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Profile Data Comparisons for Airfield Runway Pavements

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Objectives

- Clarify the restriction of highpass filtering for BBI and aircraft accelerations
- Find acceptable wavelengths for airport pavement roughness
- Compare collected profile data by the FAA's inertial profiler (Selcom, Datron, and Accelerometer), SurPro walking profiler, Dipstick, and highway profiling system

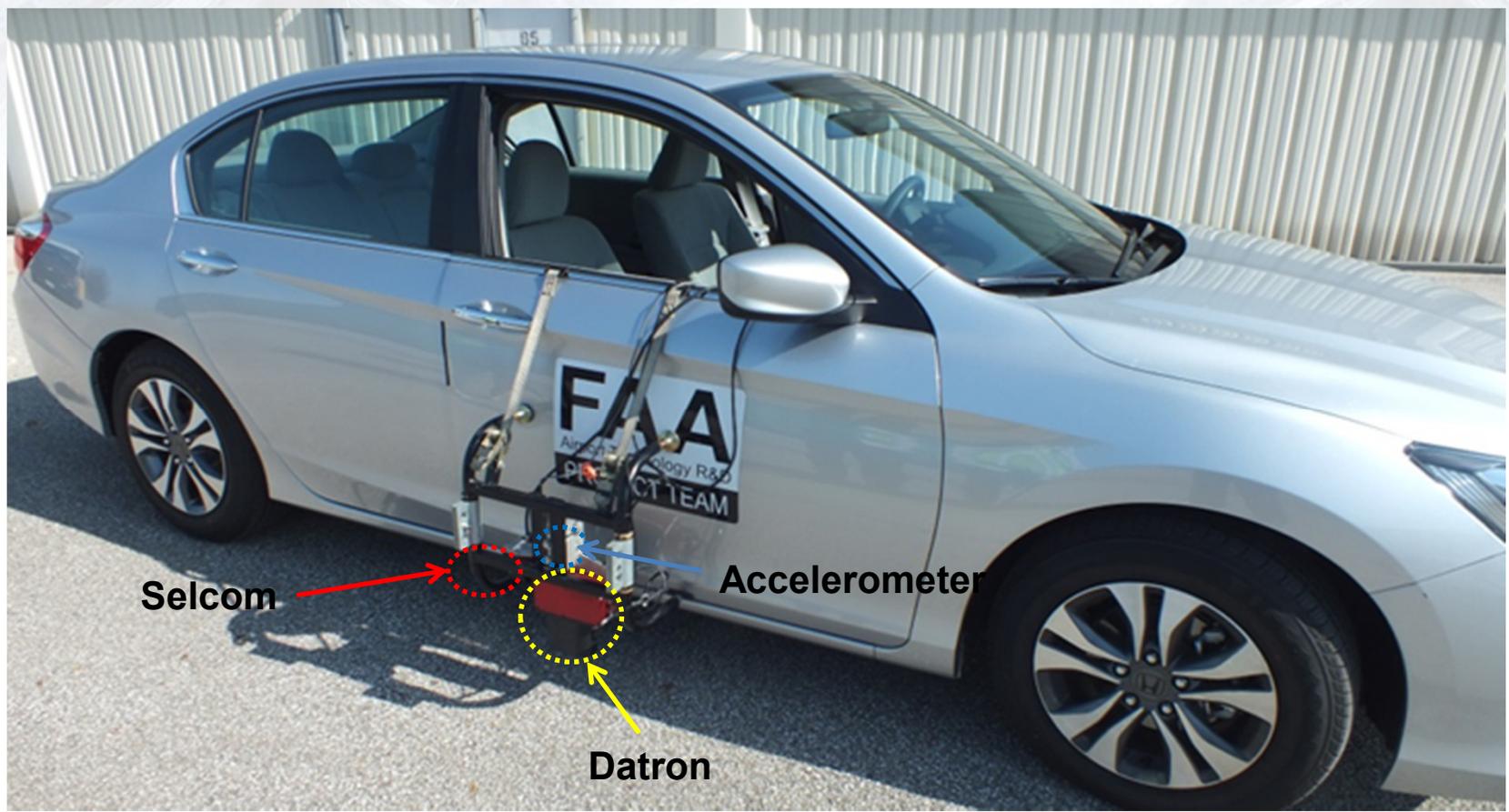
Test Condition

- The FAA owns an inertial profiling system calculating airfield roughness without highpass filtering
- The Dynatest 6650 inertial profiler representing highway roughness profiler (unknown filtering)
- Walking profilers, SurPro and Dipstick, for comparison purposes
- Collect tangential pavement surfaces at pavement test sections located at the FAA WJHTC, New Jersey, and Smart Road test facility at Blacksburg, Virginia

FAA Owned Profiling Devices

- The FAA developed inertial profiler (FIP)
 - Vertical Displacement: Selcom 2207 Optocator Laser Sensor
 - DMI: Datron DLS-2 Optical Speed and Distance Sensor
 - Vehicle Elevation: Allied Signal QA700 Accelerometer
- Dynatest/KJL6850 runway friction tester equipped with a Dynatest 6650 inertial profiler
- Dipstick 2272
- SurPro 2000

