Comparisons of Pavement Profiles Created by Airport Pavement Profiler and Highway Profiling System

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Federal Aviation Administration
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Acknowledgement

- Mr. Albert Larkin, FAA (Project Manager)
- Dr. Gordon Hayhoe
- Mr. Chuck Teubert, SRA
- Mr. James Zargan, SRA

Overviews

Why

- **Advisory Circular** does not recommend use of inertial profiler with highpass filtering (highway profilers).
- **Increased interests** in wavelengths for standardization.

What

- **Find conditions** for processing profiles in highway profiler.
- **Provide highway profiler ideas** to be qualified for airfield pavement roughness.

How

- **Comparisons** between airfield and highway profilers by longitudinal profiles, BBI, and aircraft simulations.

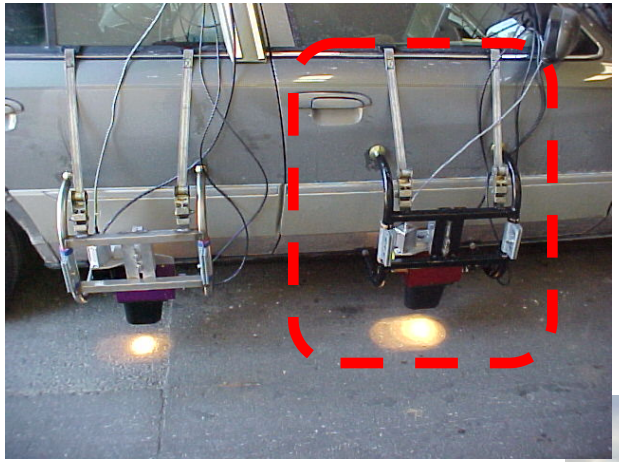
Wavelength in Advisory Circular

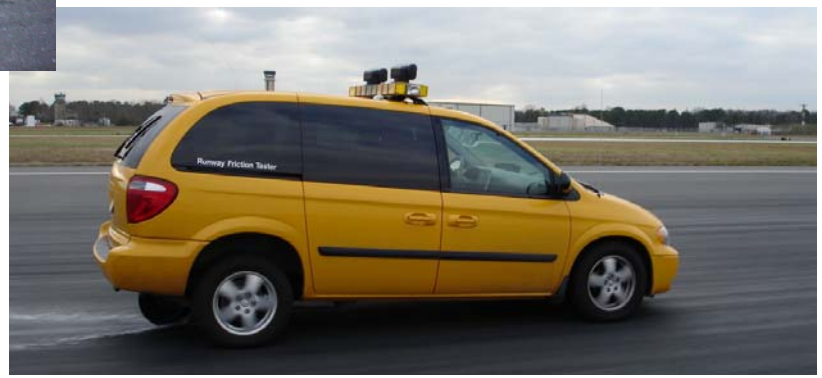
- "*…the use of inertial profilers that include* ***highpass filtering is not recommended*** *for measuring profiles which are to be used for computing BBI indexes or simulated airplane accelerations on airport pavements*."
- ±1.5% maximum longitudinal grade, ±0.8% in the first and last quarter of runway length for sight distance.

Wavelength in ASTM

- Revision of ASTM E 950 Profile Measurements with Inertial Profilers: Wavelength of interests.
- A task group for Boeing bump index computation is started, in addition to the Advisory Circular and ICAO Annex.
- New standard for 25 feet long CA Profilograph simulation is currently on ballot.

