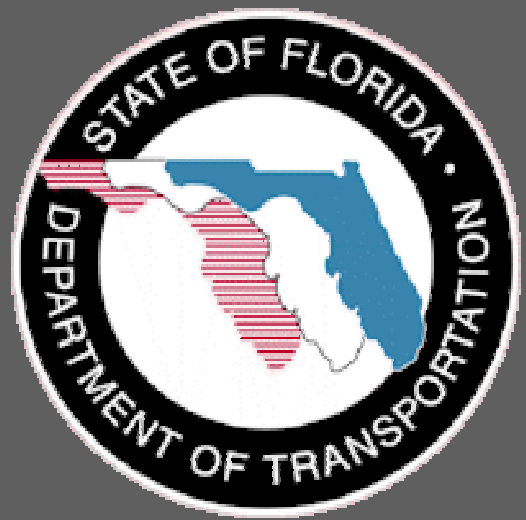
ACCELERATED PAVEMENT TESTING & RESEARCH PROGRAM



FLORIDA'S APT PROGRAM

- Housed within State Materials Research Park
- Test site consists of 8 linear tracks 150x12 ft.
- 2 additional tracks with water table control capability
- Loading using a Heavy Vehicle Simulator (HVS)


APT SITE

APT PITS

LOADING CAPABILITIES

- Loading: 7 to 45 kips
- Wheel speed: 8 mph
- Sinusoidal loading
- Maximum passes/day
  - 29,000 bi-directional
  - 14,000 uni-directional

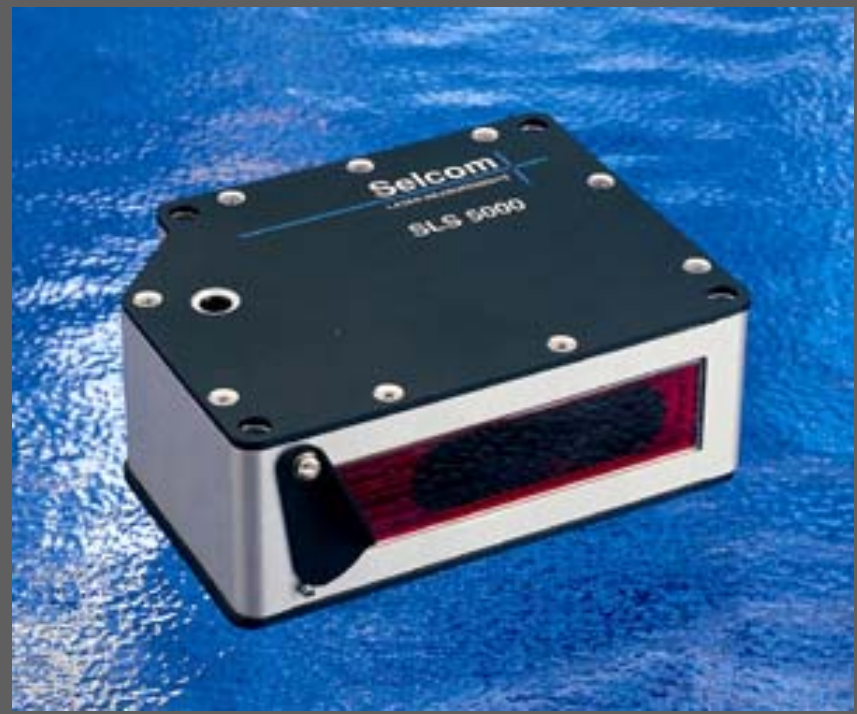
TESTING CAPABILITIES

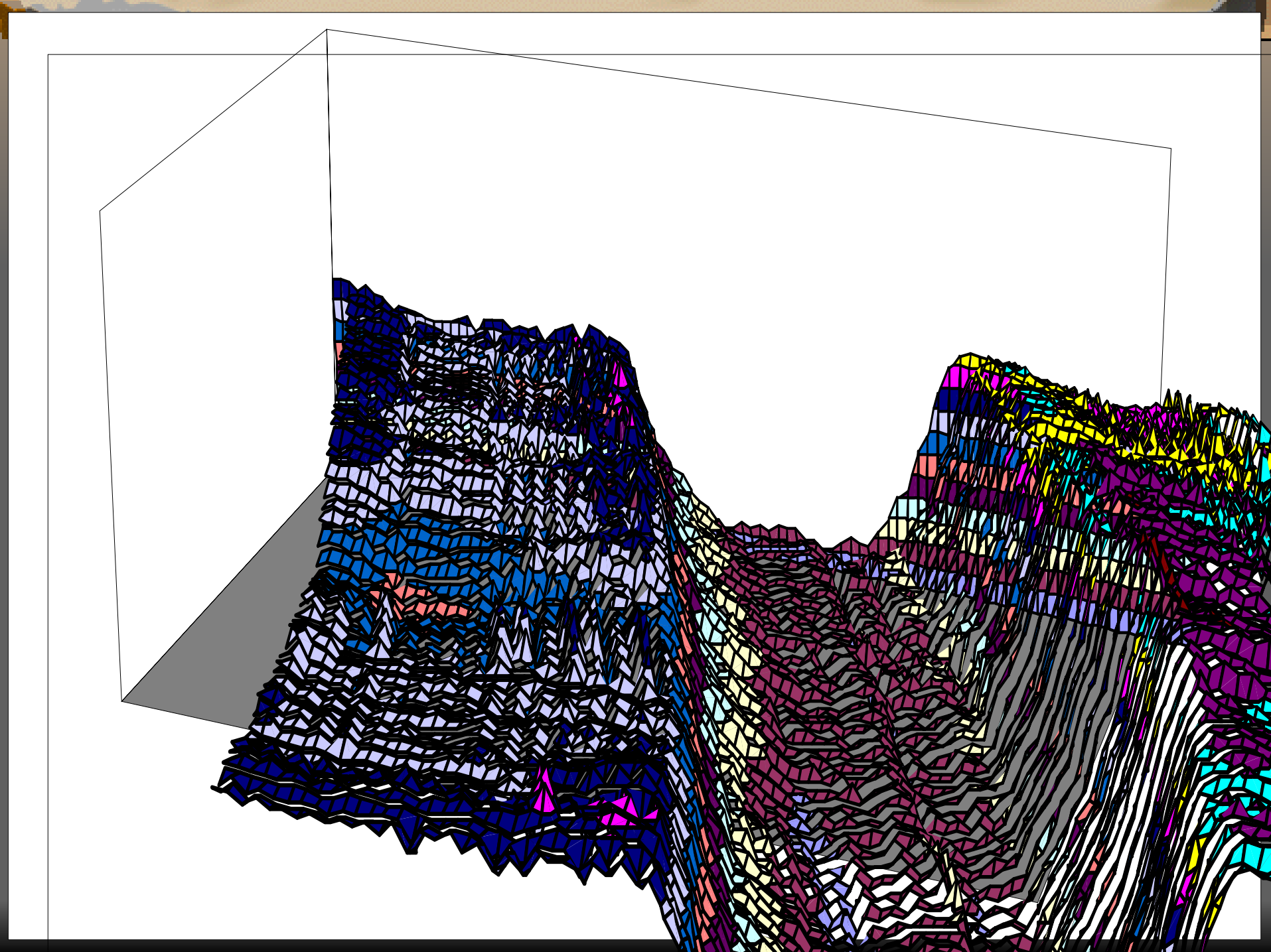
- Test Track Length: 20’
- Wander From 0 – 30”
- Super-Single vs. Dual
- Maximum Rut Depth: 4”


LASER
PROFILING

Laser Profiling System

- Dual Selcom SLS 5200-300-RO
- Accuracy: 0.2% of Measurement Range (~0.6 mm)
- Sampling Rate: 16 kHz

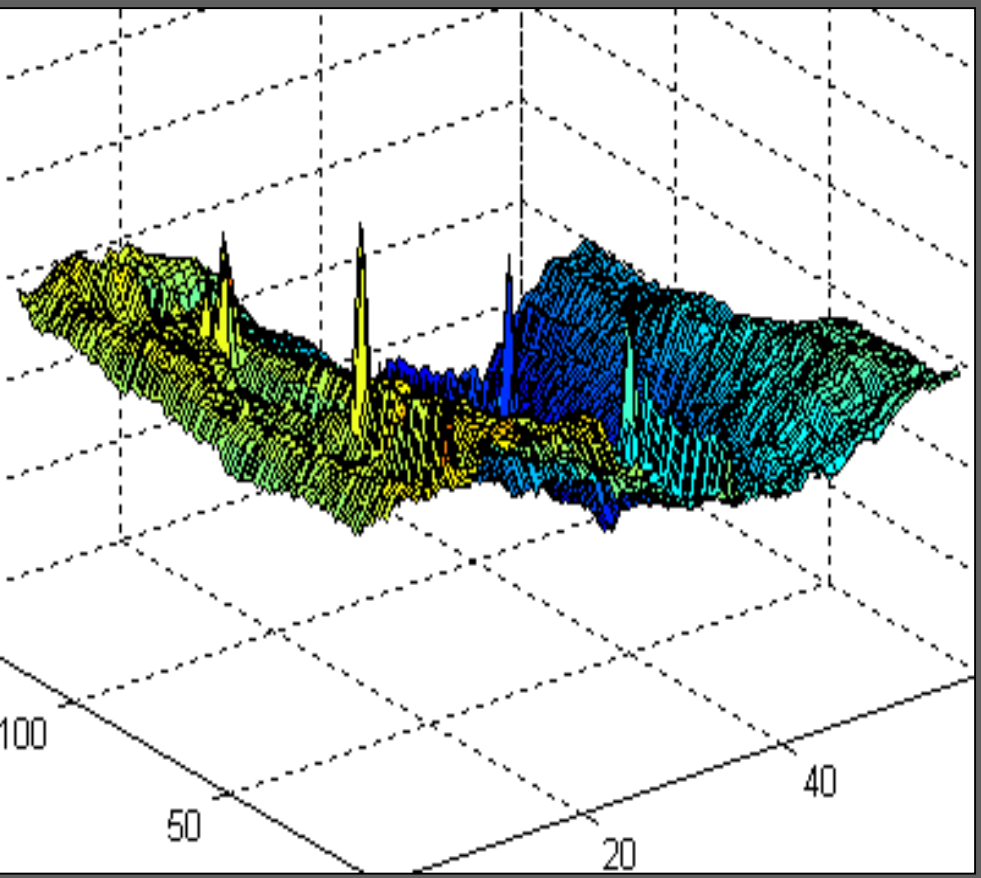




Animated Comparison of Tracks 4A & 1B Showing Rut Progression

Modified vs. Unmodified Rut Progression

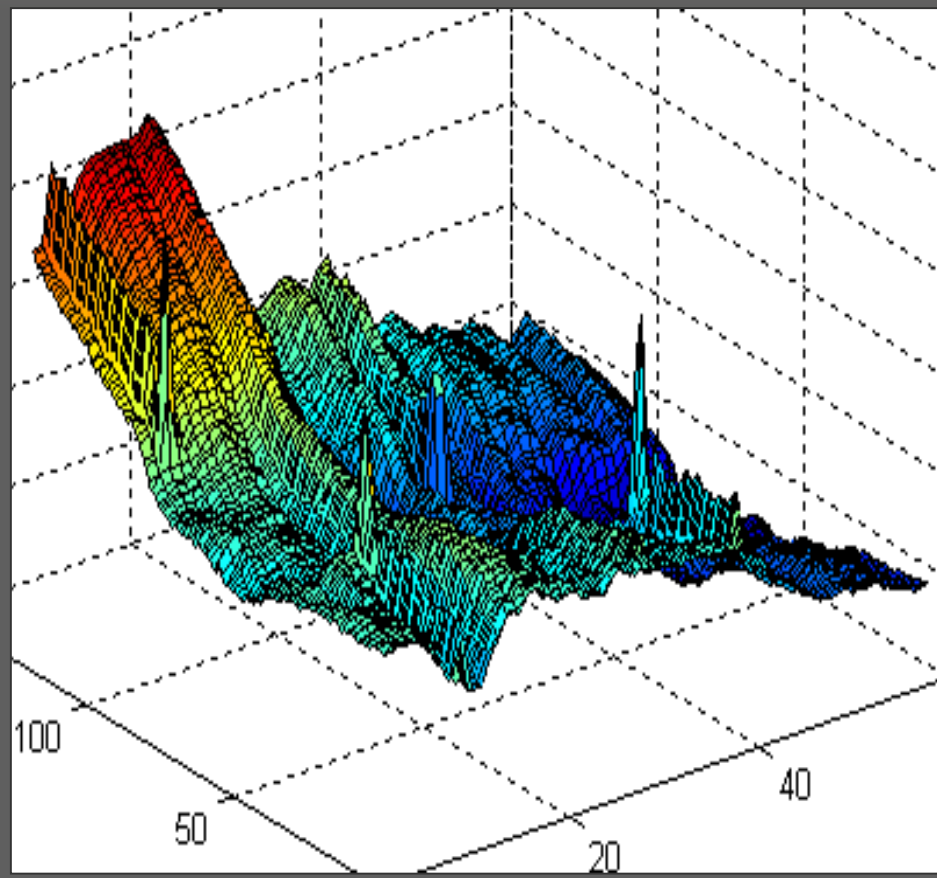
Track 4A (Unmodified)



Avg. Rut- 0 mm

0 Passes

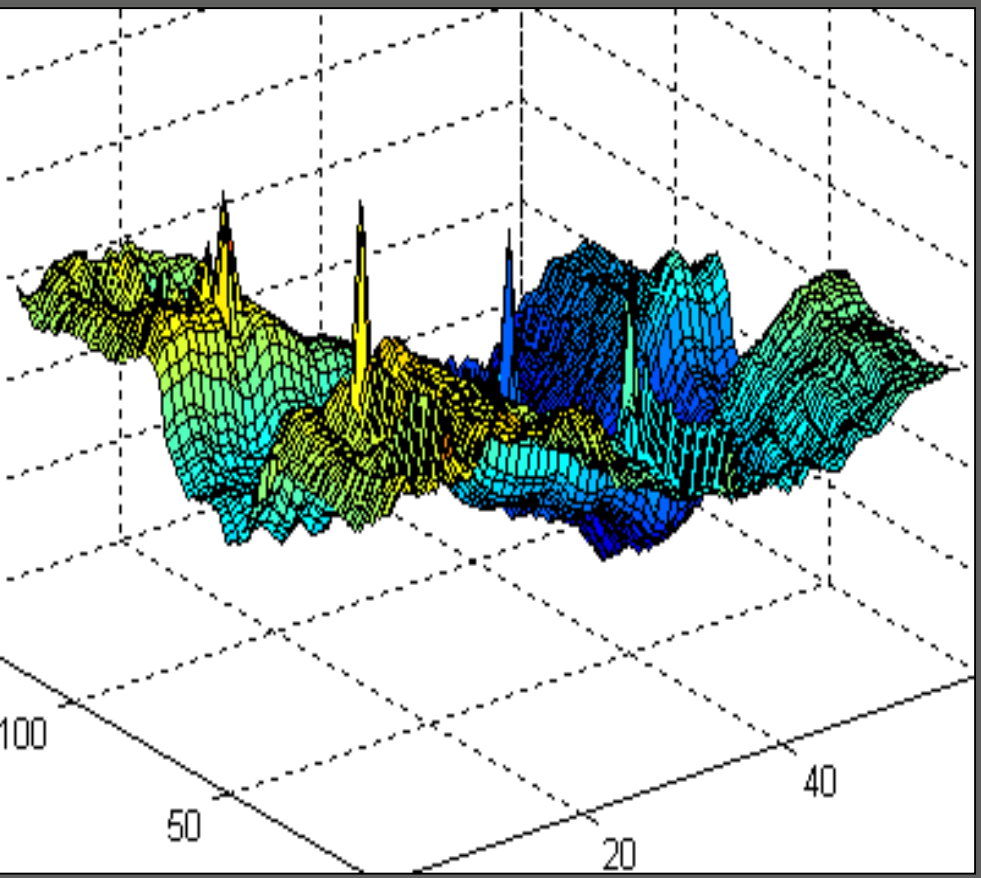
Track 1B (Modified)