FAA Inertial Profiler

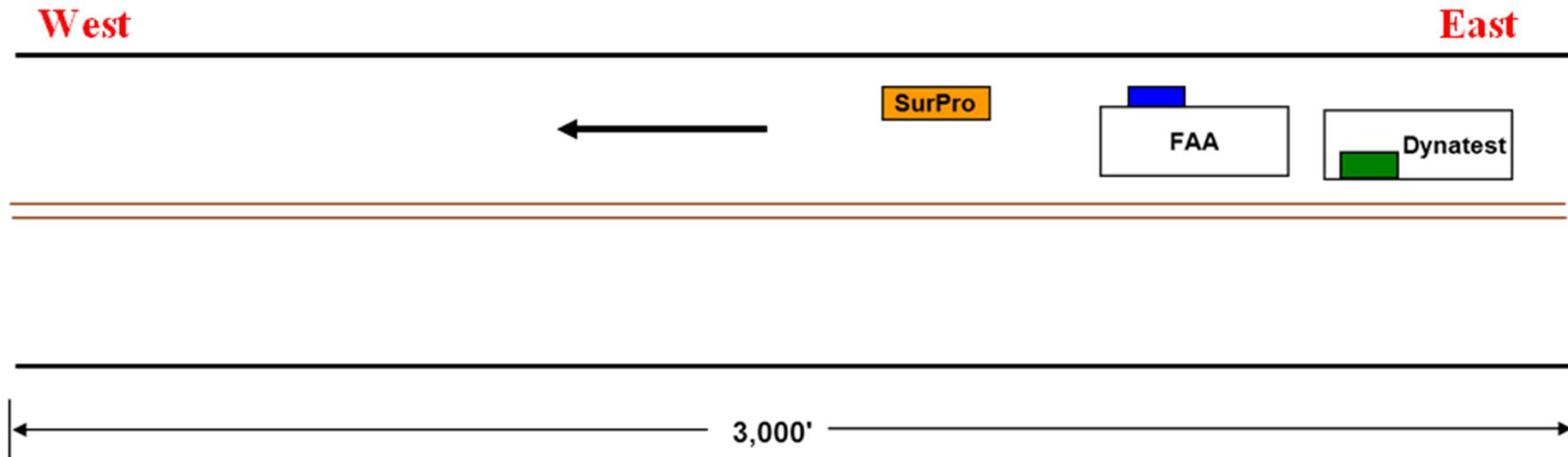


Preliminary Test Section at FAA WJHTC



Data Collection at Preliminary Test Section

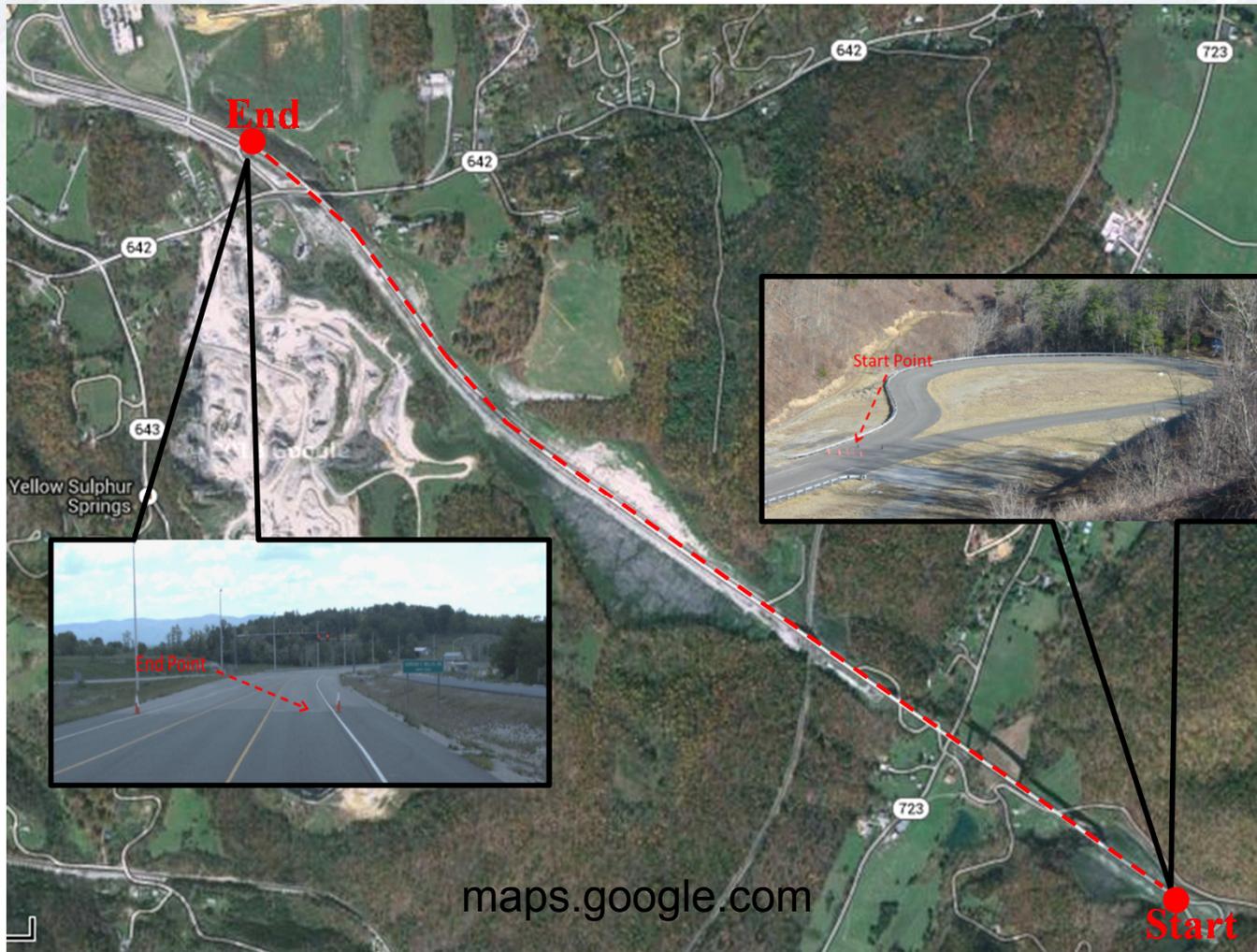
- FAA Inertial and Dynatest Profilers at 30 mph with 1 inch data collection rating
- SurPro at 0.8 mph (Walking Speed) with 12 inches data collection rating