FAA Owned Profiling Devices

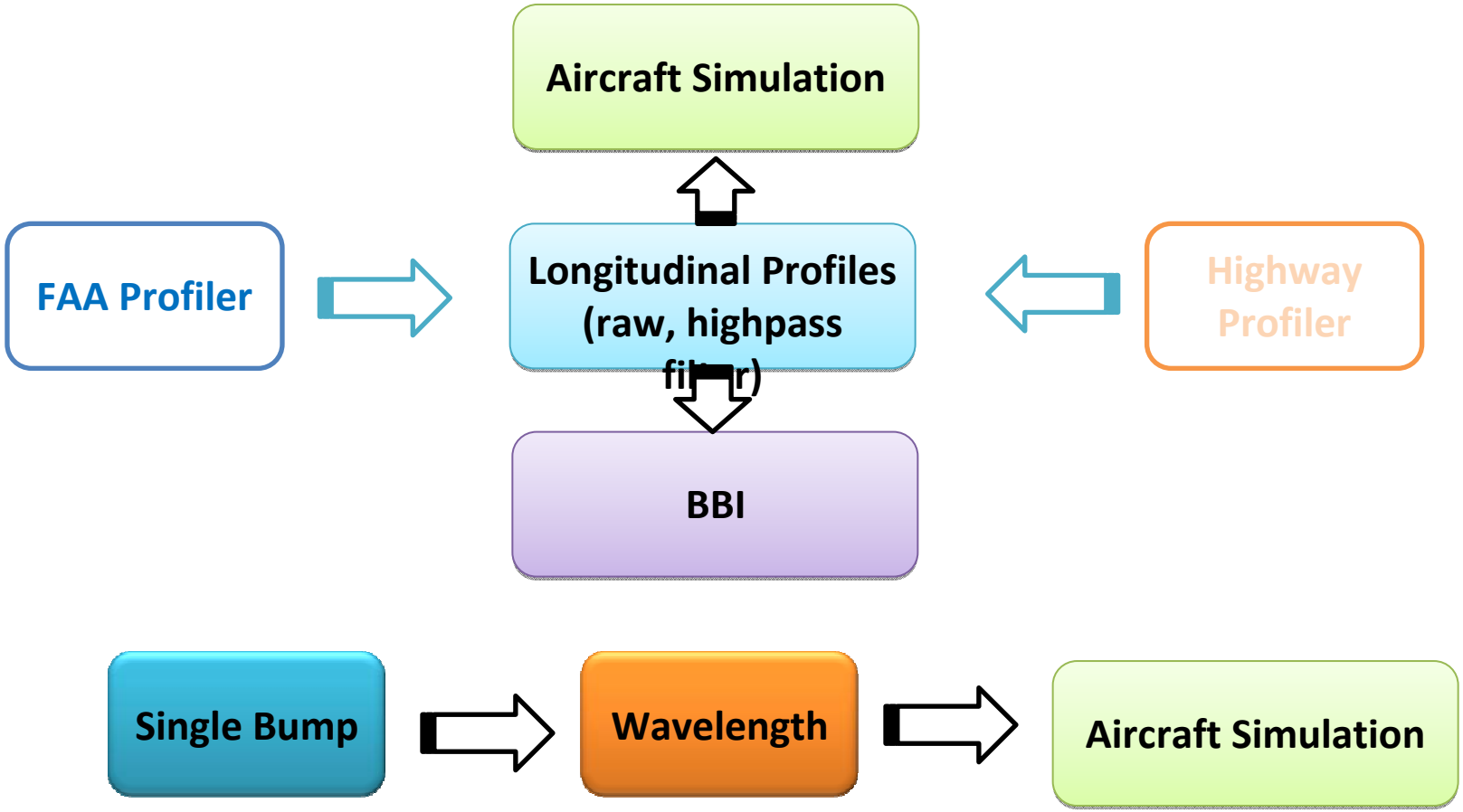




Data Collection

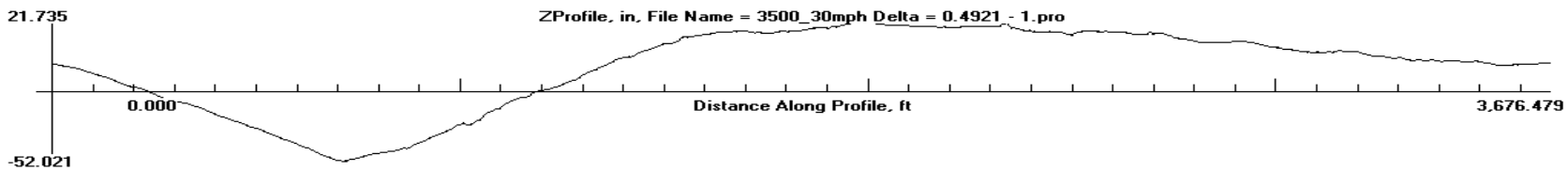
- The FAA customized inertial profiler and Highway profiling system (Dynatest 6850).
- 3500 feet tangent section of asphalt pavement.
- 30 mph measurement speed.
- 3 replicates.
- 1-inch sample spacing.