Avg. Rut- 0 mm

Modified vs. Unmodified Rut Progression

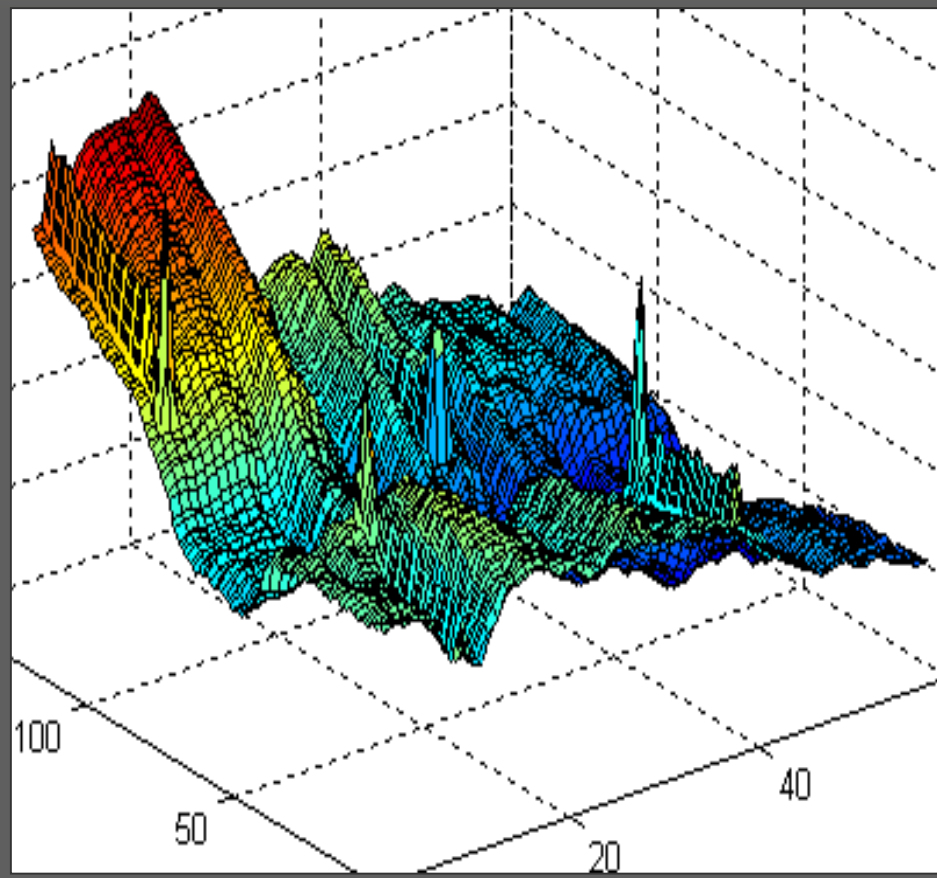
Track 4A (Unmodified)



Avg. Rut- 2.2 mm

200 Passes

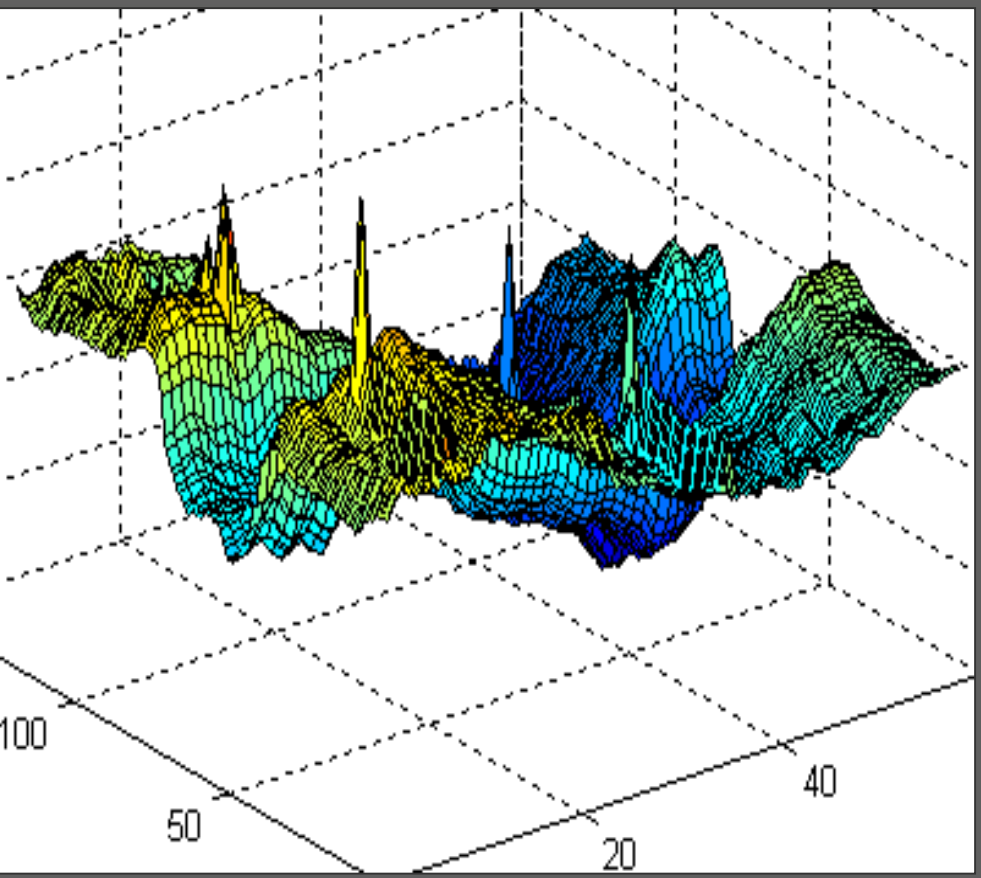
Track 1B (Modified)



Avg. Rut- 1.3 mm

Modified vs. Unmodified Rut Progression

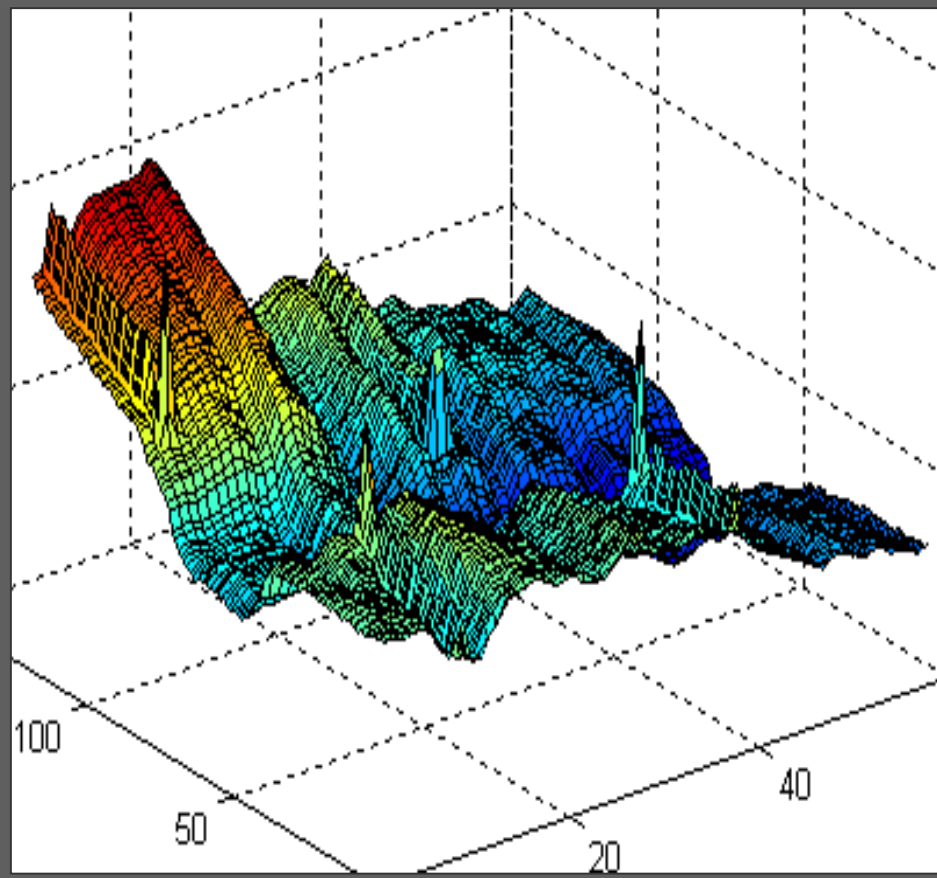
Track 4A (Unmodified)



Avg. Rut- 2.6 mm

300 Passes

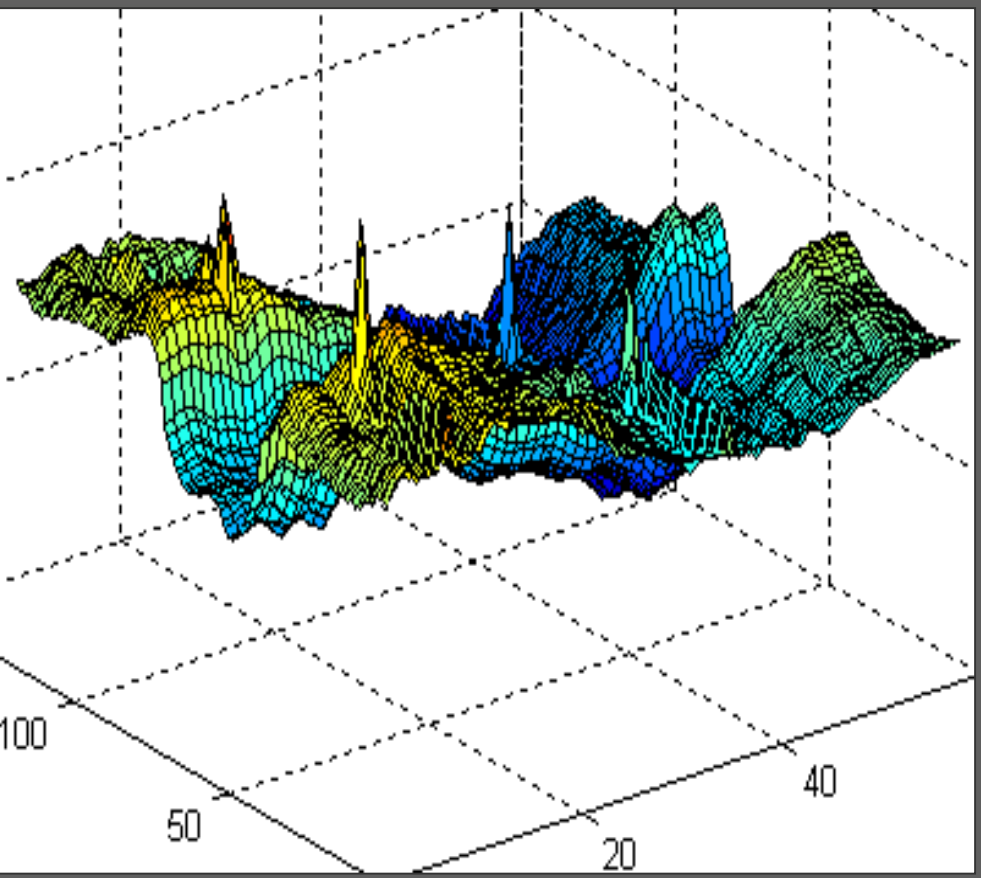
Track 1B (Modified)



Avg. Rut- 1.5 mm

Modified vs. Unmodified Rut Progression

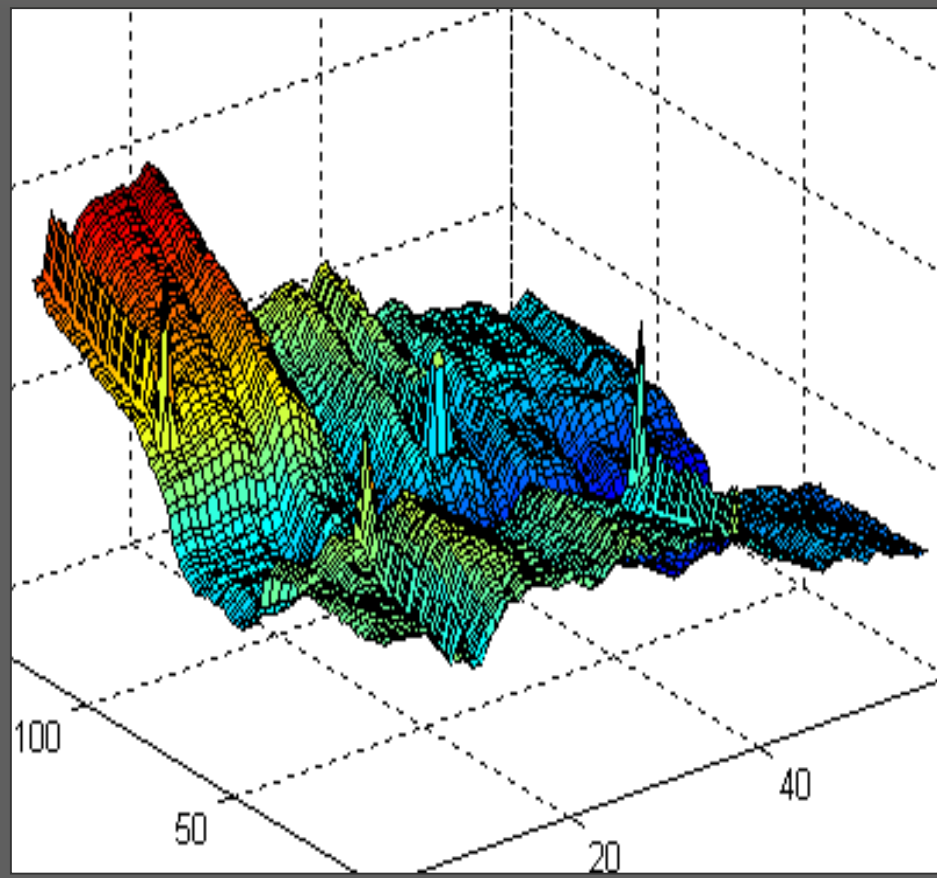
Track 4A (Unmodified)