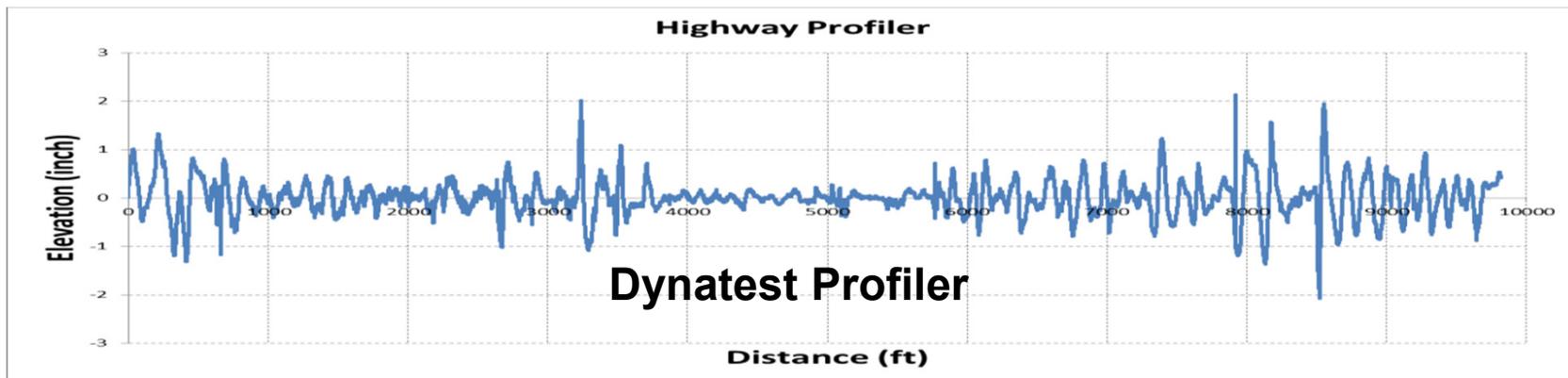
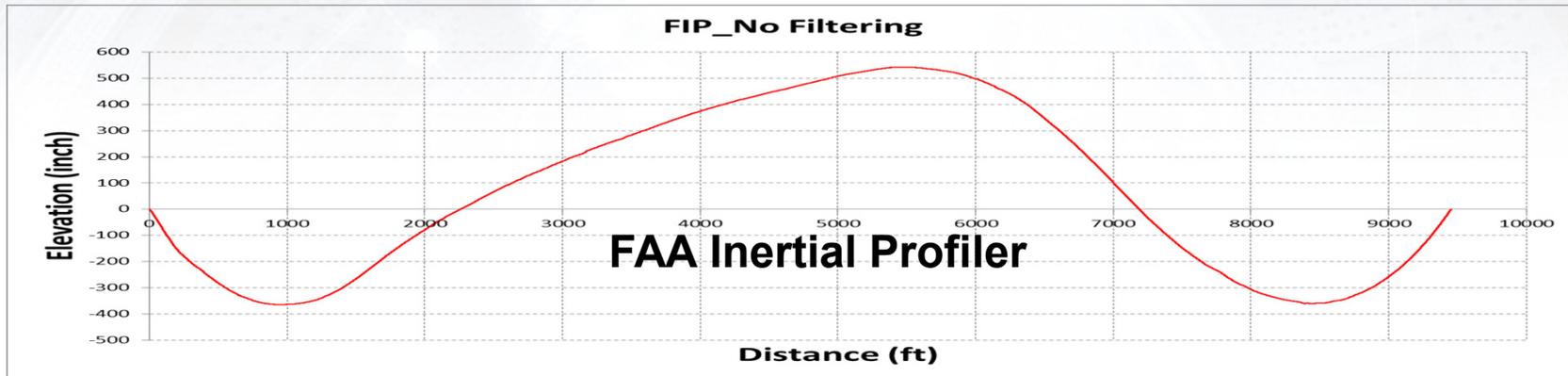
Virginia Smart Road

- A closed test-bed research facility managed by Virginia Tech Transportation Institute (VTTI) and owned and maintained by the Virginia Department of Transportation (VDOT) (<http://www.vtti.vt.edu/smart-road/virginia-smart-road.html>)
- Approximately 1.85 mile-long pavement sections were selected from a 2.2 mile-long highway test pavement facility by excluding loop areas for profile data collection at tangent line.

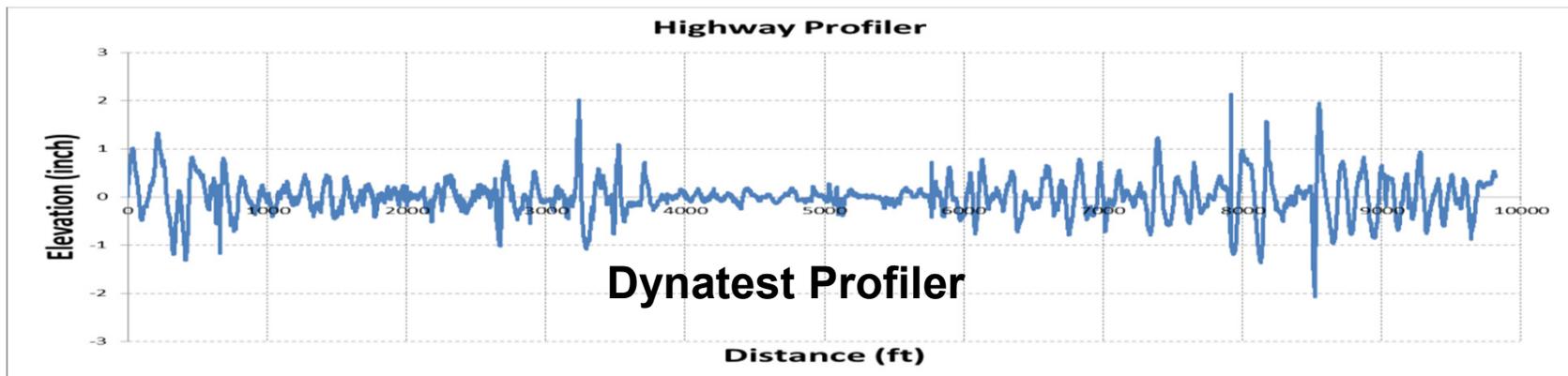
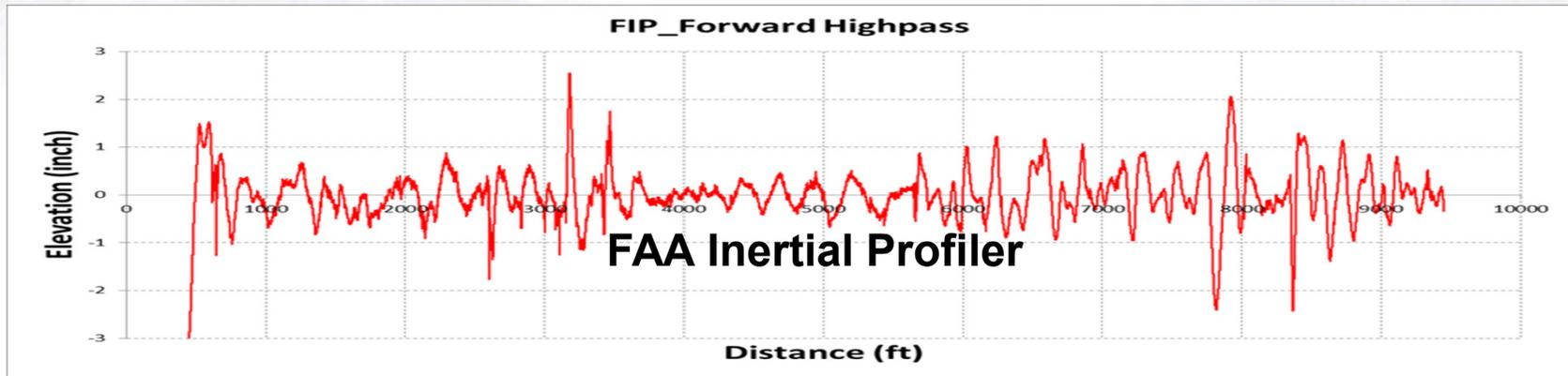
Selected Pavement Sections for Profile Data Collection at Smart Road