Data Processing and Analysis

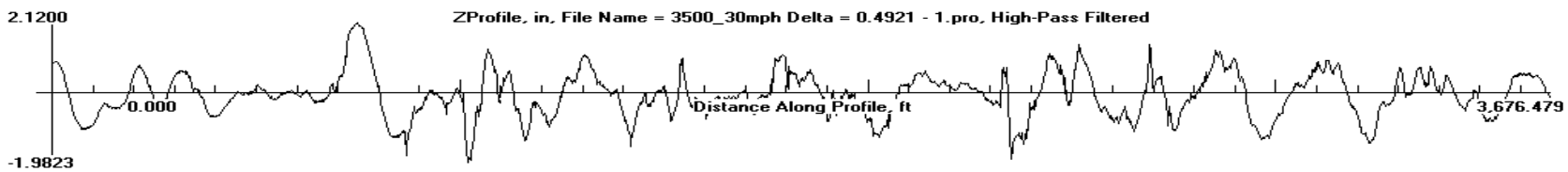


Longitudinal Profiles from FAA Profiler

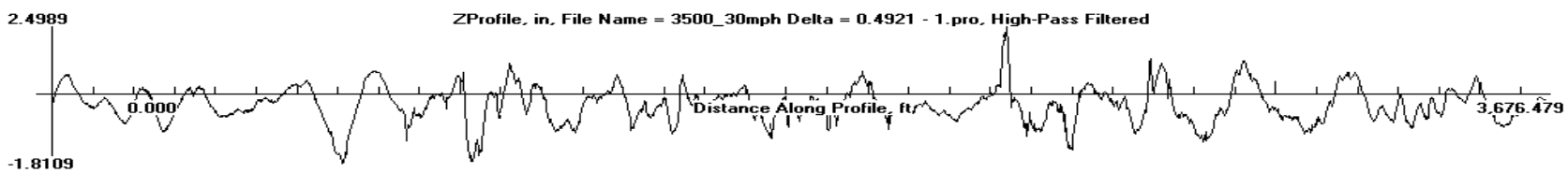
- Raw Data



- 300 ft/cy High Pass Filter (Forward)

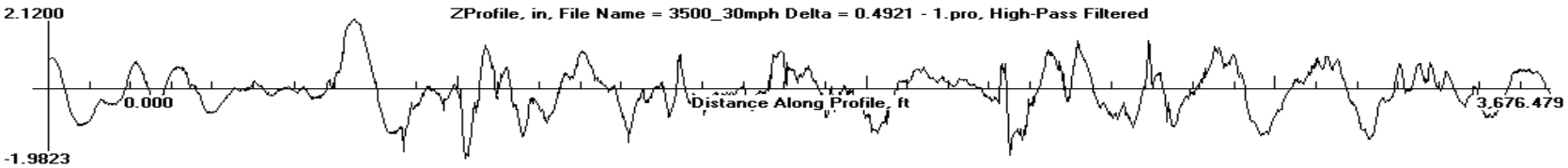


- 300 ft/cy High Pass Filter (Bi-direction)

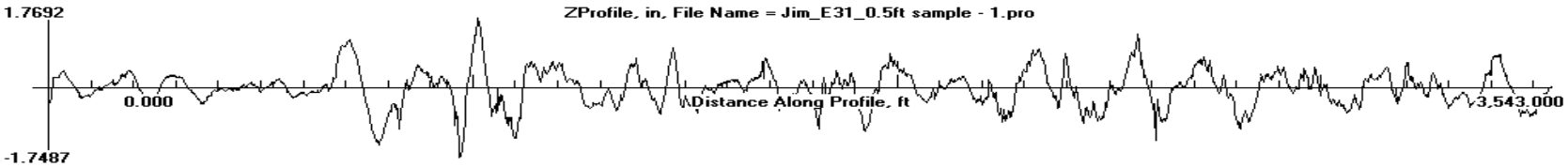


Longitudinal Profiles

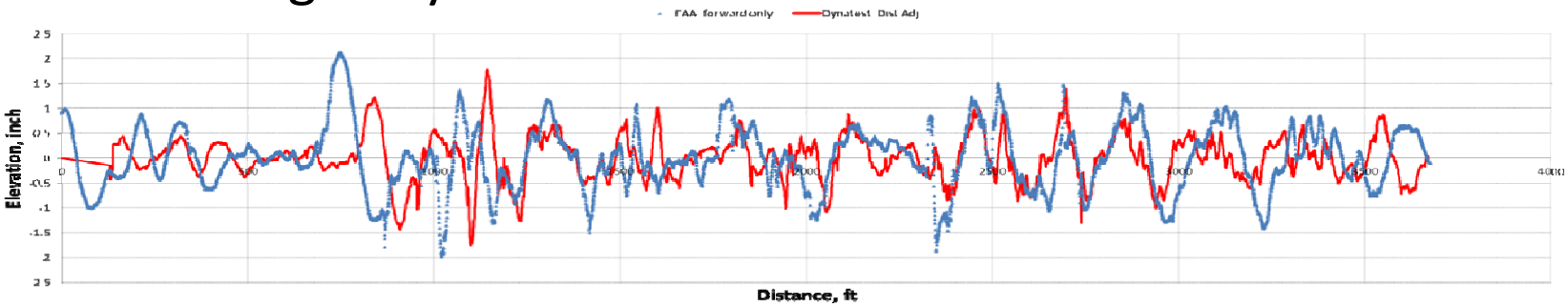
- FAA Profiler with 300 ft/cy High Pass Filter (Forward).



- Highway Profiler.