Avg. Rut- 3.2 mm

500 Passes

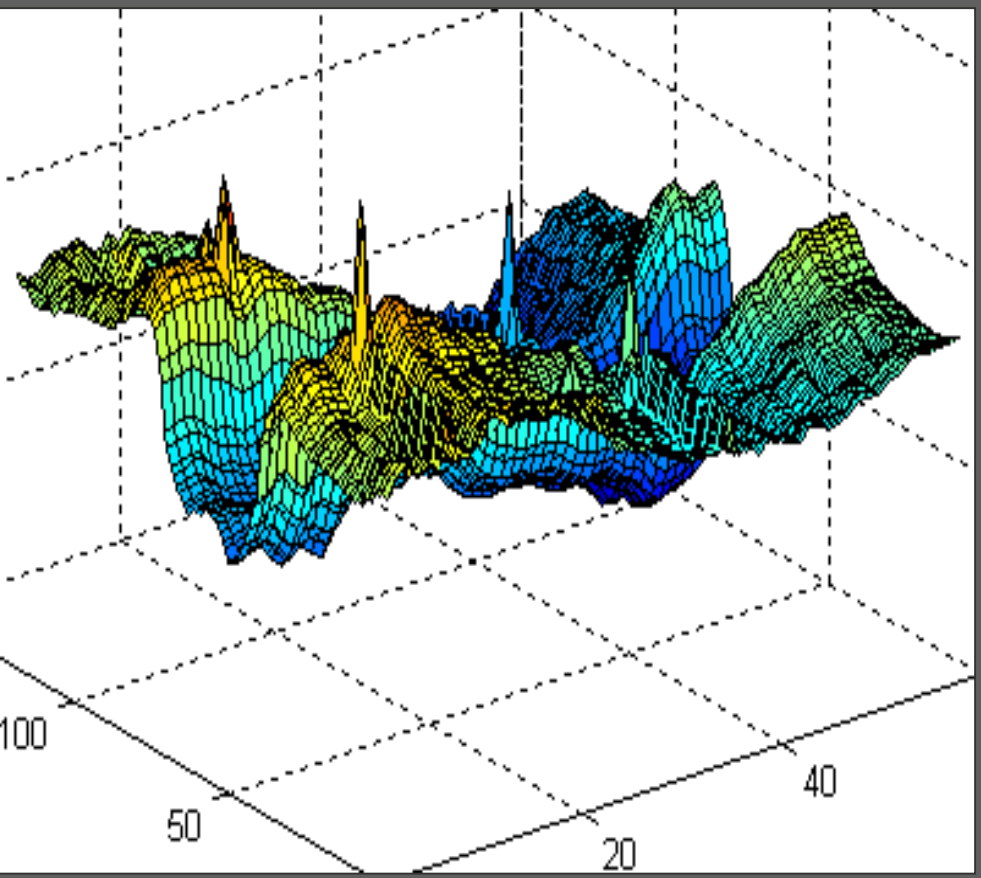
Track 1B (Modified)



Avg. Rut- 1.9 mm

Modified vs. Unmodified Rut Progression

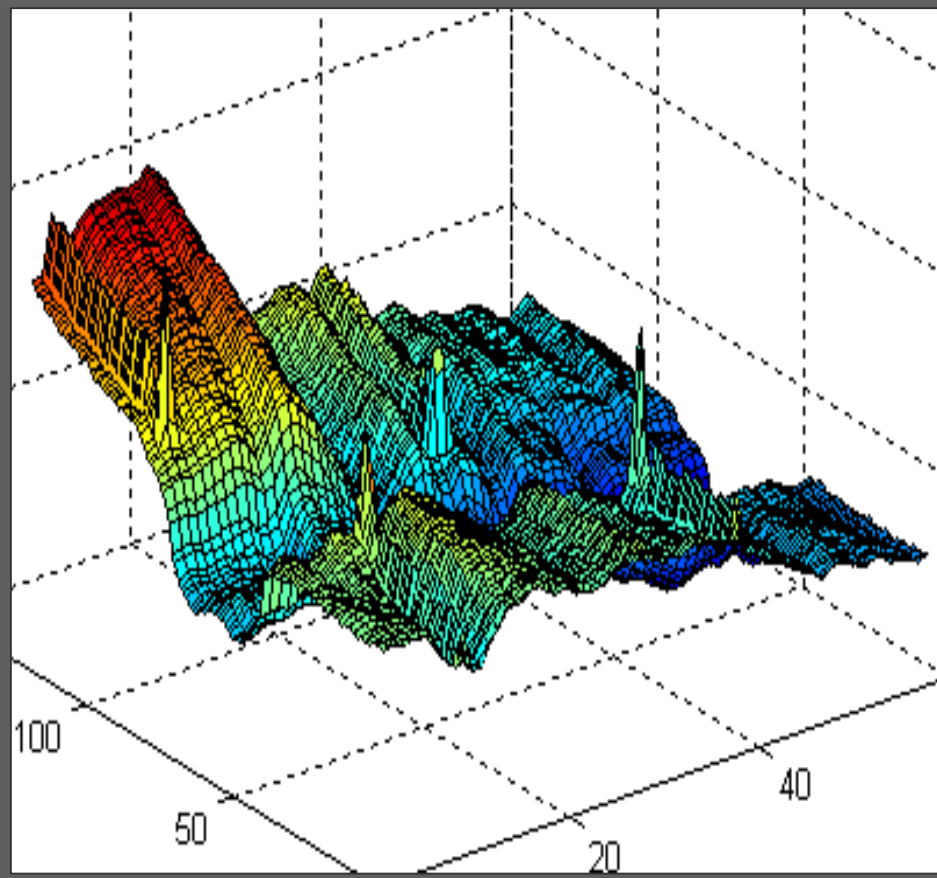
Track 4A (Unmodified)



Avg. Rut- 4.1 mm

1000 Passes

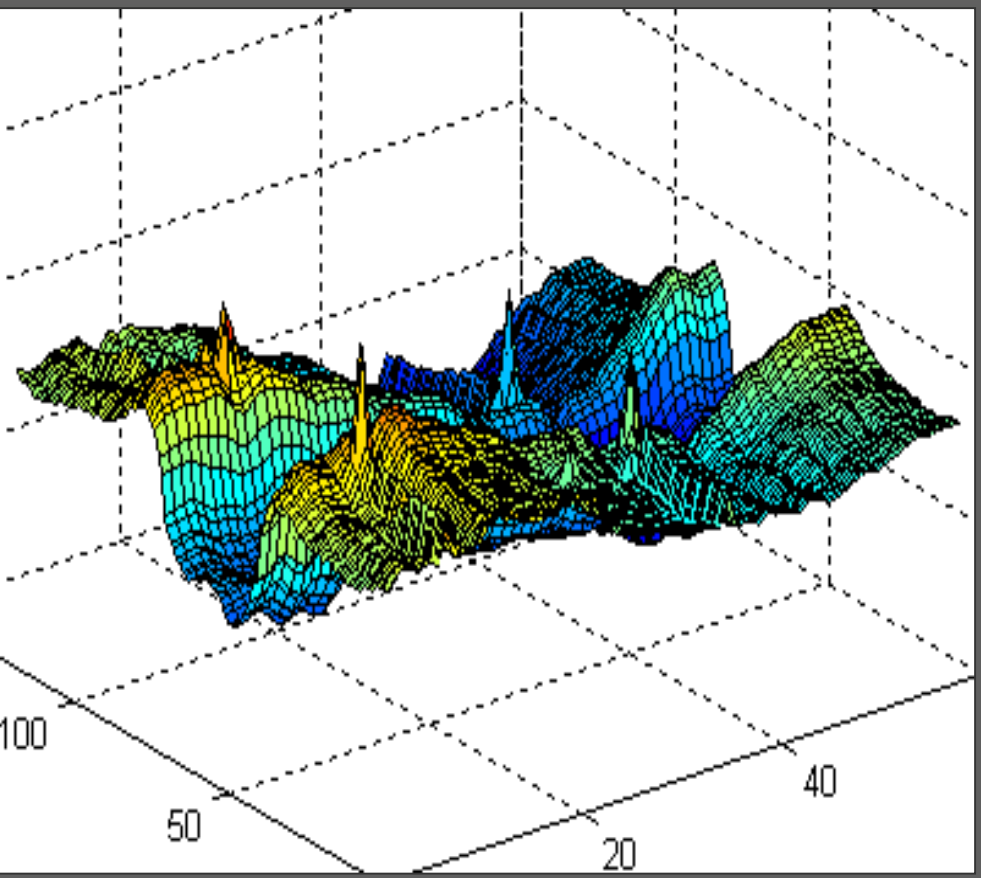
Track 1B (Modified)



Avg. Rut- 2.4 mm

Modified vs. Unmodified Rut Progression

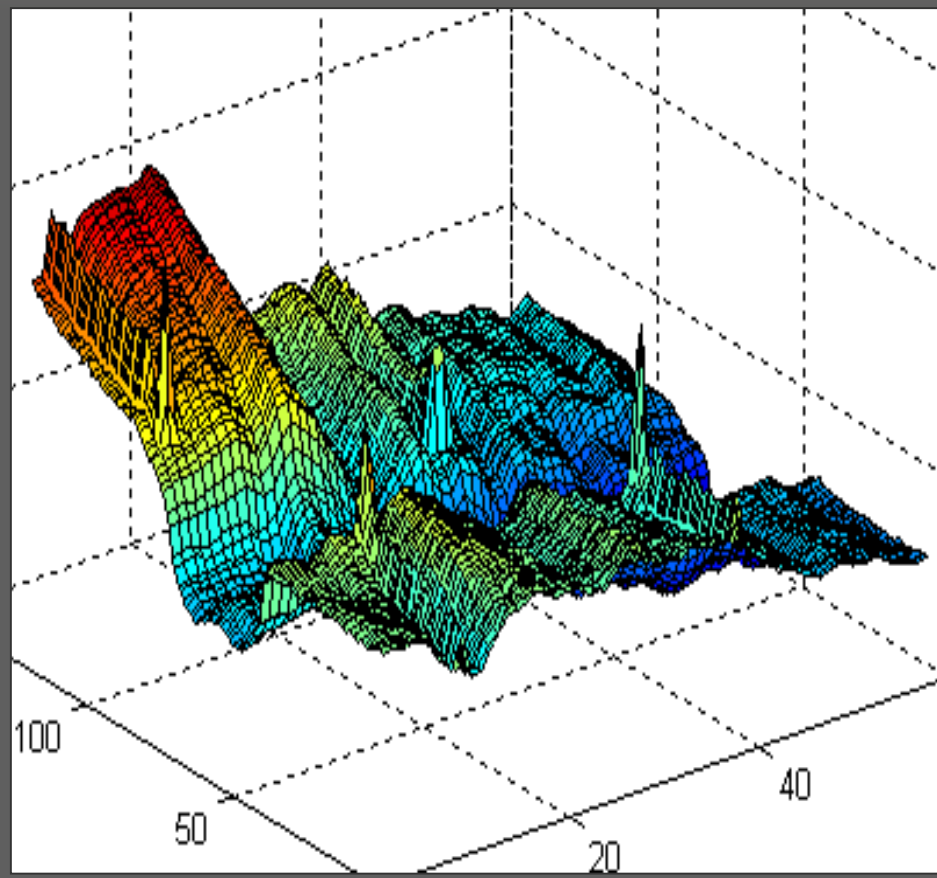
Track 4A (Unmodified)



Avg. Rut- 4.4 mm

1300 Passes

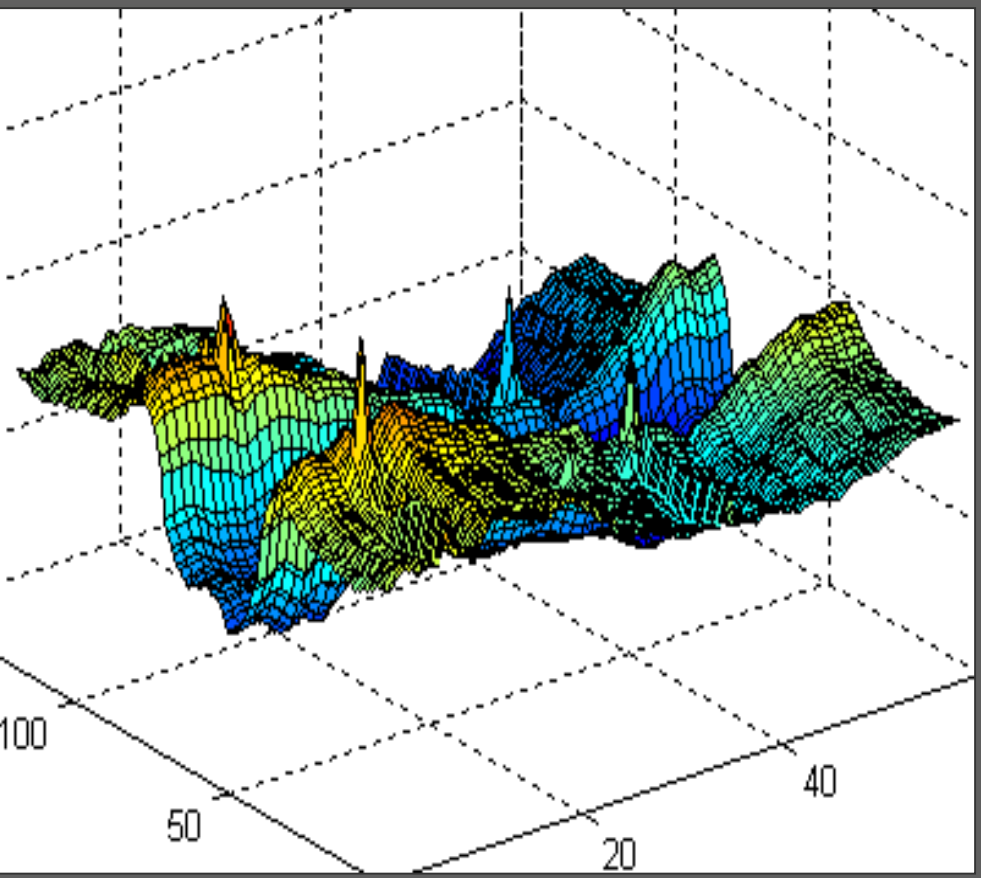
Track 1B (Modified)