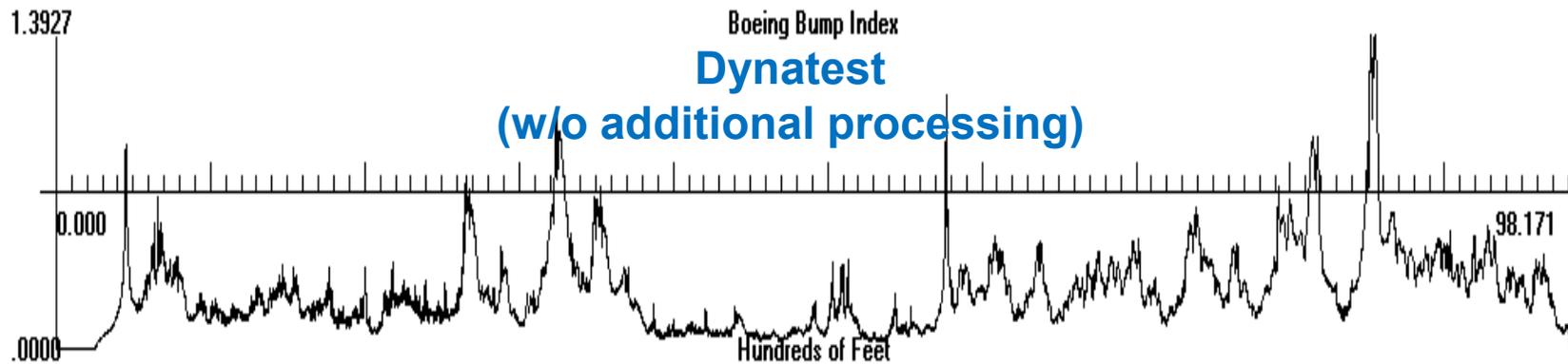
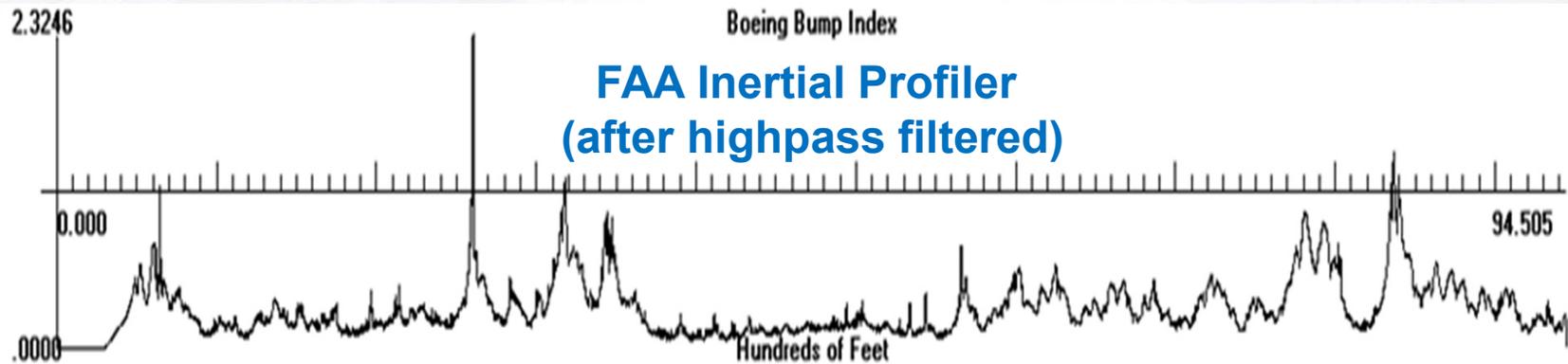
Inertial Profiler Collected Data