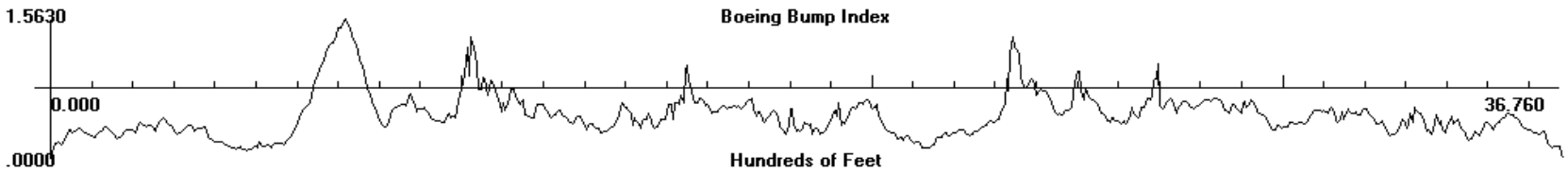


- FAA and Highway Profilers.

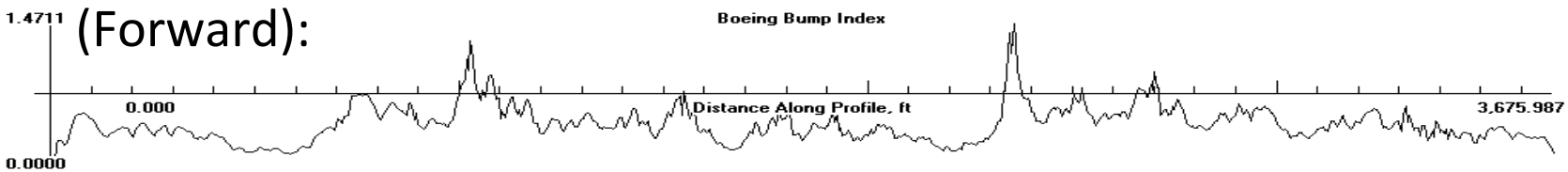


Boeing Bump Index

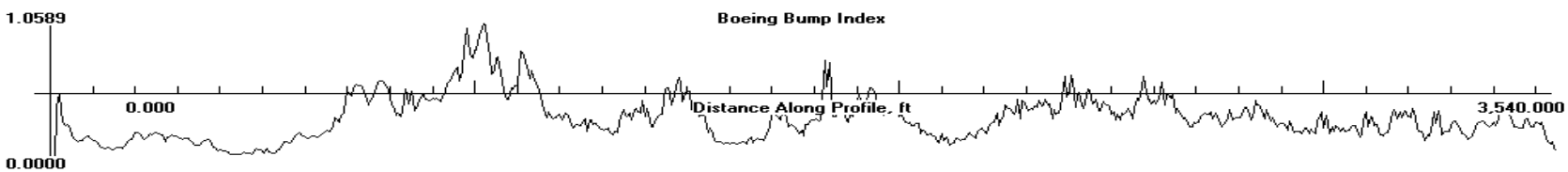
- FAA Profiler (Raw Data): 0.48



- FAA Profiler with 300 ft/cy Highpass Filter (Forward): 0.39

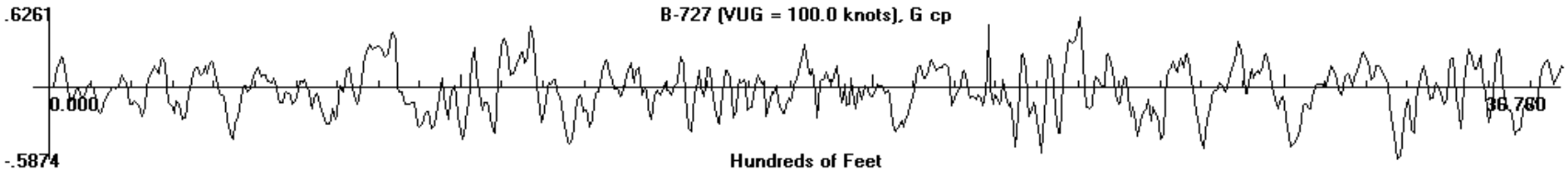


- Highway Profiler: 0.34

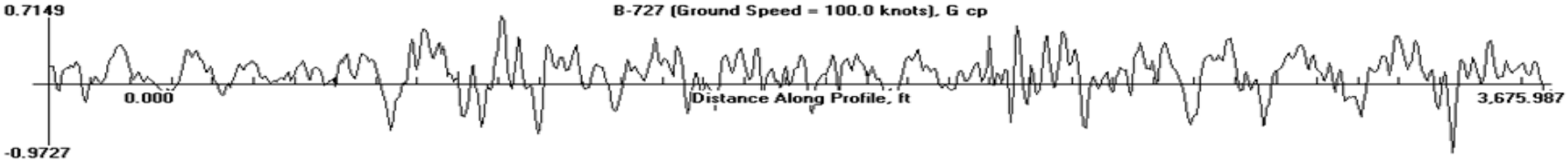


Gcp (B-727 @ 100knots)