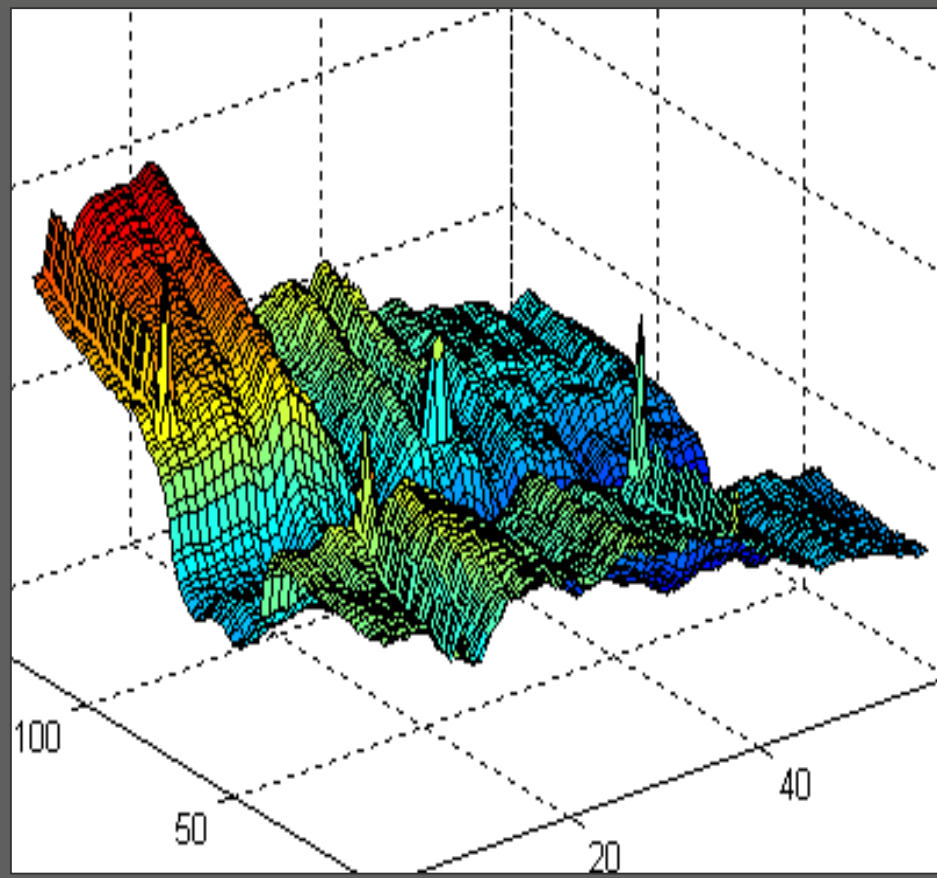
Avg. Rut- 2.6 mm

Modified vs. Unmodified Rut Progression

Track 4A (Unmodified)



Track 1B (Modified)



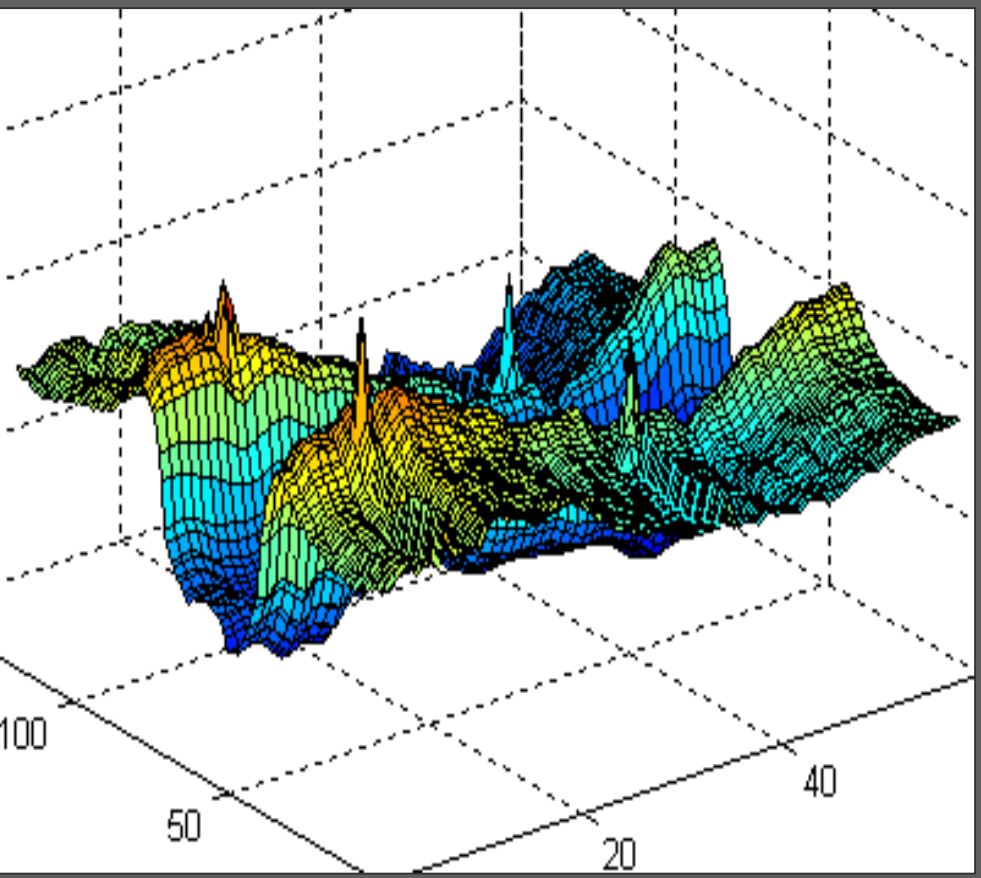
Avg. Rut- 4.8 mm

1600 Passes

Avg. Rut- 2.8 mm

Modified vs. Unmodified Rut Progression

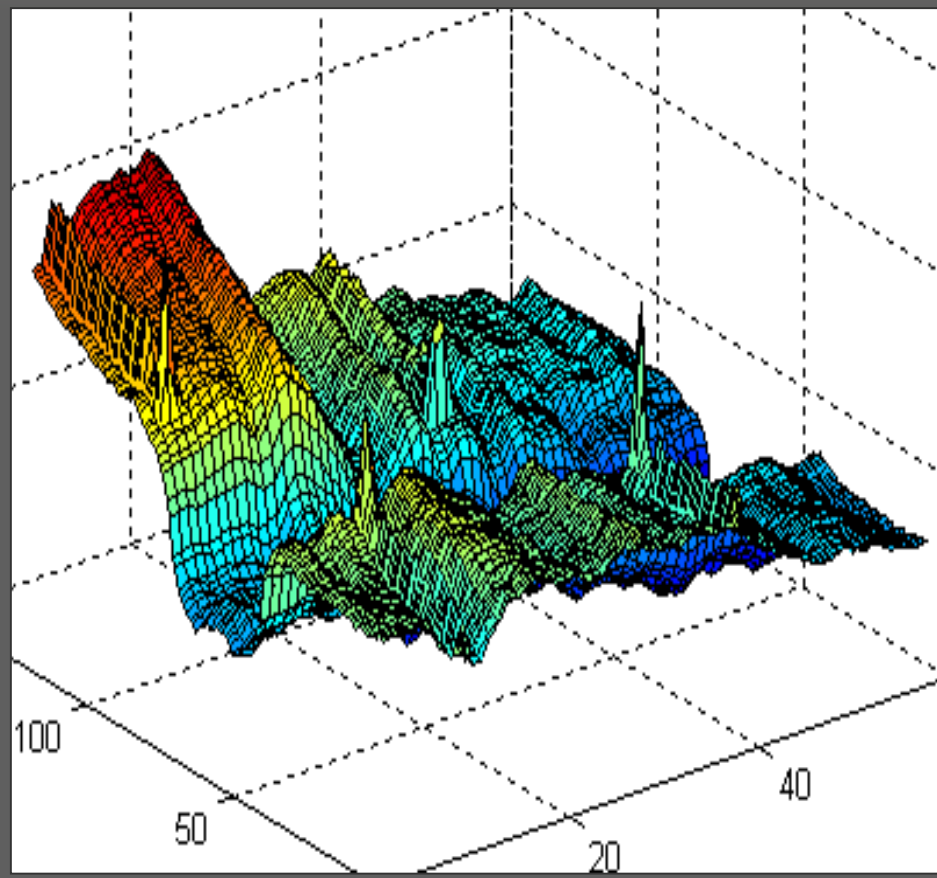
Track 4A (Unmodified)



Avg. Rut- 5.8 mm

3000 Passes

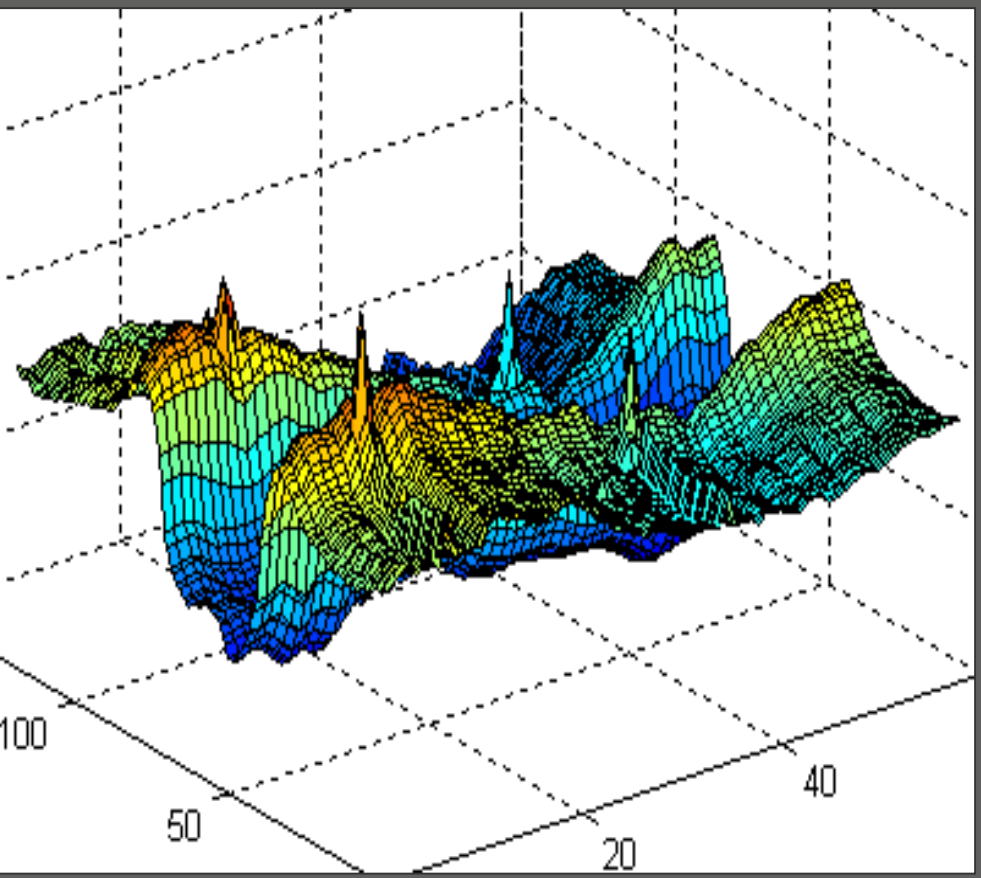
Track 1B (Modified)



Avg. Rut- 3.3 mm

Modified vs. Unmodified Rut Progression

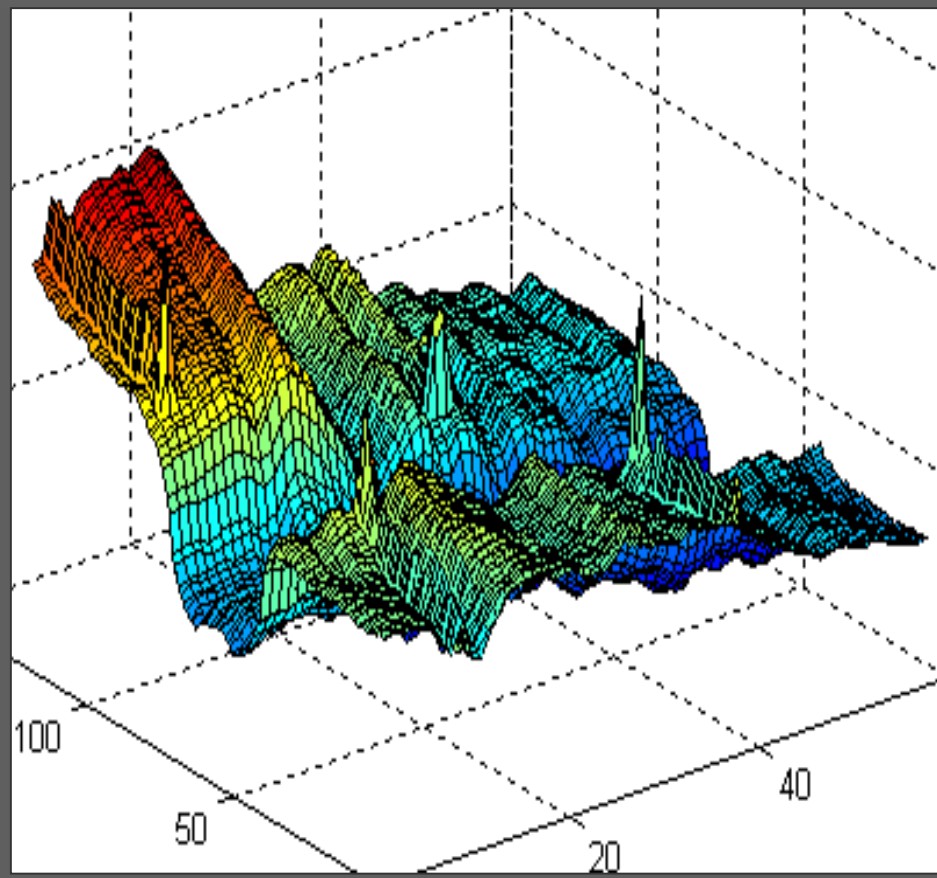
Track 4A (Unmodified)