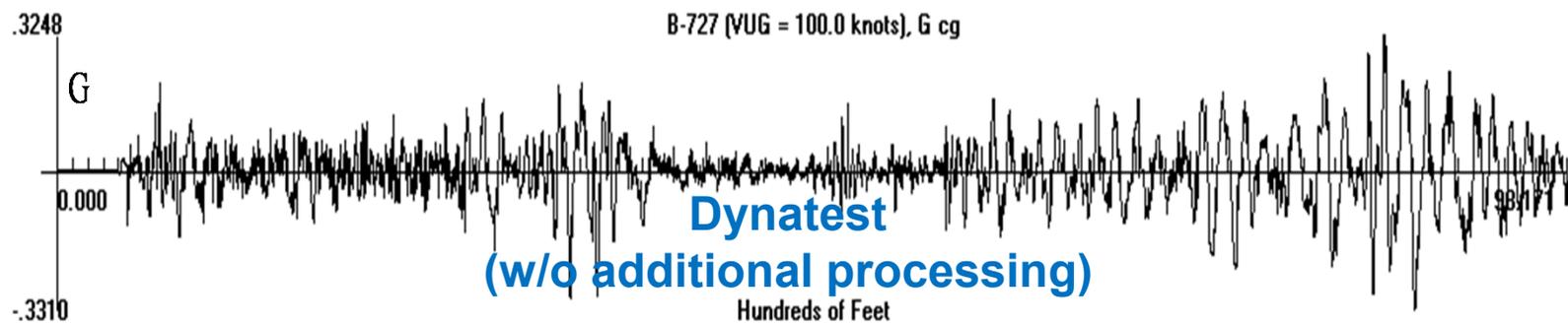
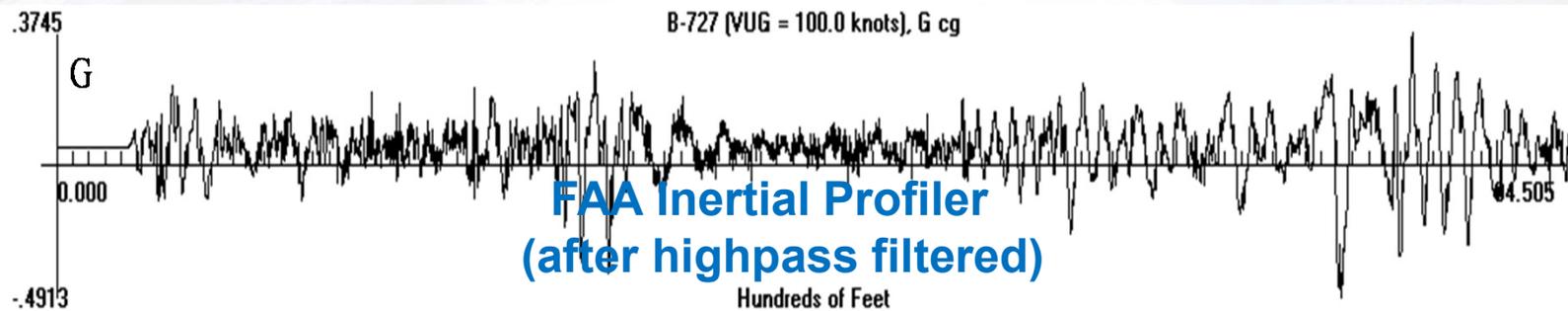
Inertial Profiler Collected Data (300 feet/cycle Highpass Filtered on FIP)



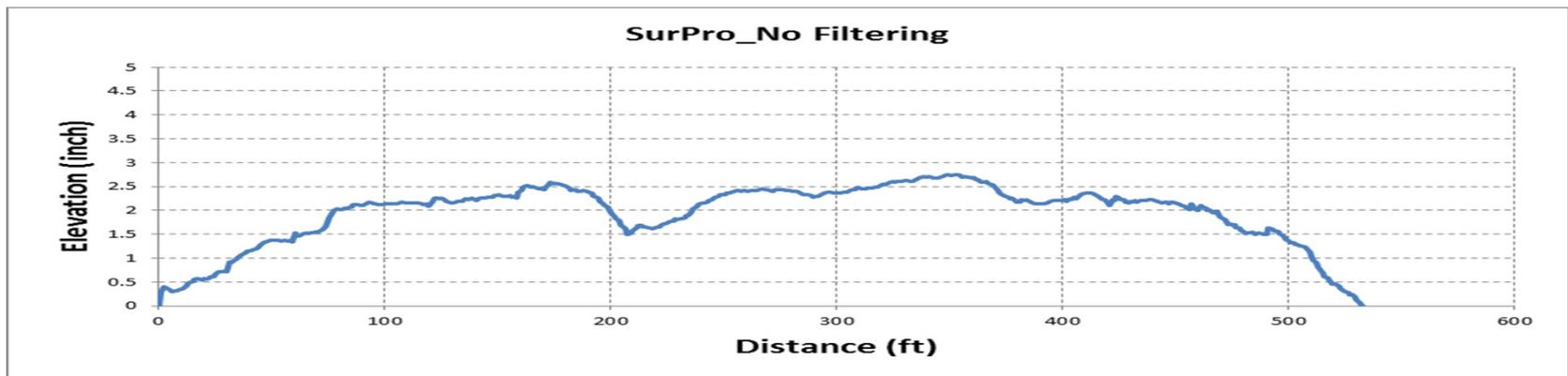
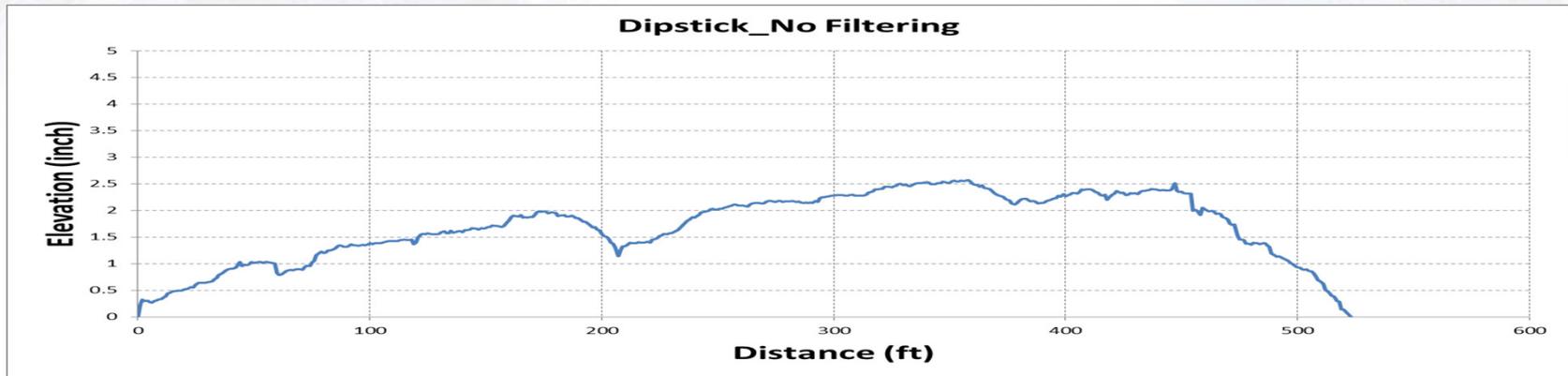
ProFAA Computed BBI (300 feet/cycle Highpass Filtered on FIP)