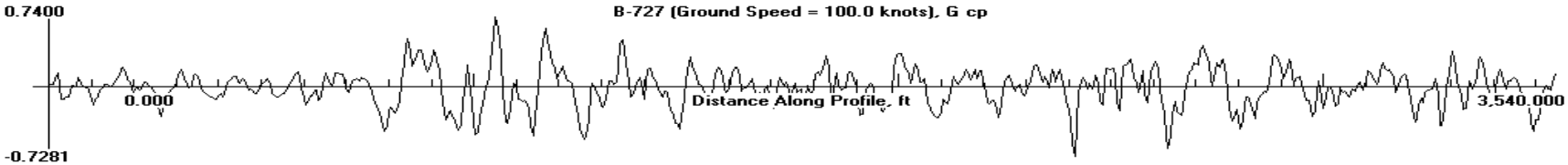
- FAA Profiler (Raw Data): 0.20



- FAA Profiler with 300 ft/cy Highpass Filter (Forward): 0.18

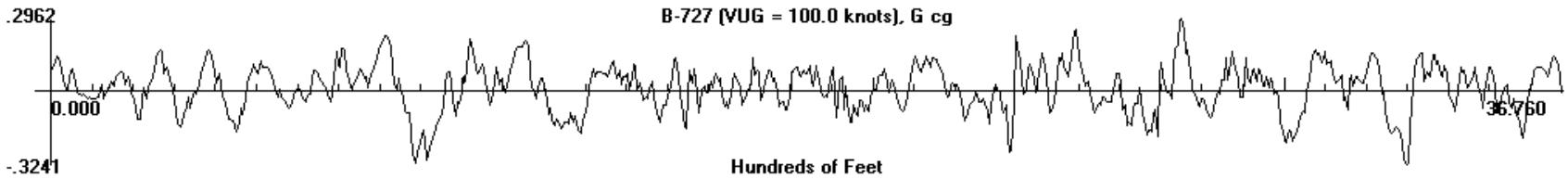


- Highway Profiler: 0.17

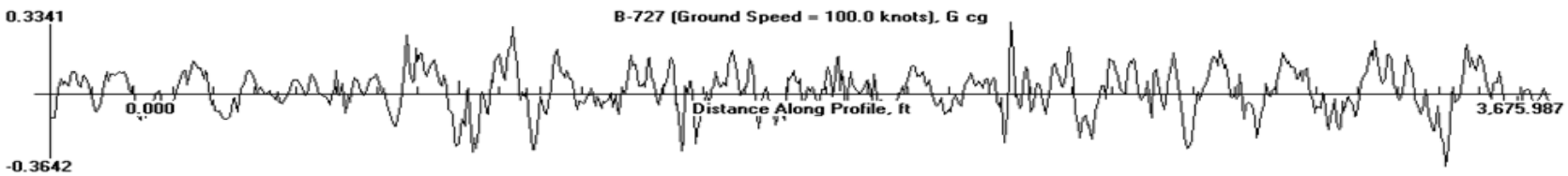


Gcg (B-727 @ 100knots)

