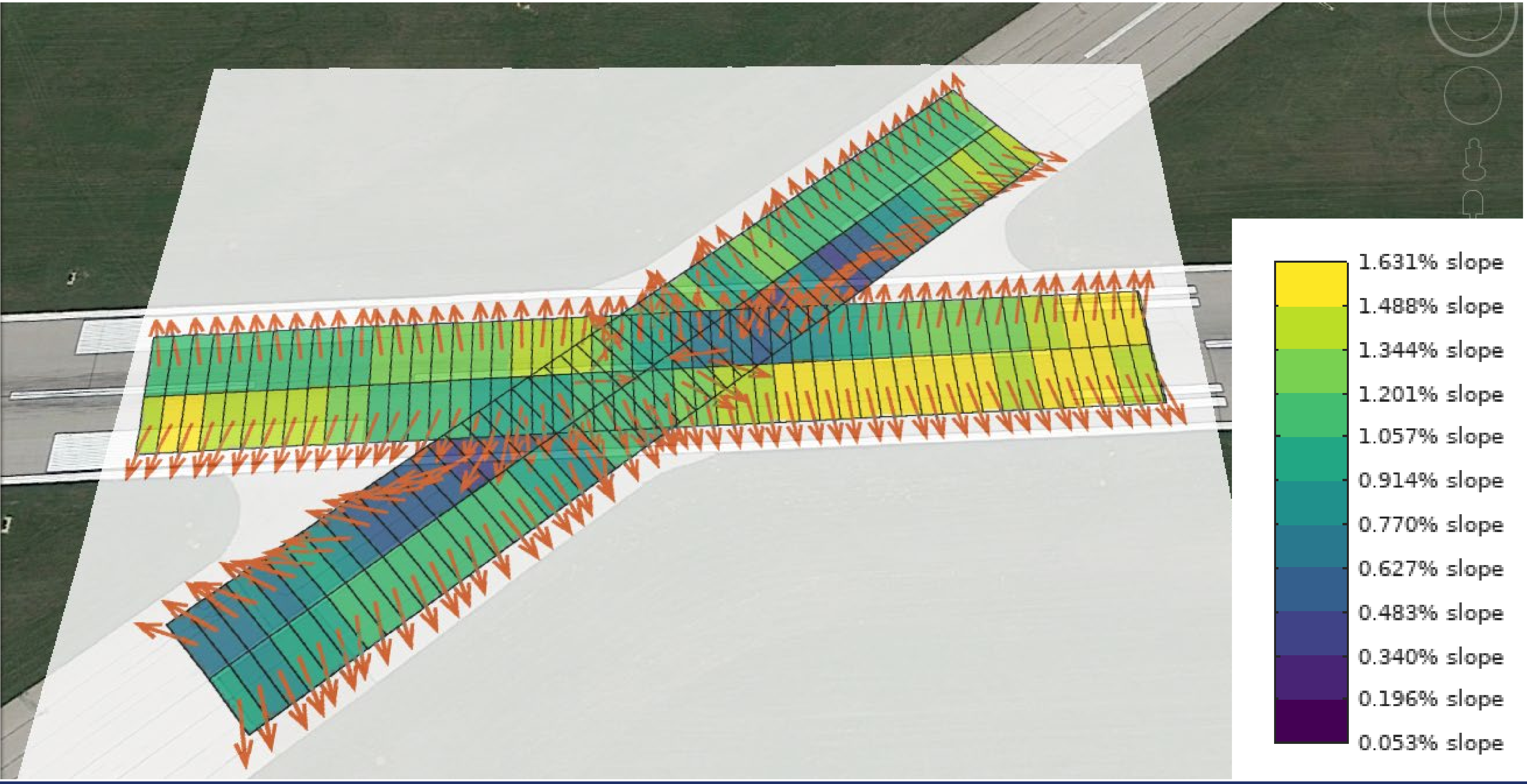
OSU Intersection – SurPro Data



OSU Intersection – Contours



OSU Intersection – Maximum Slope Plot for 10 x 35 ft. Sections



Thank You

- QUESTIONS?