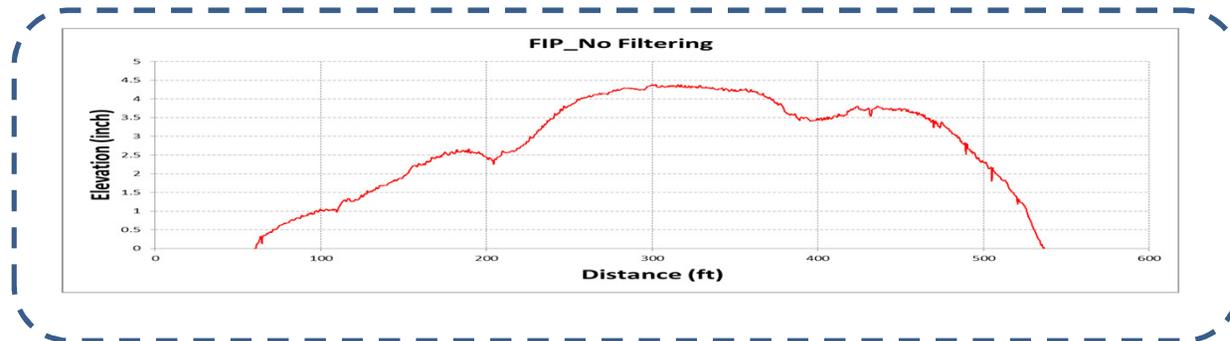
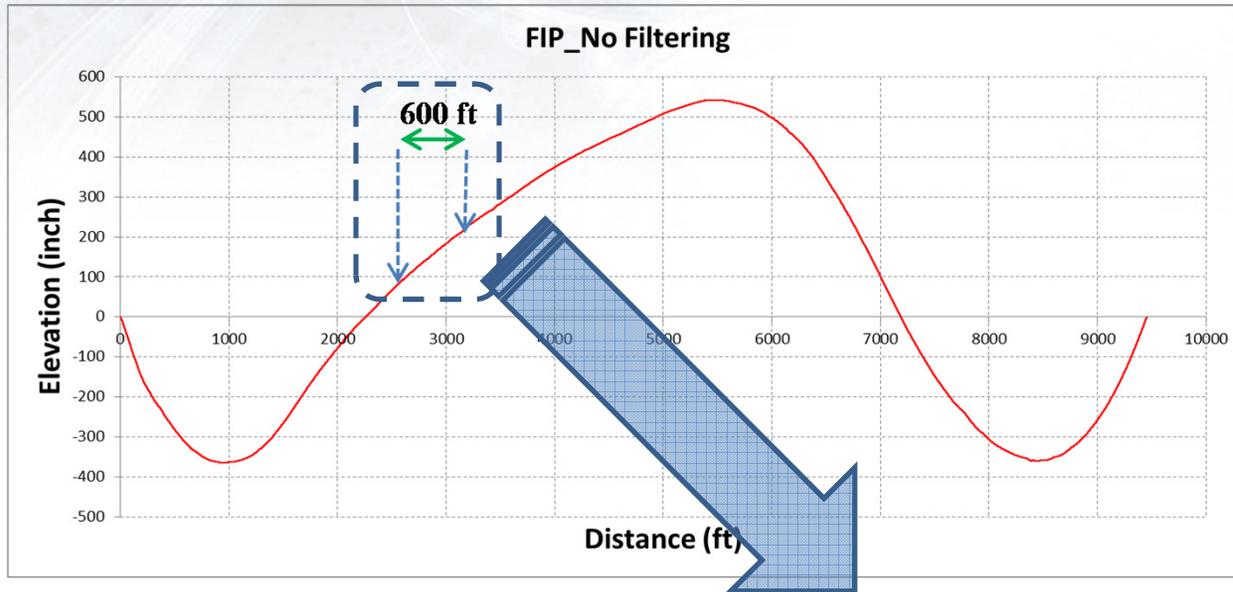
ProFAA Computed Gcg (300 feet/cycle Highpass Filtered on FIP)



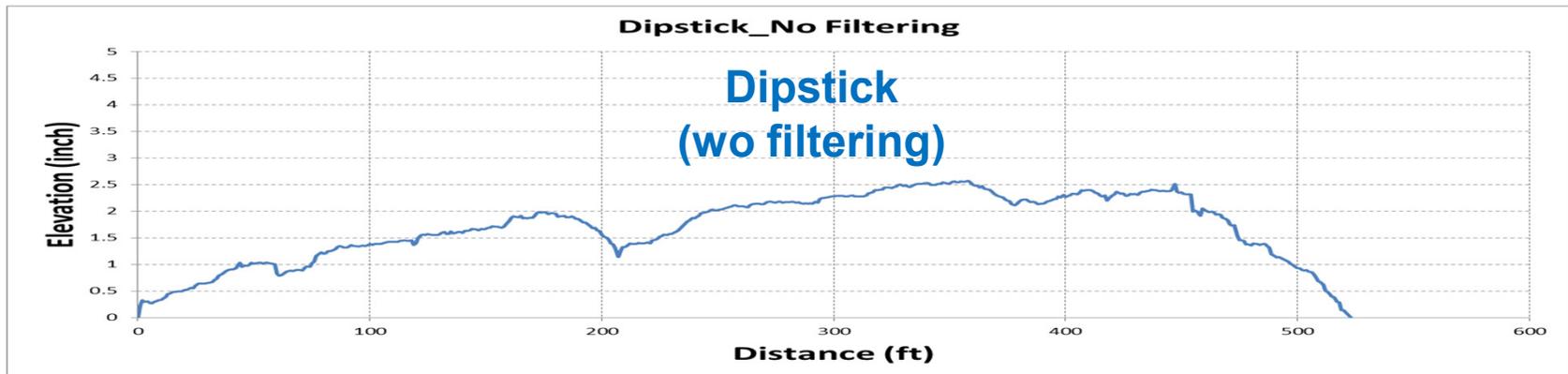
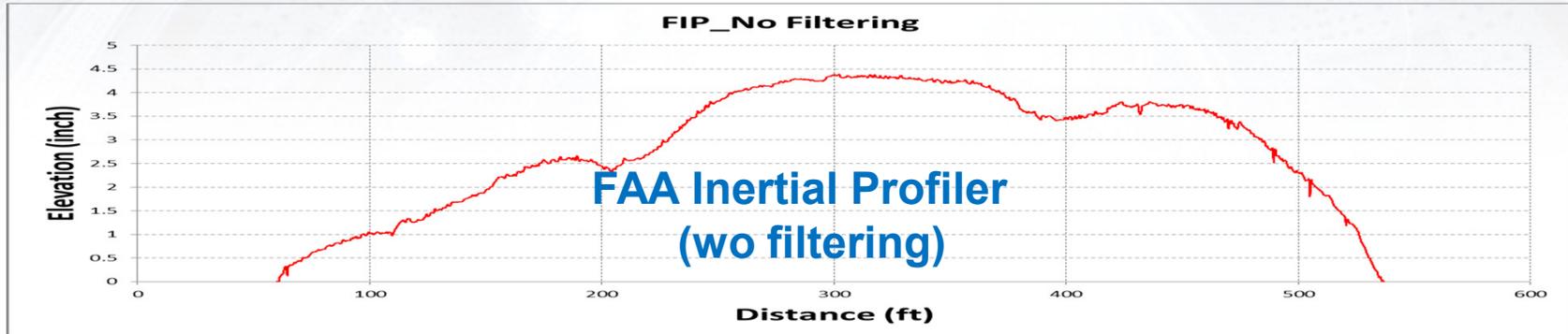
Walking Profiler Collected Data