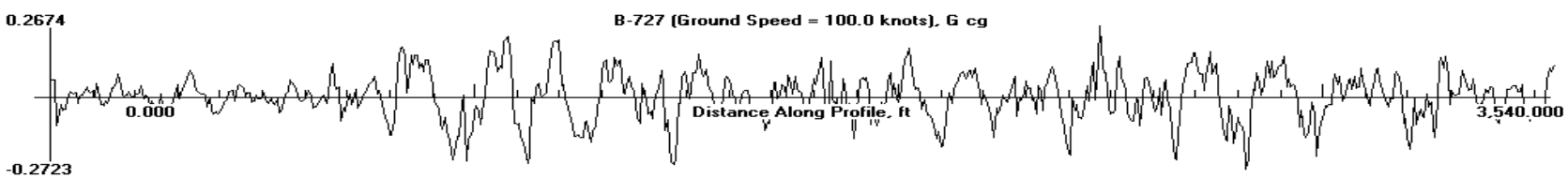
- FAA Profiler (Raw Data): 0.100



- FAA Profiler with 300 ft/cy Highpass Filter(Forward): 0.092



- Highway Profiler: 0.087



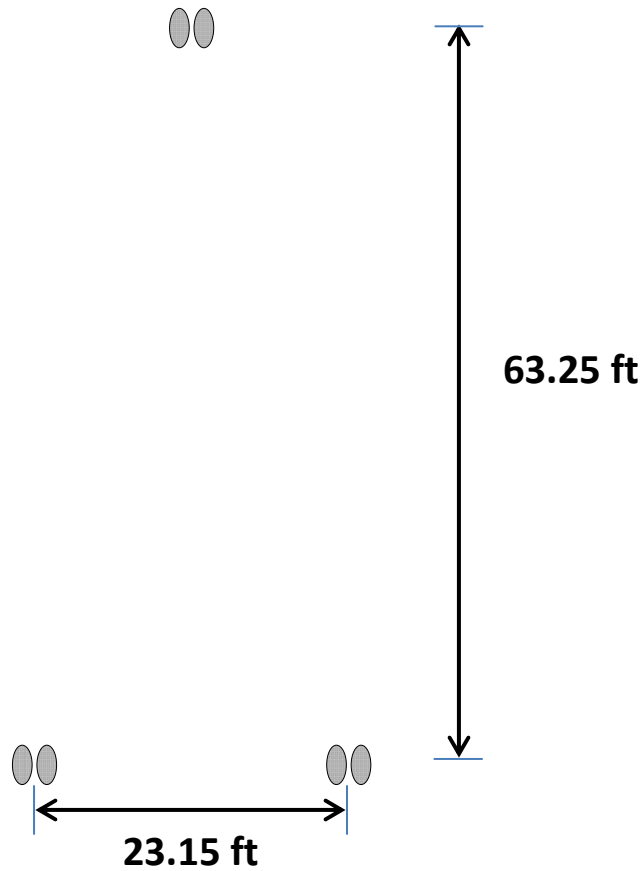
Single Bumps

- Confirm the needs of 300 feet long and longer wavelengths for airfield roughness.
- Construct haversine artificial single bumps for aircraft simulations.
- Change wavelength from 150 feet to 750 feet with 3, 9, 13.5 inches bump height corresponding longitudinal grades from ±0.07% to ±1.5% (max. for category D) .

