SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING
College of Engineering, Architecture and Technology

Analysis of Instrumented Airfield Pavement Data

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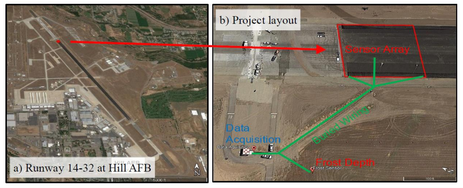
1. Introduction

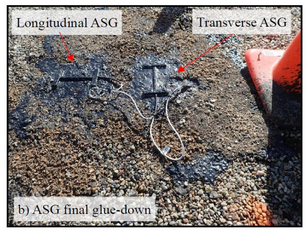
The Army Corps of Engineers has initiated a project for long-term monitoring of an airfield runway: 'Smart' Runway

- Utah
- Four different seasons
- Aircrafts
  - Fighter jet
  - Cargo

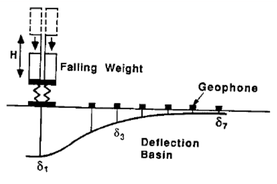


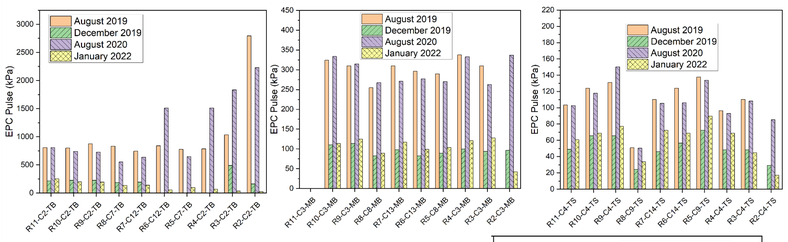
2. Instrumentation Details

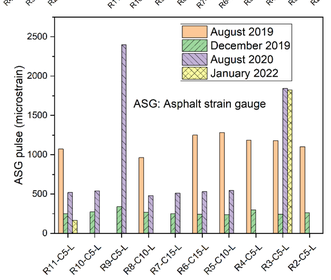
- Dynamic Sensors
  - Earth pressure cell
  - Asphalt strain gauges
  - Multi-depth Deflectometer
  - Laser Distance Meters
- Environmental Sensors
  - Moisture/Temperature probe
  - Asphalt Temperature
  - Surface Temperature



4. Sensor Response Under HWD loading



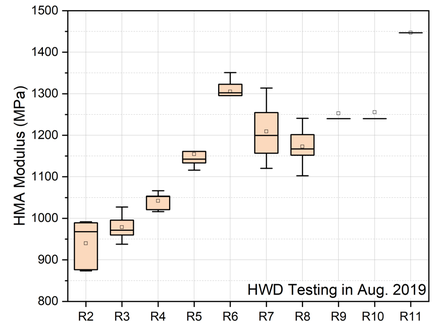




- EPC-TB: Erratic
- EPC-TB>EPC-TSB>EPC-TSG
- Missing values for ASGs
- EPC-TSB: Okay
- EPC-TSG: Okay

5. Back-Calculation of Pavement Layer Moduli

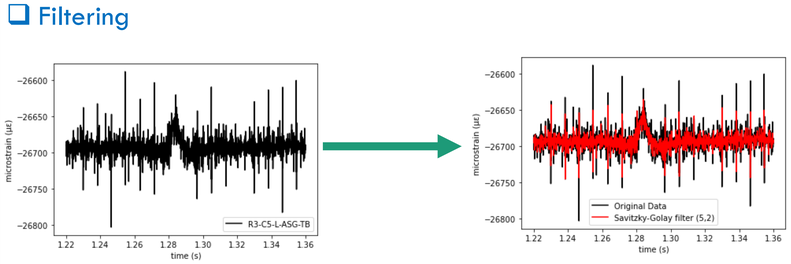
Season	E_{HMA} (MPa)	$E_{Base/Subbase}$ (MPa)	$E_{Subgrade}$ (MPa)
Aug. 2019	1175.7	279.2	247.7
Dec. 2019	12216.7	352.4	240.3
Aug. 2020	1946.9	380.8	287.3
Jan. 2022	13768.0	482.0	303.0



- Lower Asphalt moduli: Aug. 2019 and Aug. 2020
- Higher Asphalt moduli: Dec. 2019 and Jan. 2022
- Base and Subgrade modulus: Increased with time

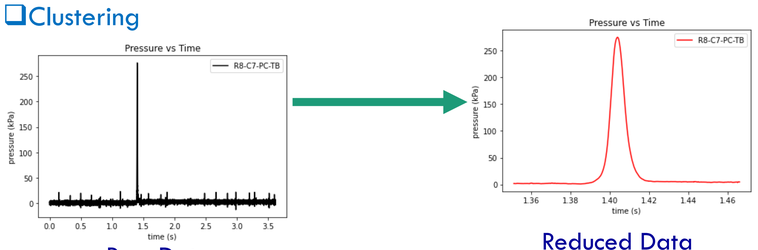
6. Reduction and Analysis of Real-Time Sensor Data: A 'Big Data' Problem