FAA Inertial Profile Data for Comparison to Dipstick



FAA Inertial Profiler vs Dipstick



Aircraft Simulations on Single Bump

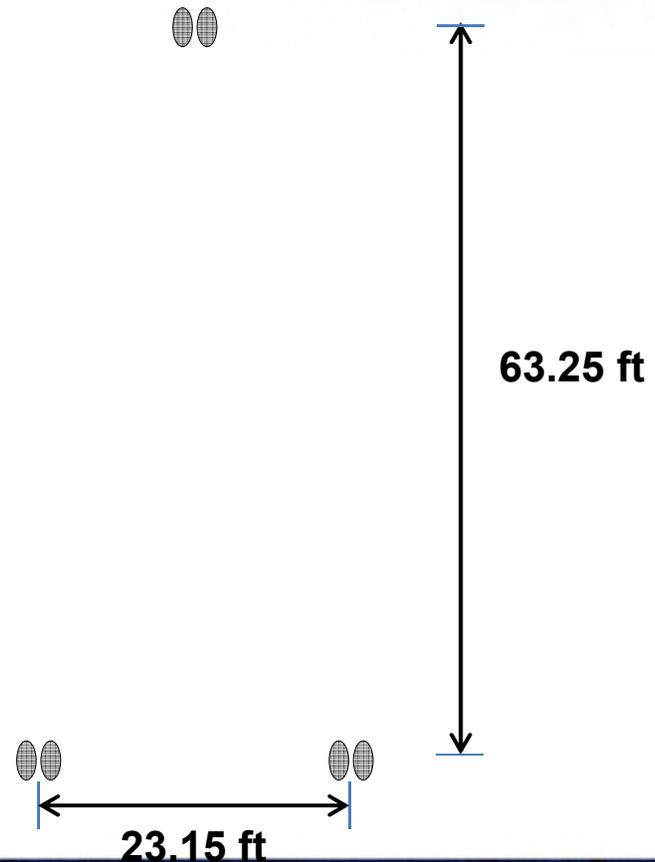
- Artificially constructed half-sine single bumps ranging from 150 to 750 feet with 3, 9, 13.5 inches bump height corresponding longitudinal grades from ± 0.07 to ± 1.5 percent following maximum grades for category C & D aircrafts as defined in 150/5300-13A
- Confirm the needs of 300 feet long minimum and longer wavelengths for airfield roughness

Calculated Grades for Single Bumps

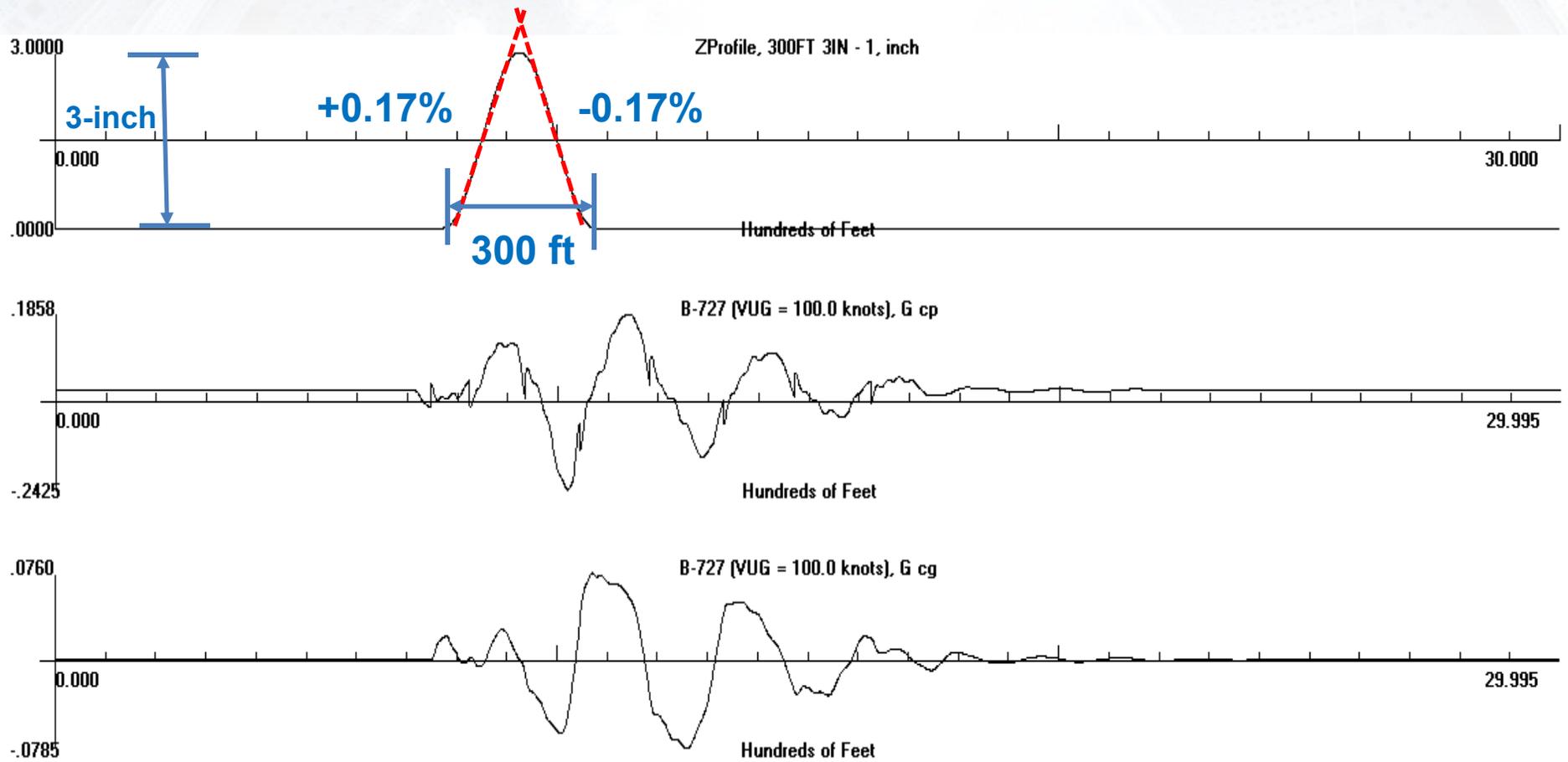
Bump Height, inch	Bump Width, ft	150	300	450	600	750
	Grade, %					
3		0.33	0.17	0.11	0.08	0.07
9		1.00	0.50	0.33	0.25	0.20
13.5		1.50	0.75	0.50	0.38	0.30