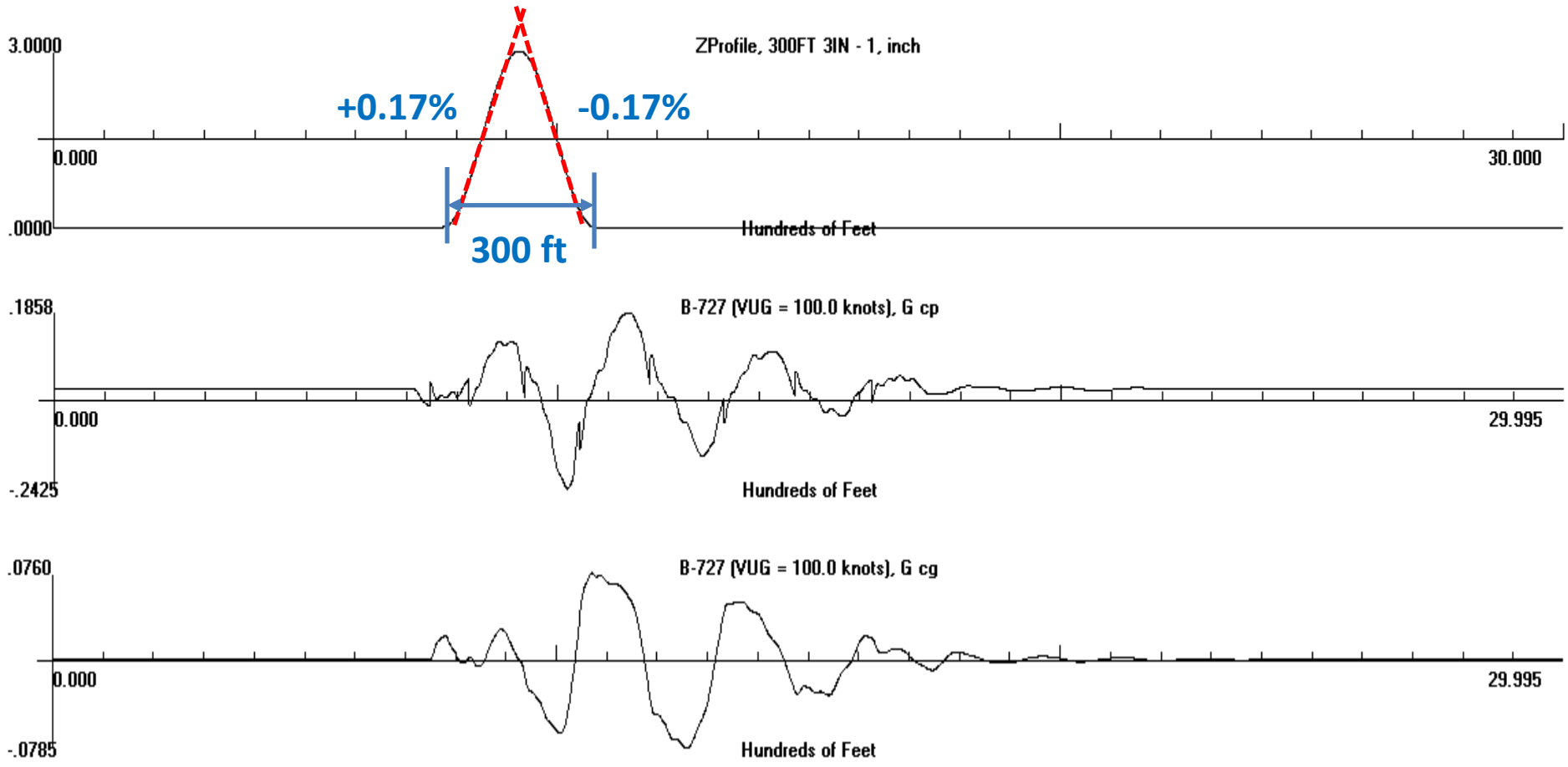
Aircraft Simulation

- 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).

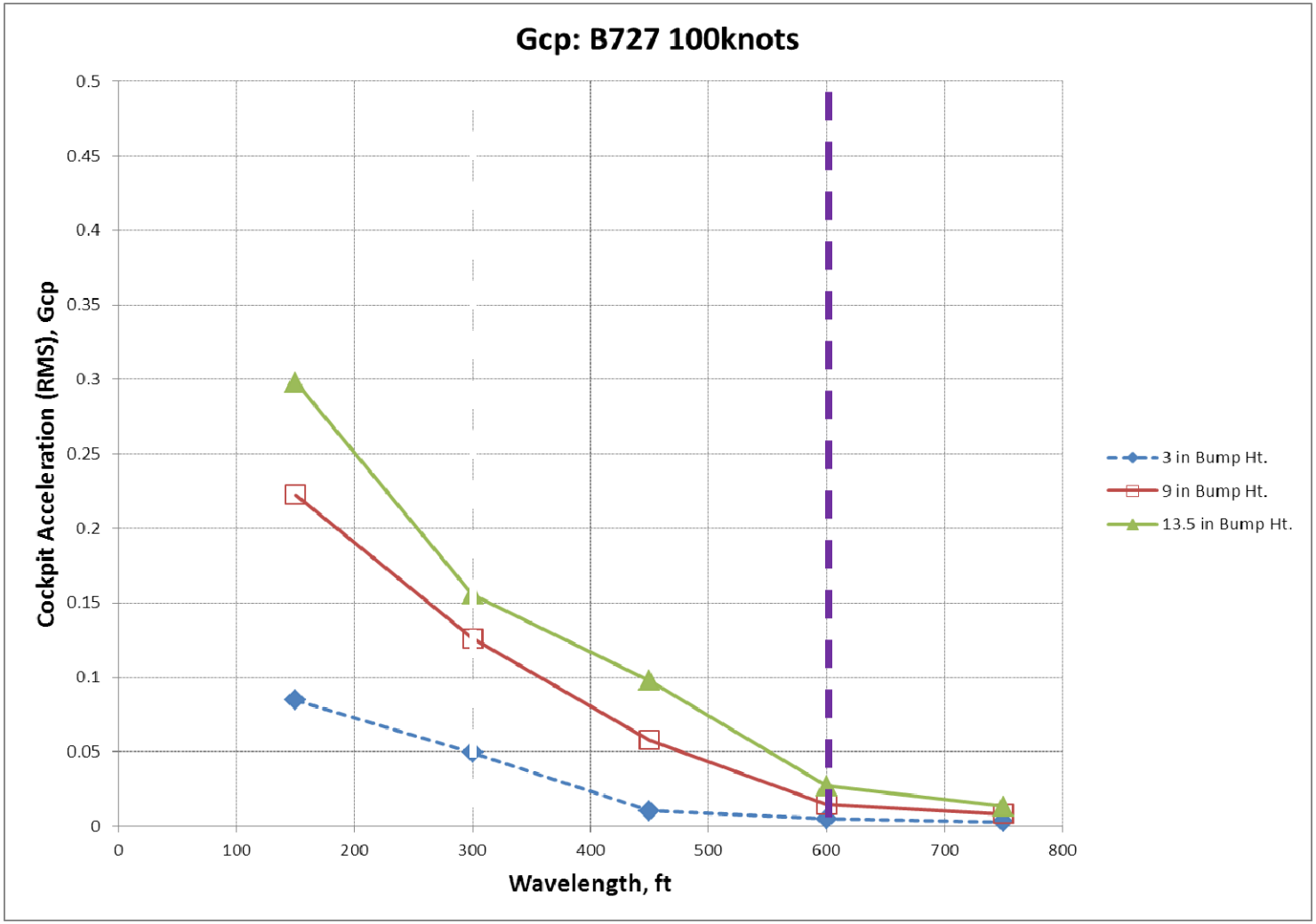
- B727 Gear Config.