Avg. Rut- 6.1 mm

3500 Passes

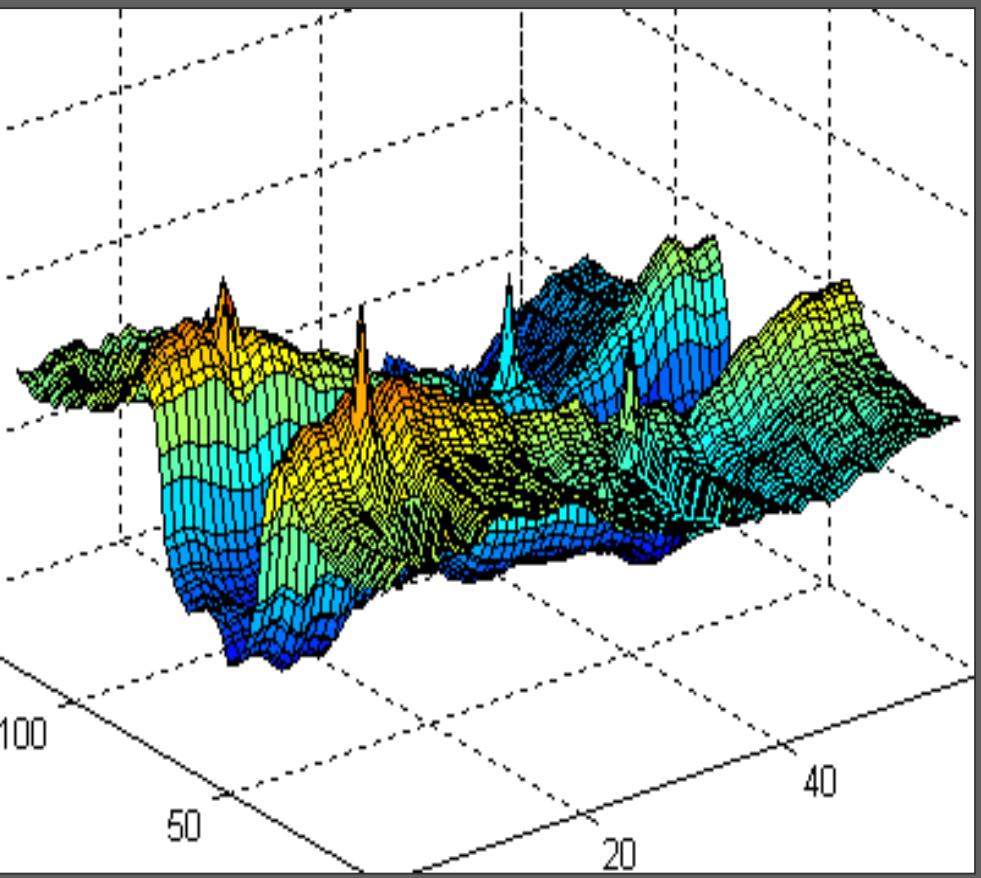
Track 1B (Modified)



Avg. Rut- 3.4 mm

Modified vs. Unmodified Rut Progression

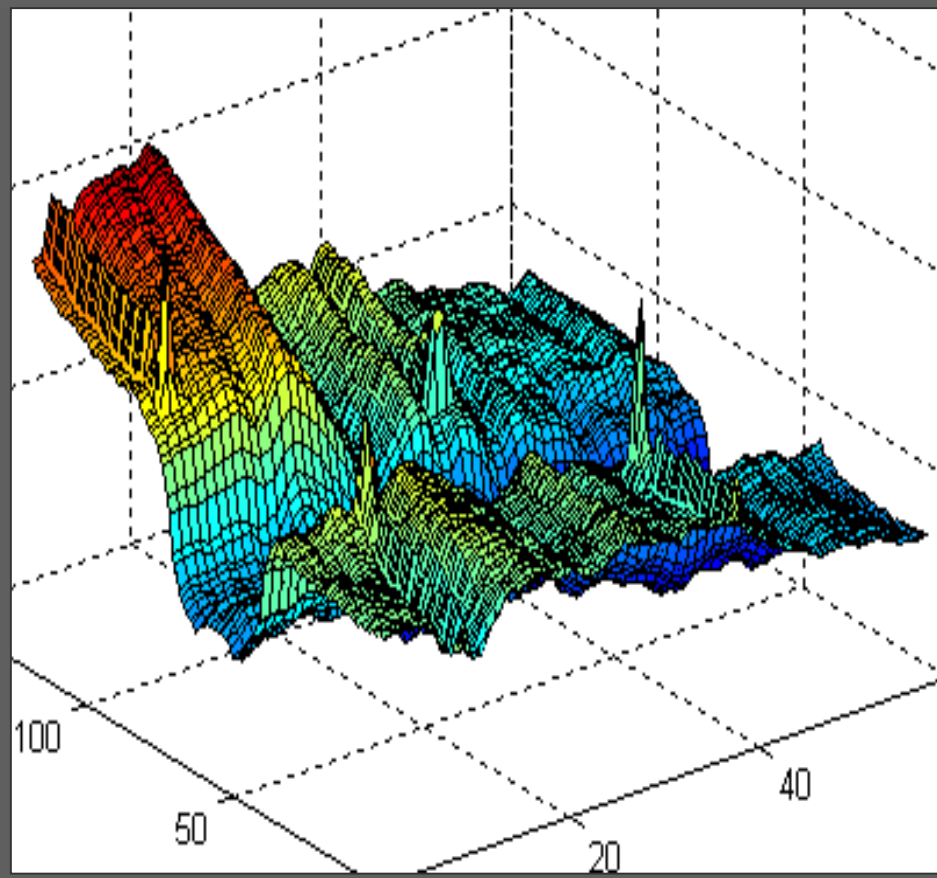
Track 4A (Unmodified)



Avg. Rut- 6.4 mm

4000 Passes

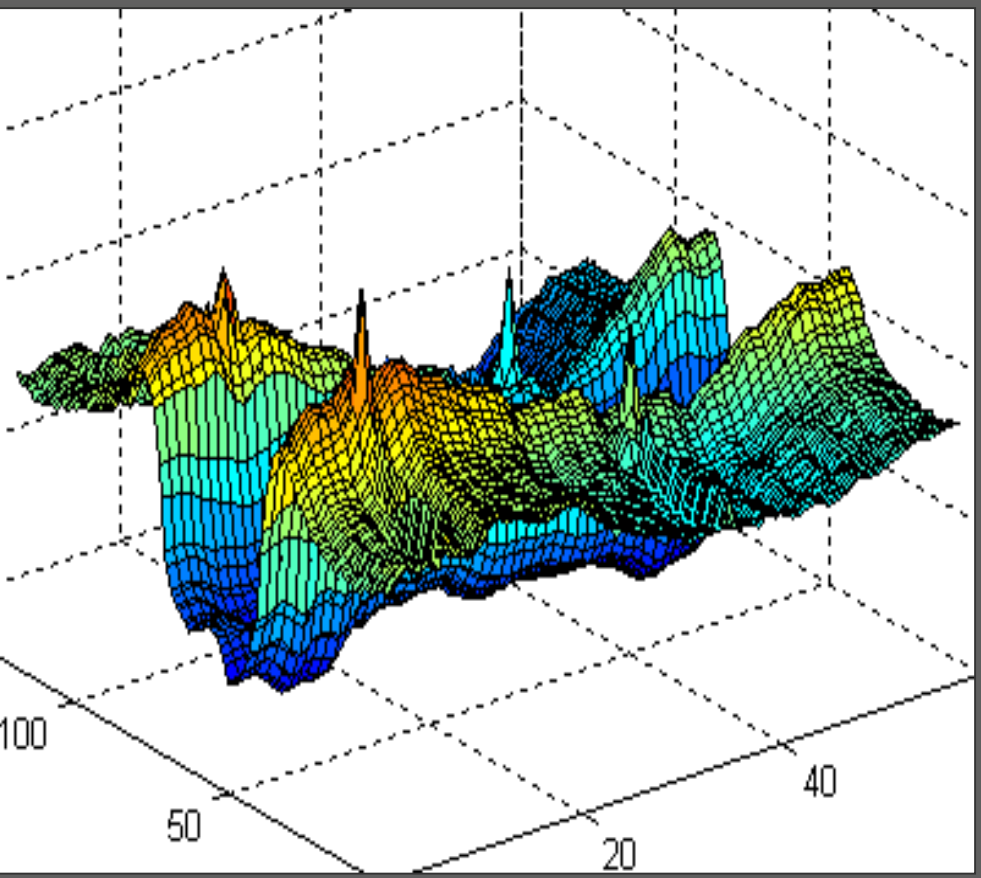
Track 1B (Modified)



Avg. Rut- 3.6 mm

Modified vs. Unmodified Rut Progression

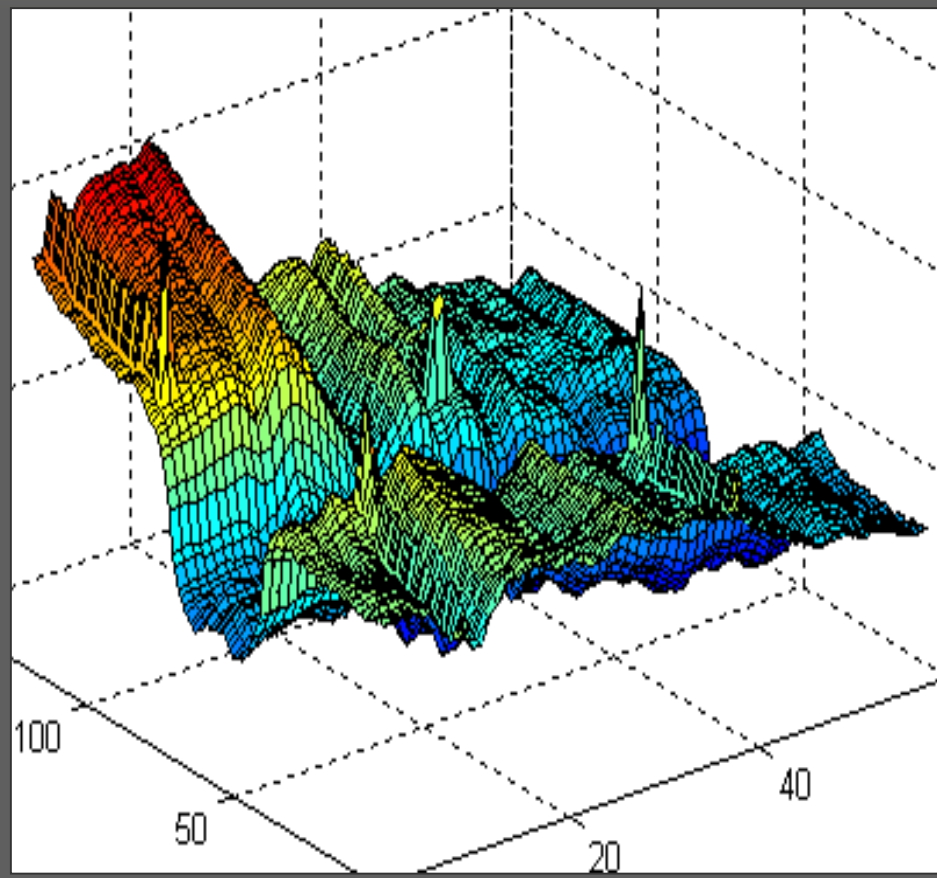
Track 4A (Unmodified)



Avg. Rut- 7.3 mm

6000 Passes

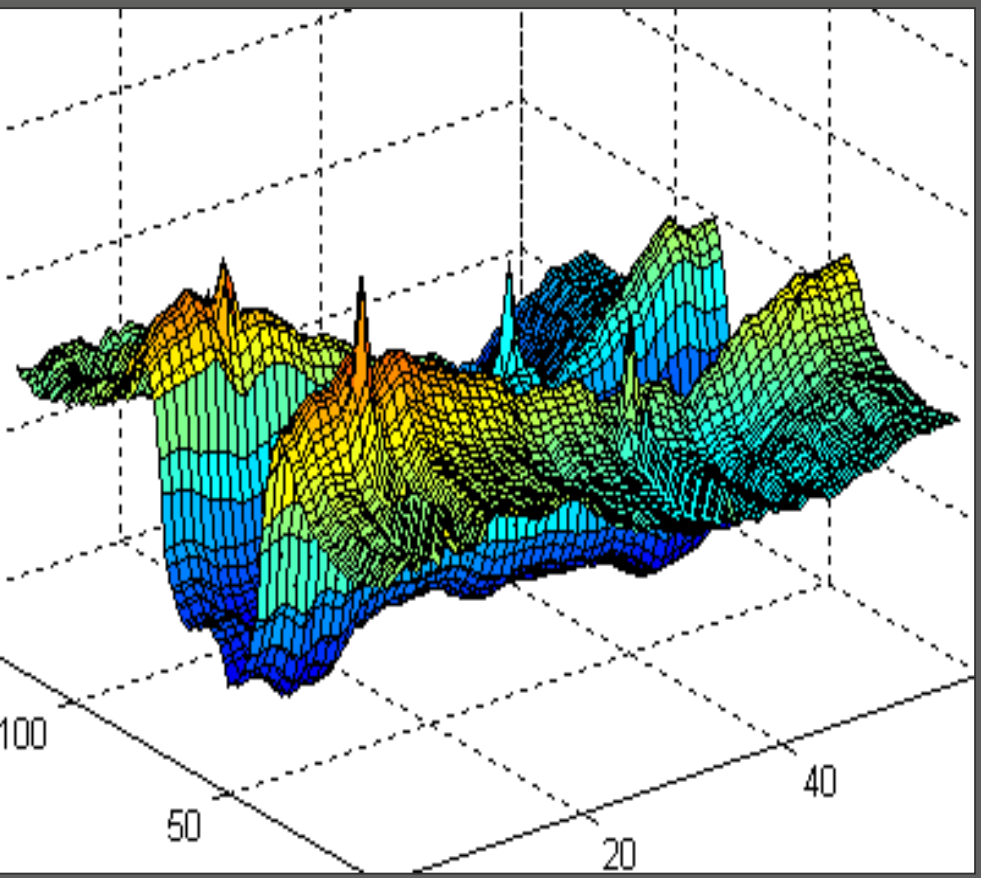
Track 1B (Modified)