- Filtering



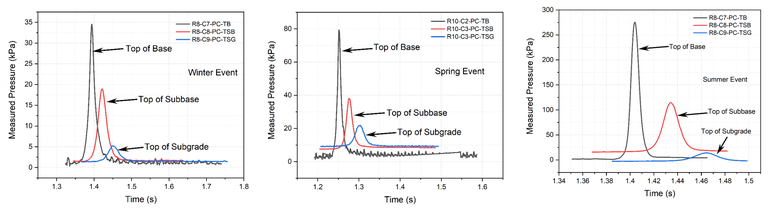
Raw Data — Filtered Data

- Clustering



Raw Data — Reduced Data

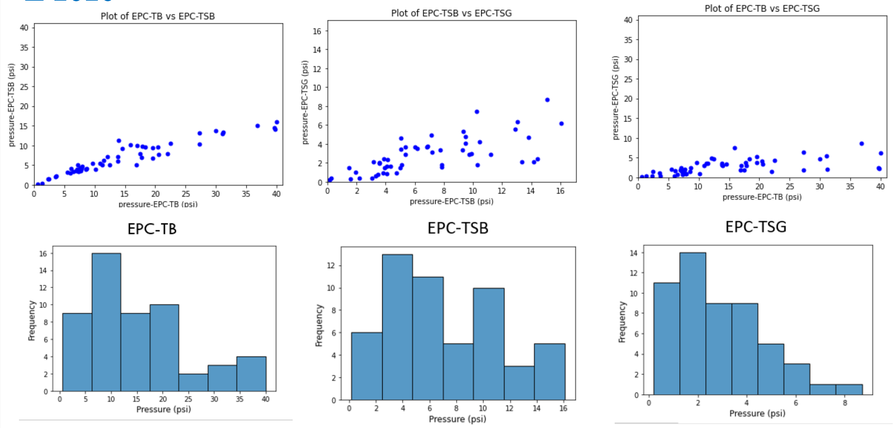
7. Sensor Response (Real-Time Aircraft Loading)



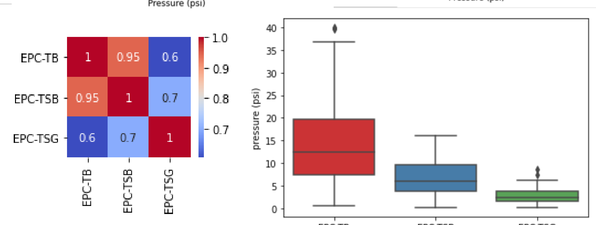
- EPC-TB>EPC-TSB>EPC-TSG

8. Analysis of Smart Runway Data: A 'Big Data' Problem

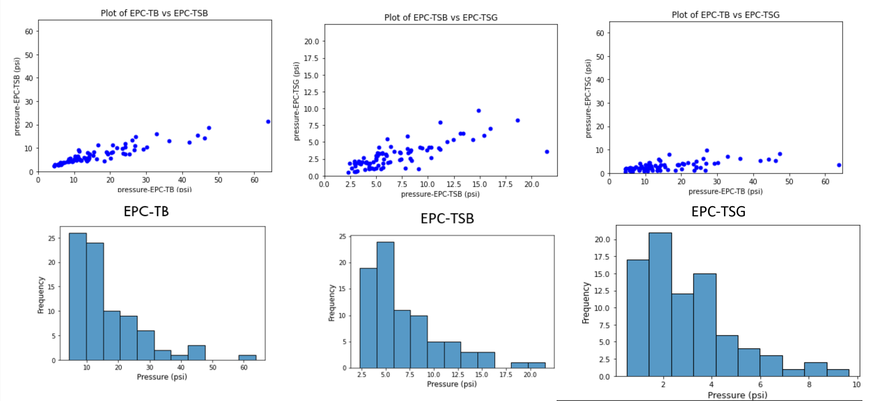
2020



- Low magnitude loading events are common
  - Fighter jets (more common)
  - Wheels away from sensor



2021



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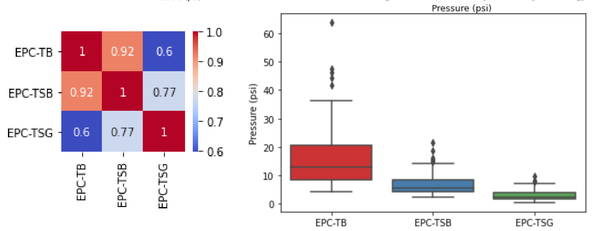

9. Future directions

- Application of machine learning to develop relationship between gear loading and pavement response
- Use of Big-Data analytics to develop analysis protocol to predict pavement performance

10. Acknowledgement

U.S.ARMY
ERDC
SmartRunway