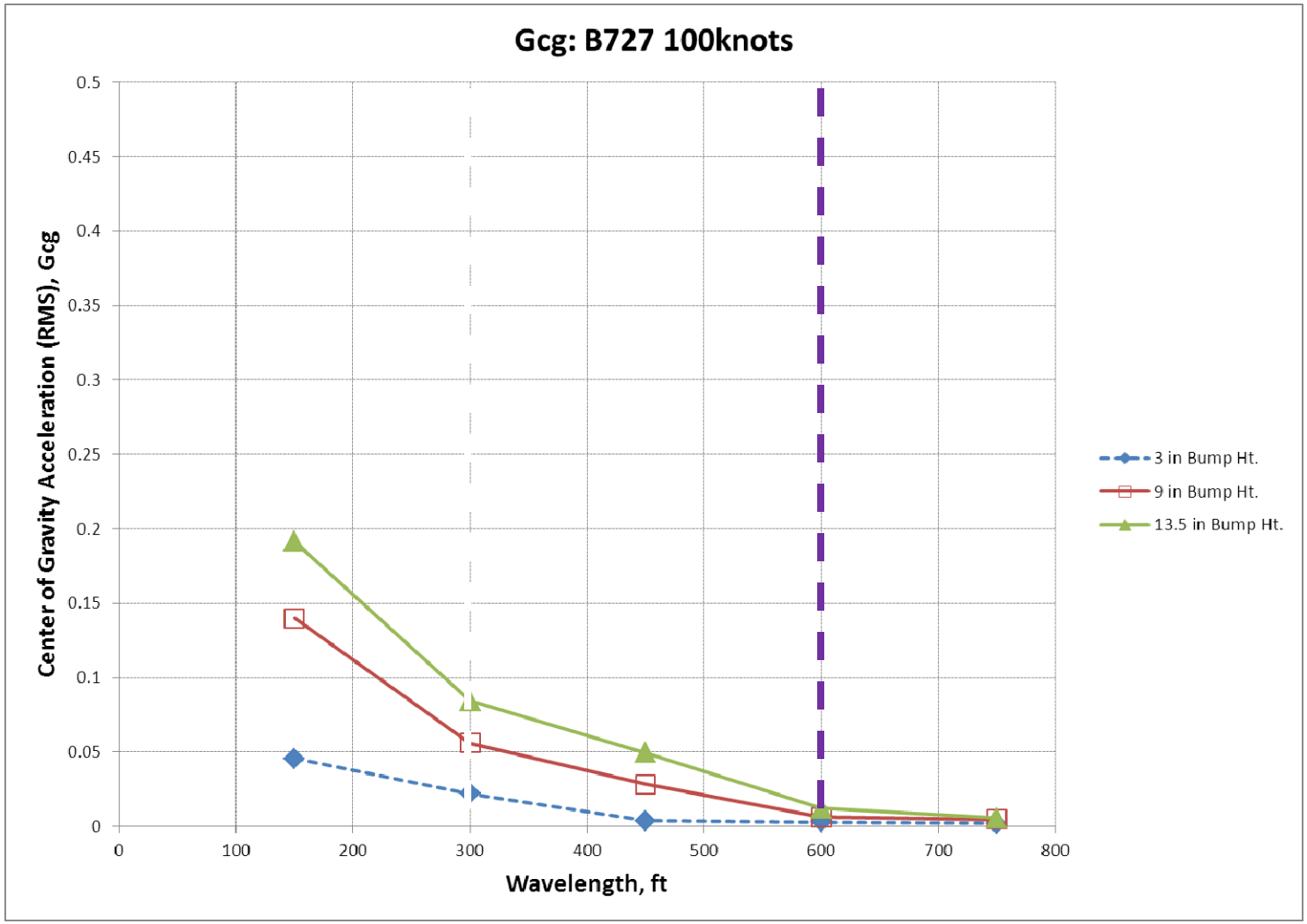
B727 Responses



Gcp at Multiple Wavelengths



Gcg at Multiple Wavelengths



Conclusions

- Highway profiling system (inertial profiler) excludes wavelength more than 300 feet.
- Filtering 300 feet long wavelength affect significantly on BBI and aircraft simulation results.
- Aircraft simulation results show airfield pavement profiles need to consider approximately up to 600 feet long wavelength. Further studies are needed considering extended aircraft types and speed levels.
- Highway profilers could be used for airfield pavements considering longer wavelengths.

Thank you

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