Avg. Rut- 3.9 mm

Modified vs. Unmodified Rut Progression

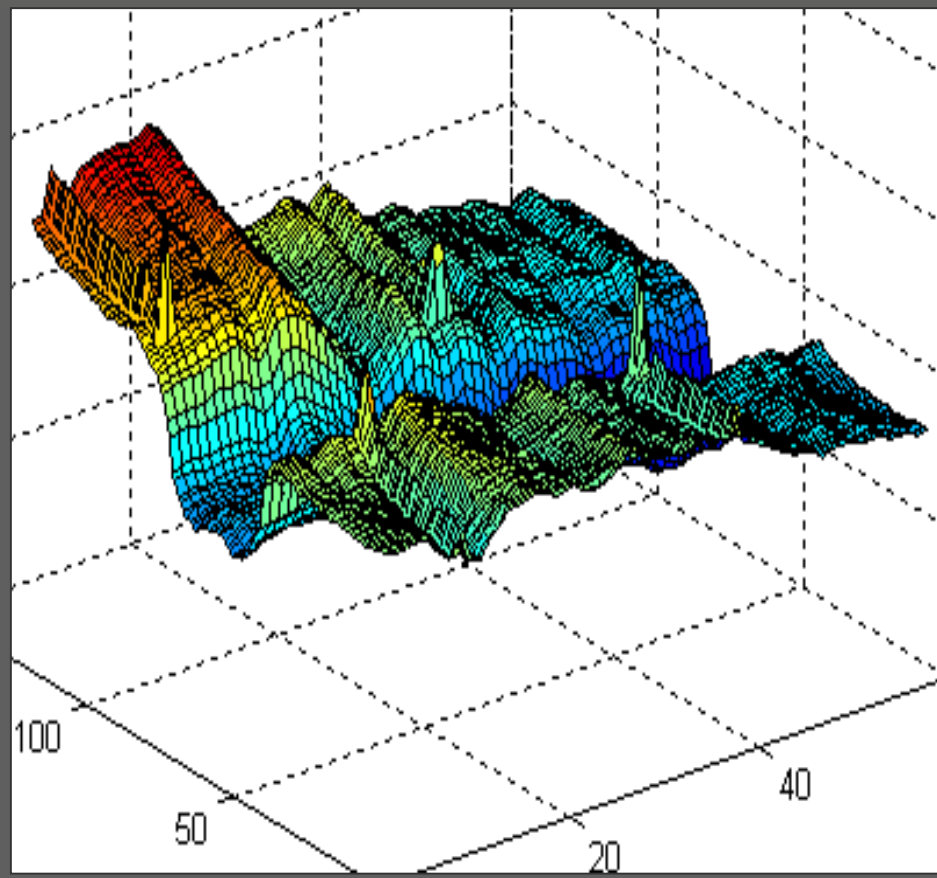
Track 4A (Unmodified)



Avg. Rut- 7.6 mm

7000 Passes

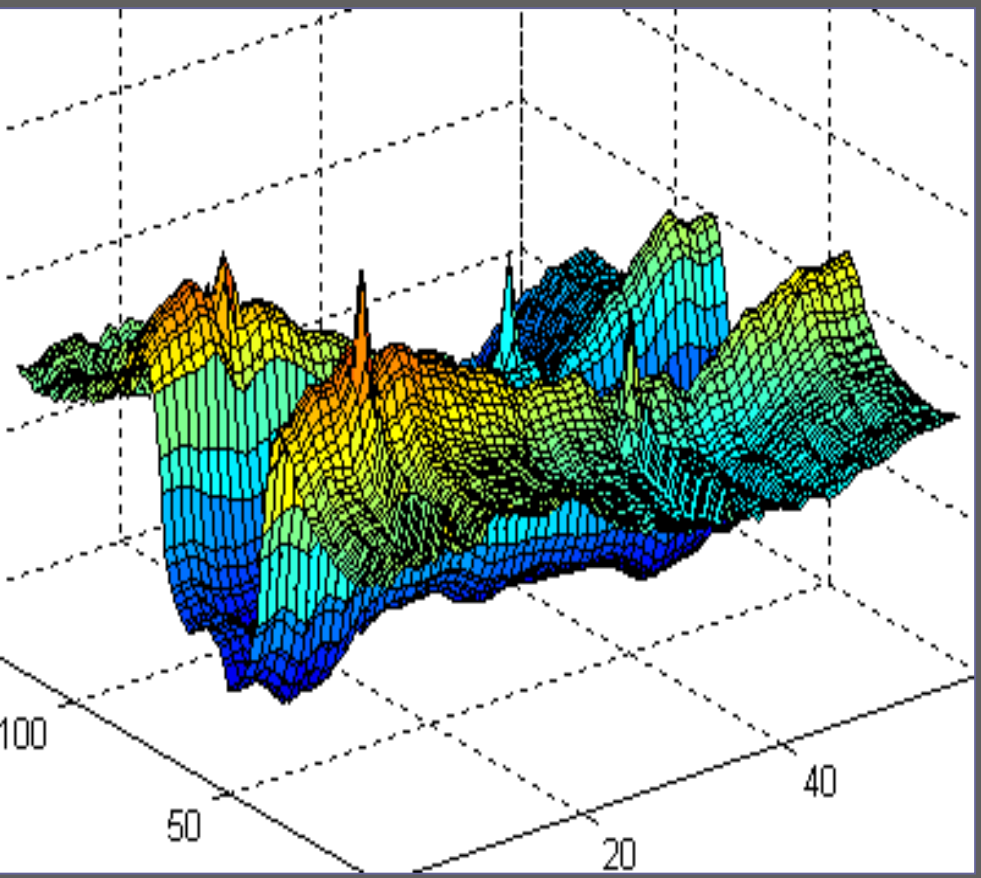
Track 1B (Modified)



Avg. Rut- 4.0 mm

Modified vs. Unmodified Rut Progression

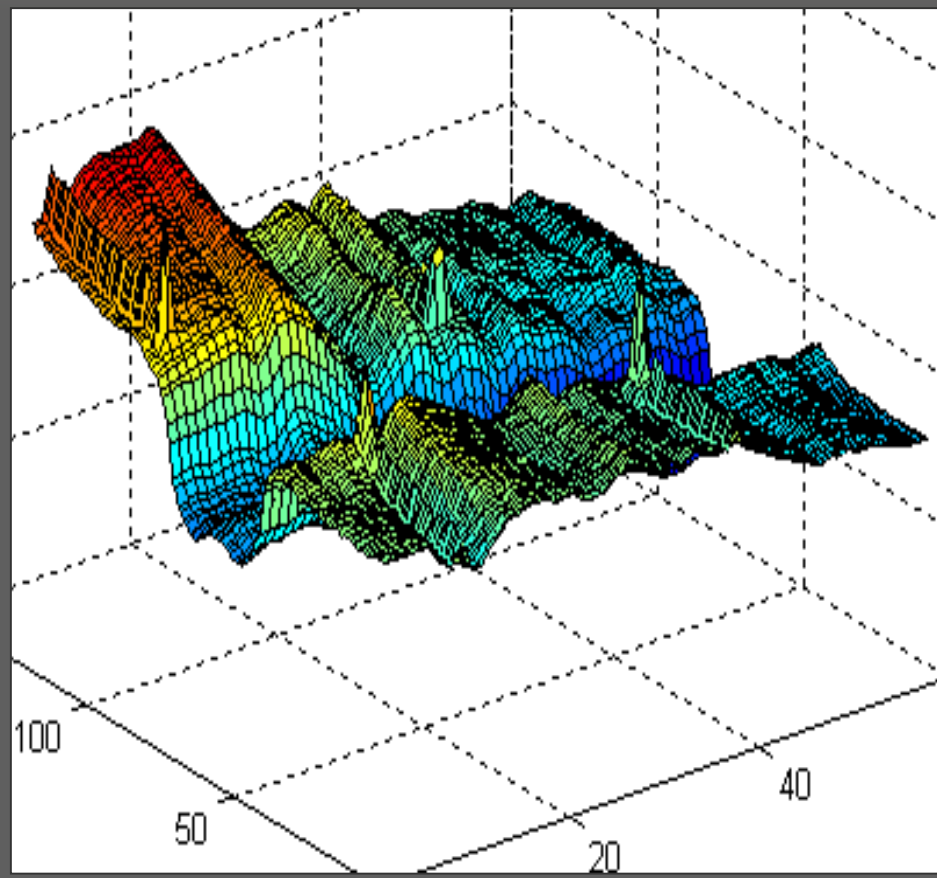
Track 4A (Unmodified)



Avg. Rut- 7.9 mm

8000 Passes

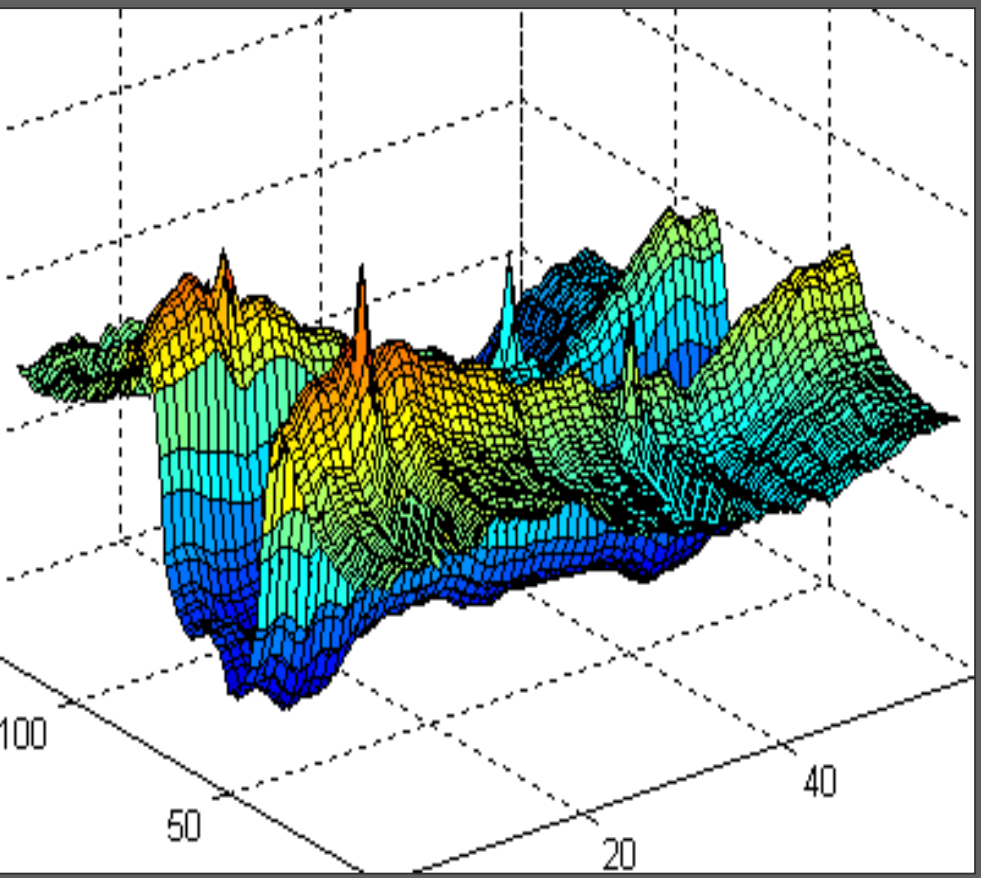
Track 1B (Modified)



Avg. Rut- 4.1 mm

Modified vs. Unmodified Rut Progression

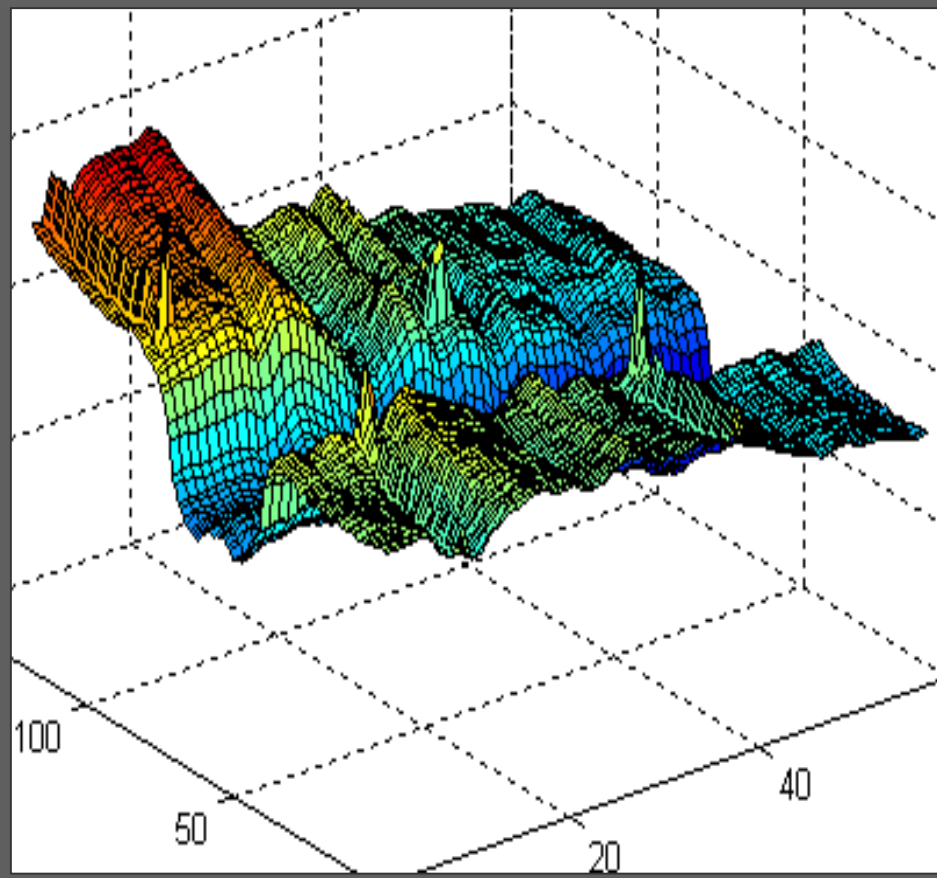
Track 4A (Unmodified)



Avg. Rut- 8.1 mm

9000 Passes

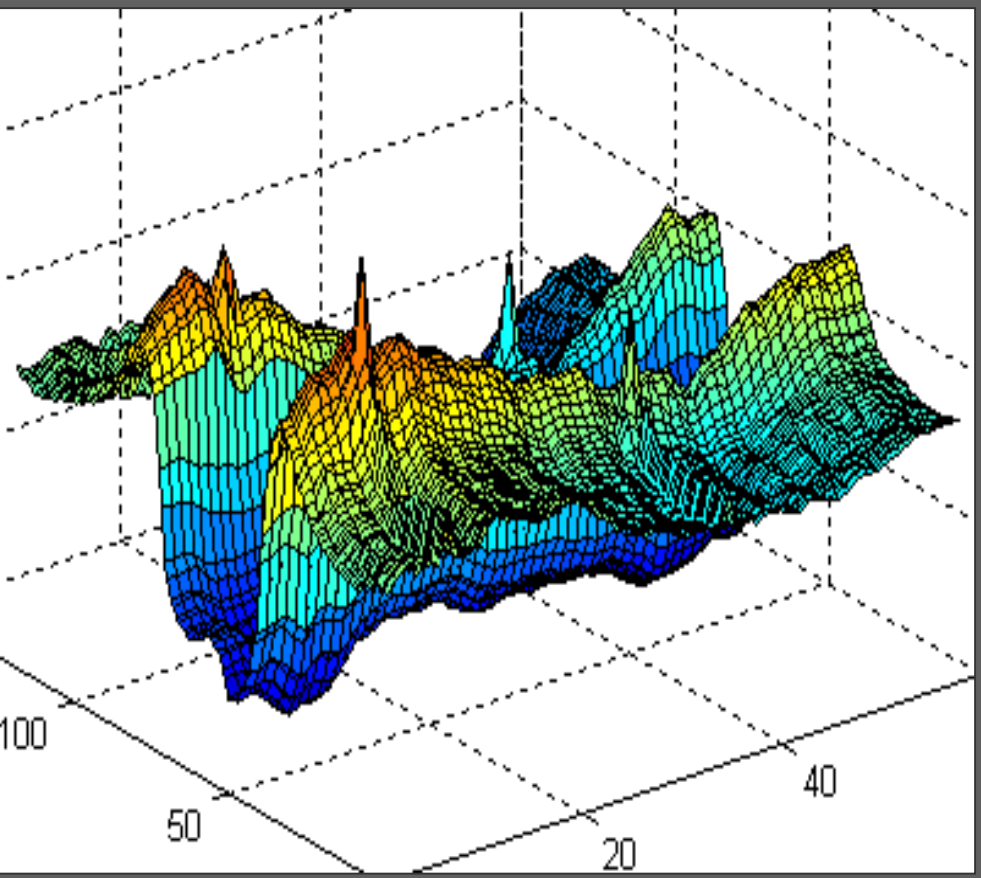
Track 1B (Modified)