ProFAA Aircraft Simulation

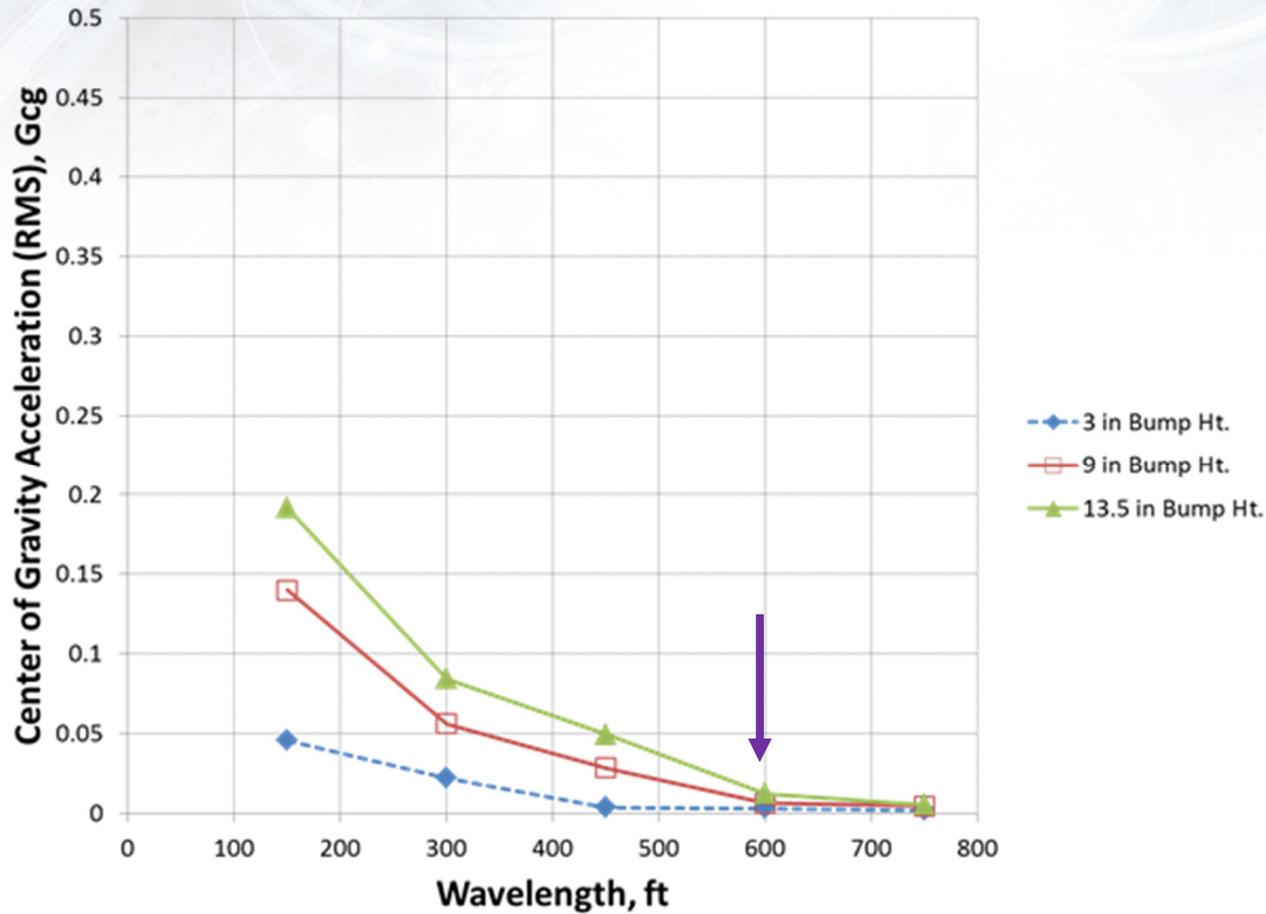
- Used FAA's ProFAA.
 - Selected Boeing 727-200.
 - Used simulation speed at 100 knots.
 - Used 0.025 damping factor.
 - Computed accelerations at cockpit (Gcp) and center of gravity (Gcg).
- B727 Gear Config.



B727 Responses Based on ProFAA



ProFAA Simulated B727 Computed Accelerations



Conclusion

- Because highpass filtering is used in highway inertial profilers, therefore, wavelengths needed for airfield roughness are eliminated. It is suggested to inactivate the highpass filtering procedures for highway profilers to be used for airfield pavement roughness as described in the AC 150/5380-9.
- The sensitivity analysis suggested effective wavelengths required for airport runway pavements for given conditions in terms of accelerations at aircraft cockpit and center of gravity. Also confirmed that wavelengths equal or longer than 300 feet should be considered for airfield roughness.
- The profile data from the FAA inertial profiler without highpass filtering is closer to walking profilers.

Questions

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