Avg. Rut- 4.2 mm

Modified vs. Unmodified Rut Progression

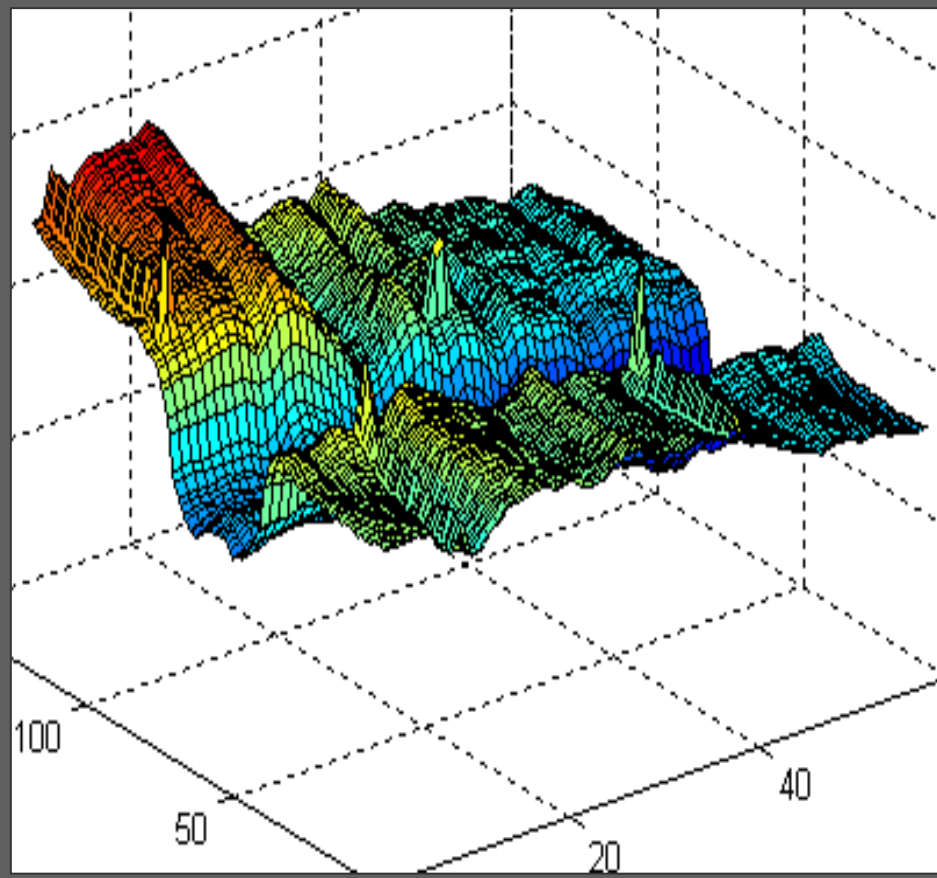
Track 4A (Unmodified)



Avg. Rut- 8.4 mm

10000 Passes

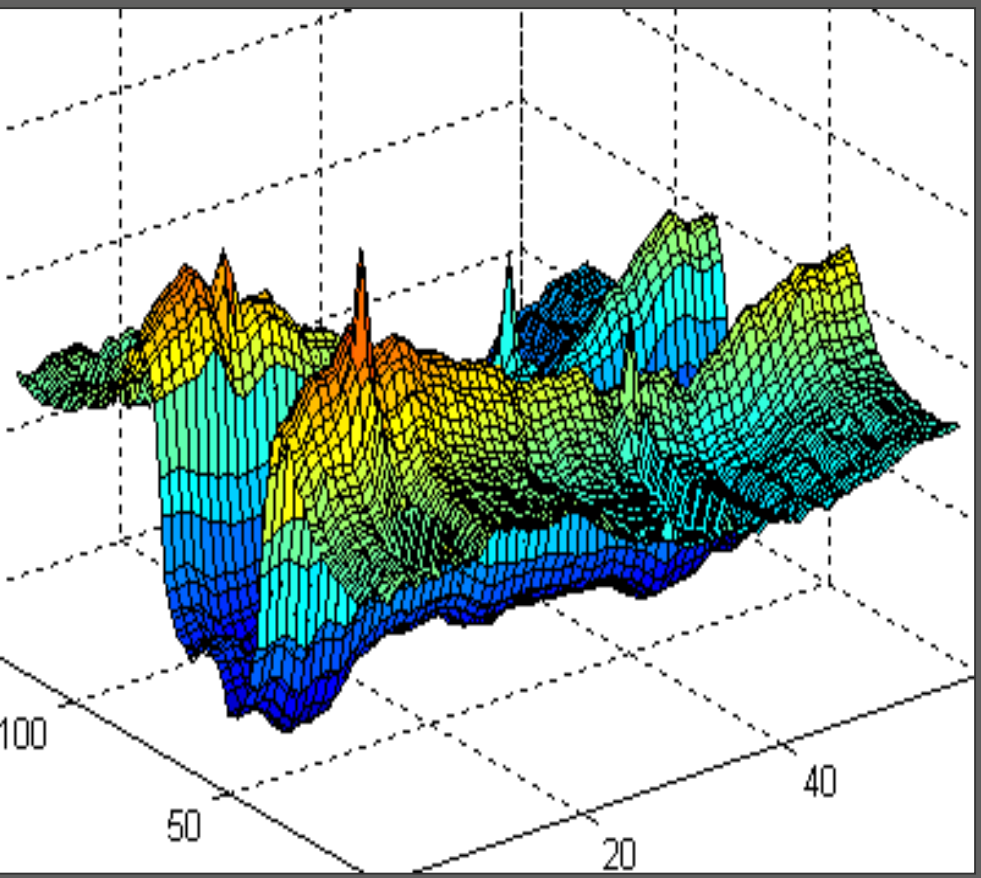
Track 1B (Modified)



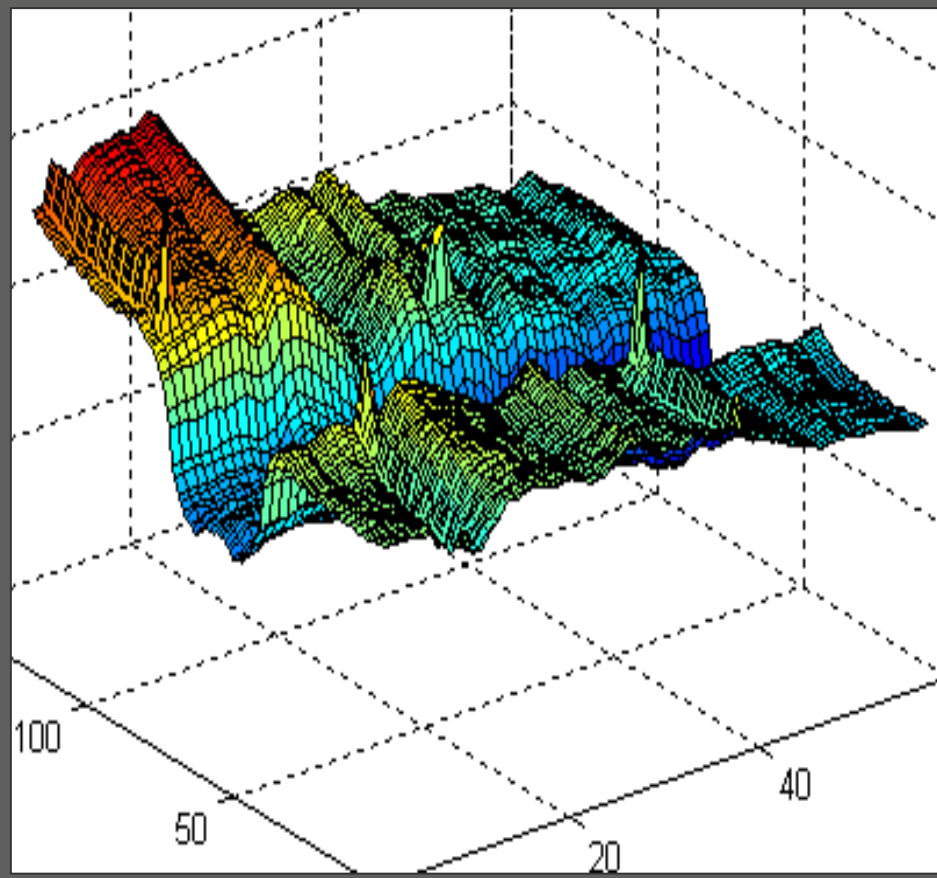
Avg. Rut- 4.4 mm

Modified vs. Unmodified Rut Progression

Track 4A (Unmodified)



Track 1B (Modified)



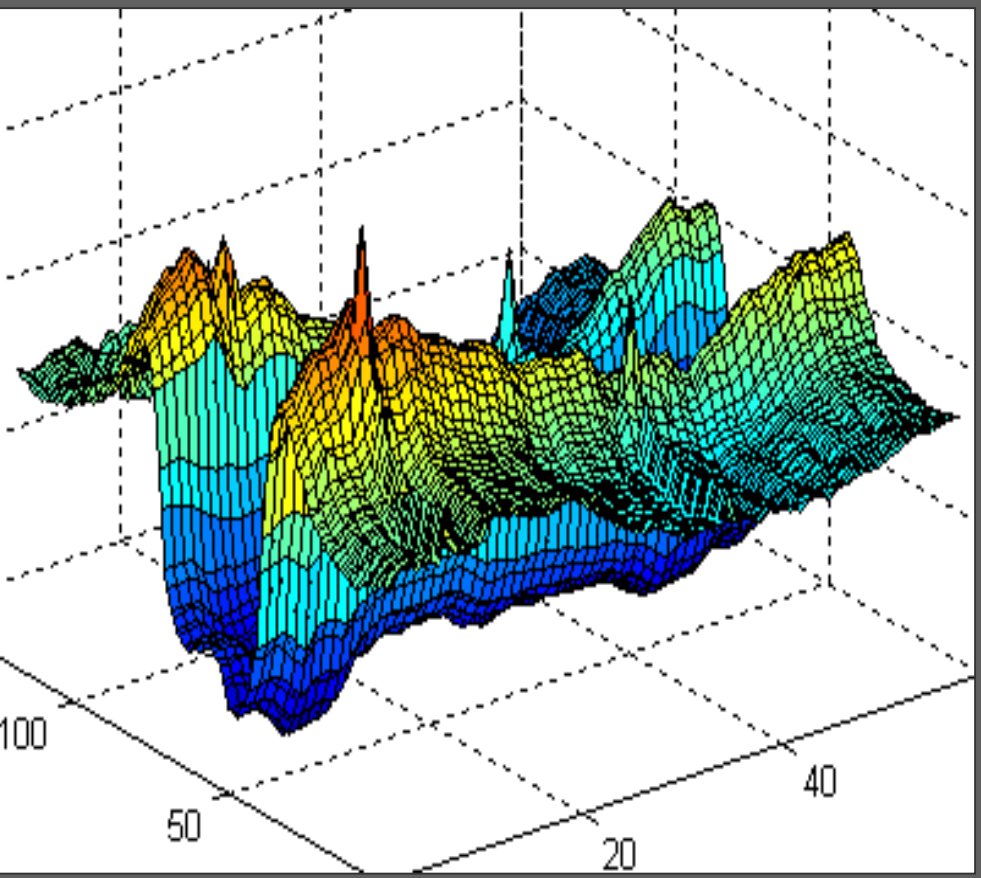
Avg. Rut- 8.9 mm

12000 Passes

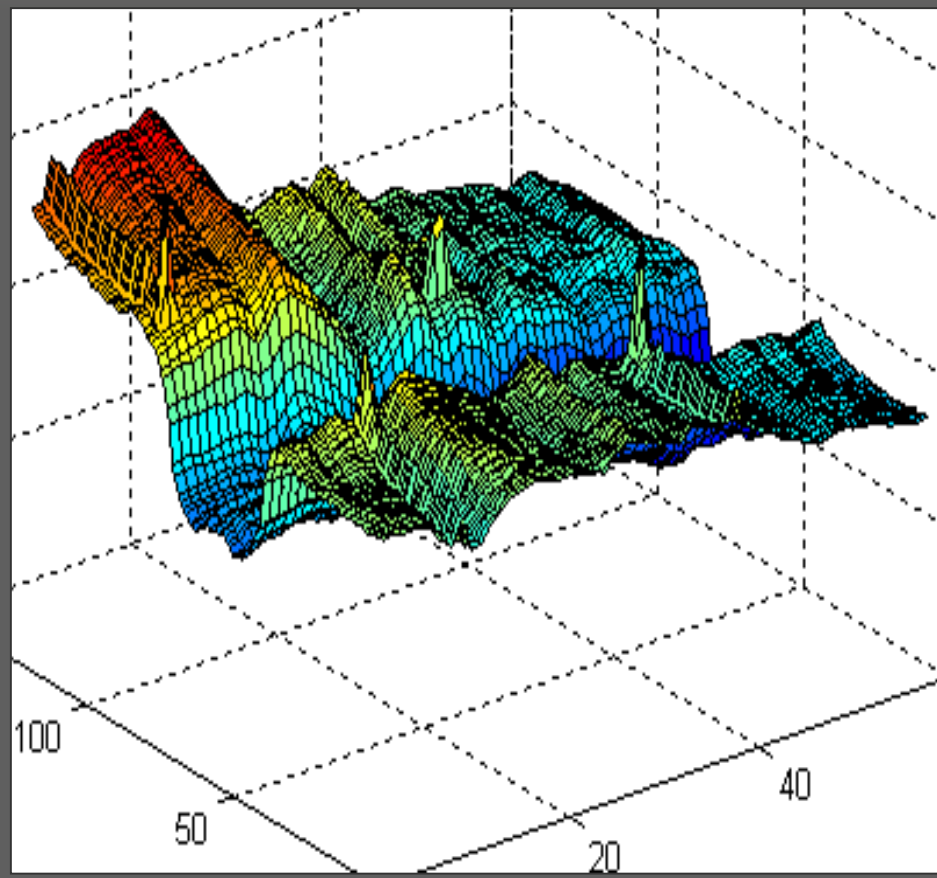
Avg. Rut- 4.5 mm

Modified vs. Unmodified Rut Progression

Track 4A (Unmodified)



Track 1B (Modified)



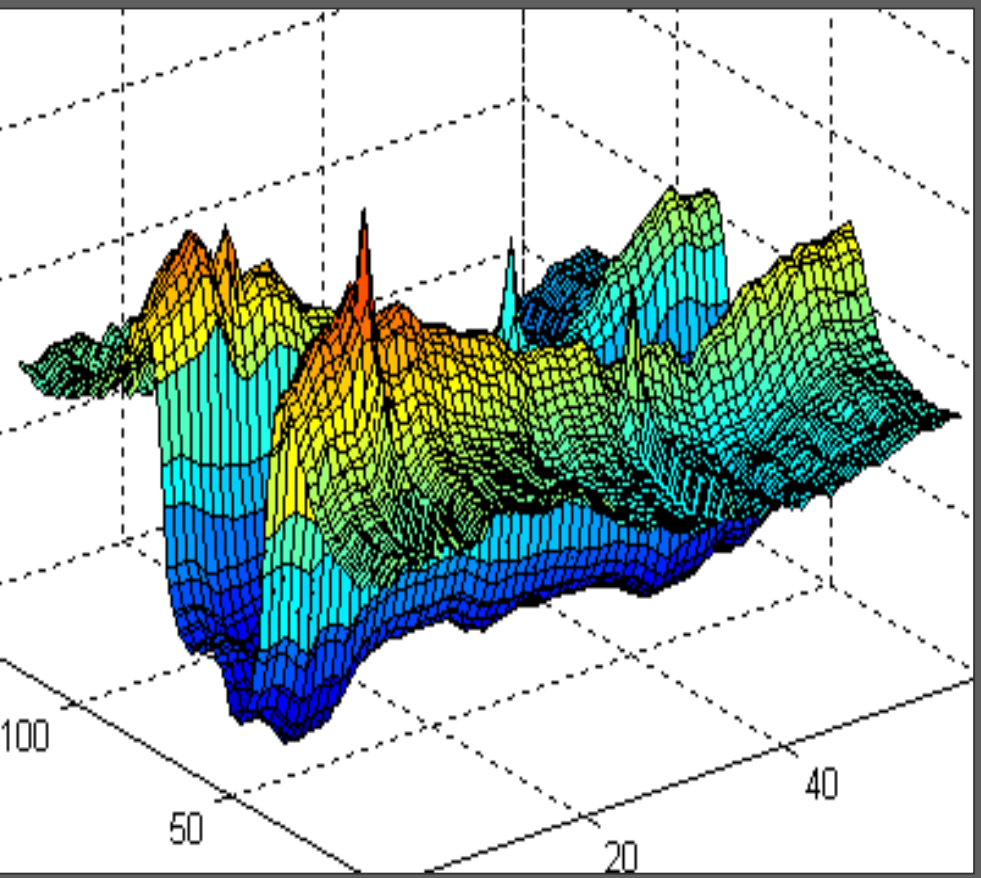
Avg. Rut- 9.4 mm

14000 Passes

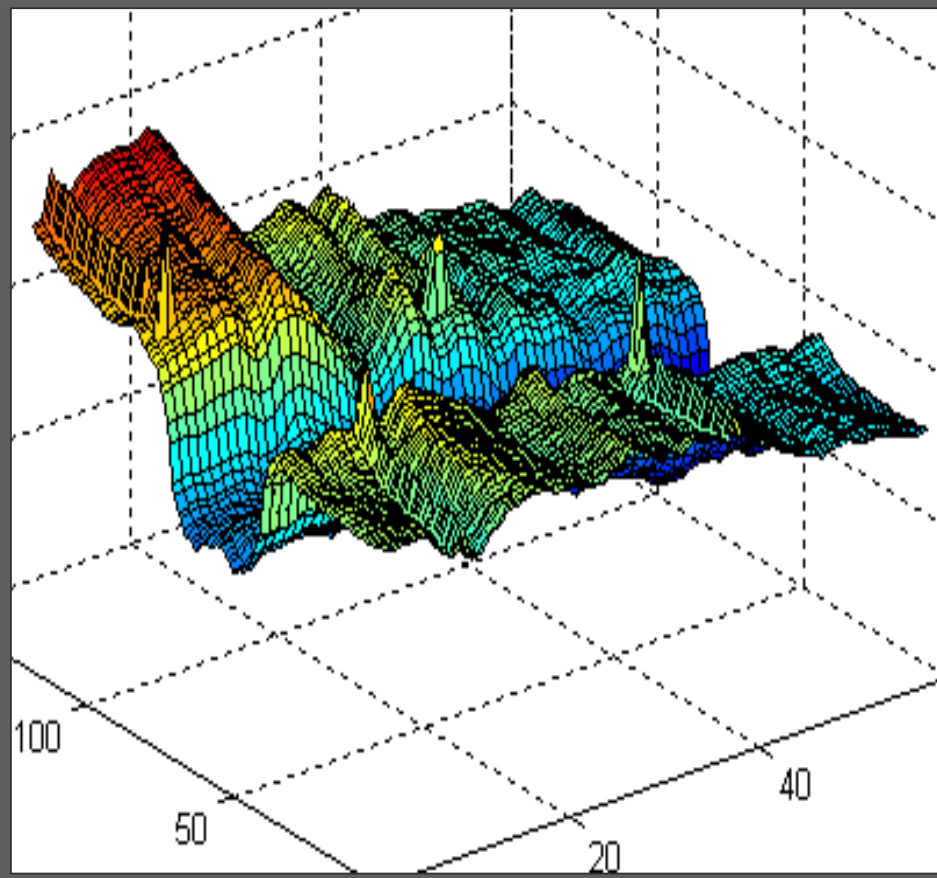
Avg. Rut- 4.7 mm

Modified vs. Unmodified Rut Progression

Track 4A (Unmodified)



Track 1B (Modified)



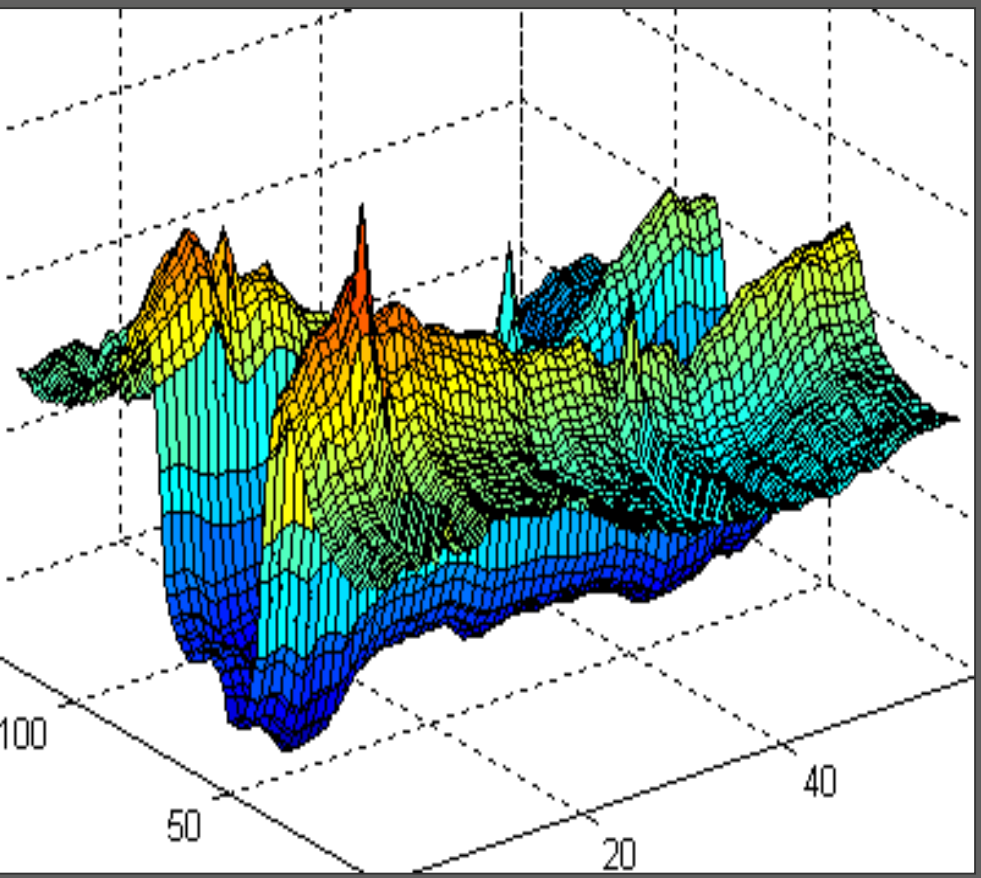
Avg. Rut- 9.7 mm

16000 Passes

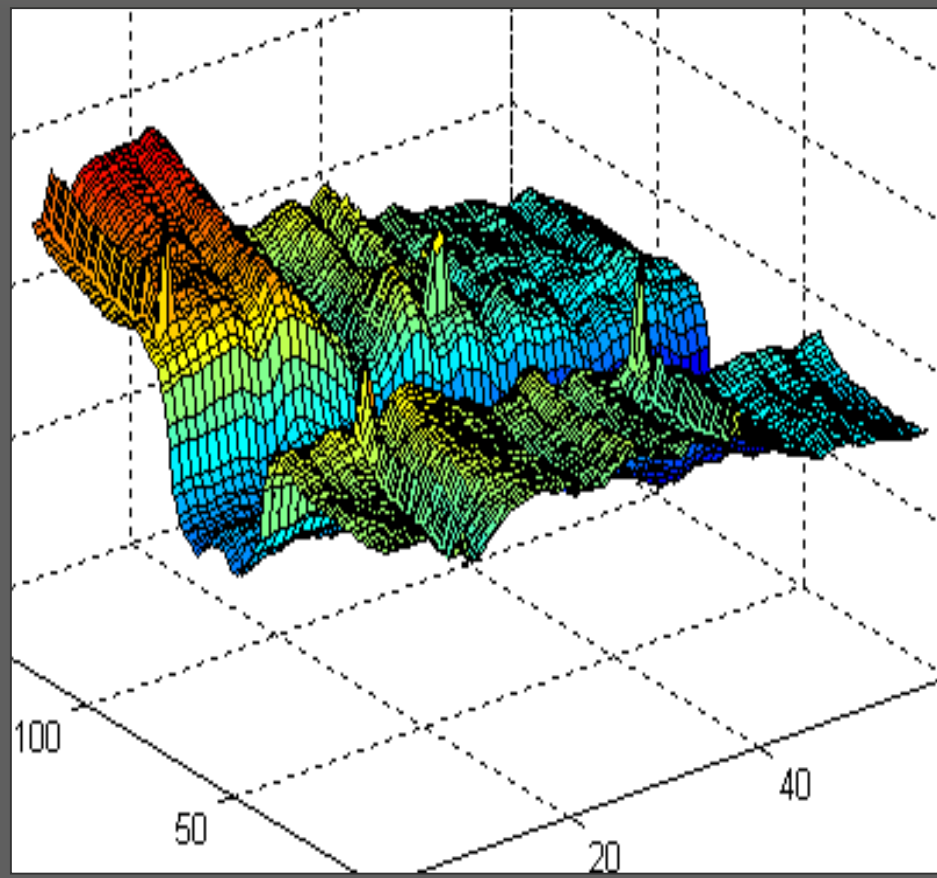
Avg. Rut- 4.8 mm

Modified vs. Unmodified Rut Progression

Track 4A (Unmodified)



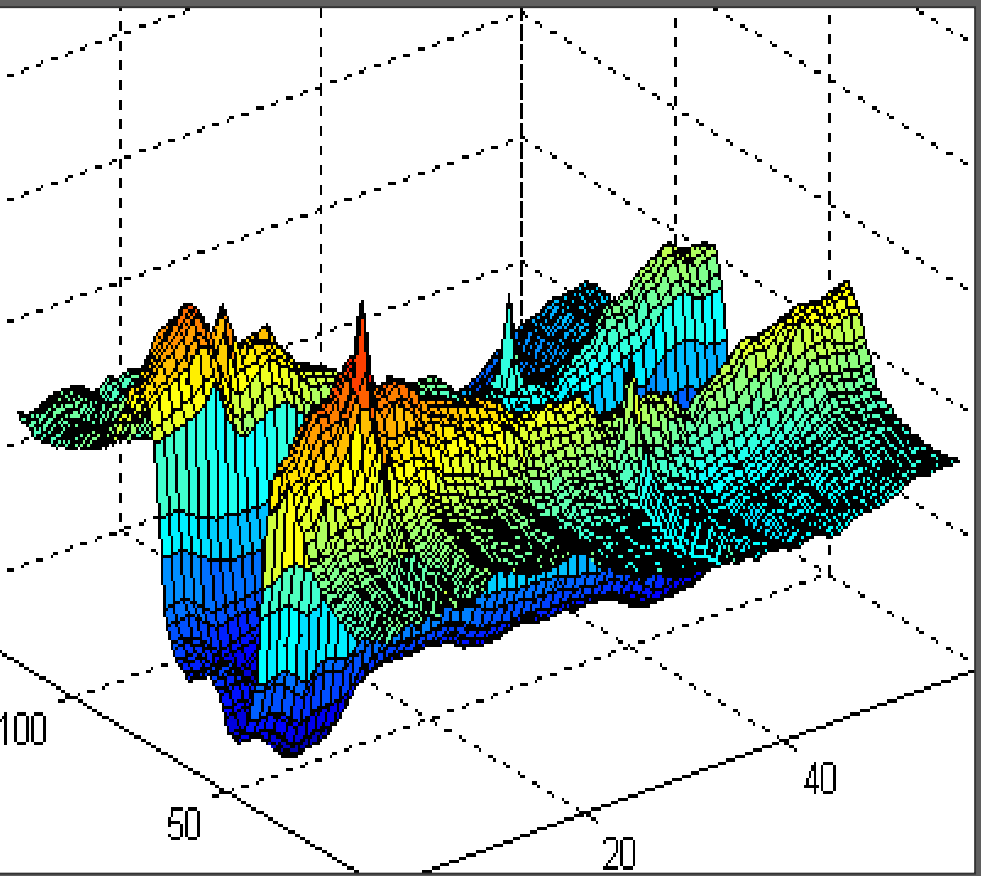
Track 1B (Modified)



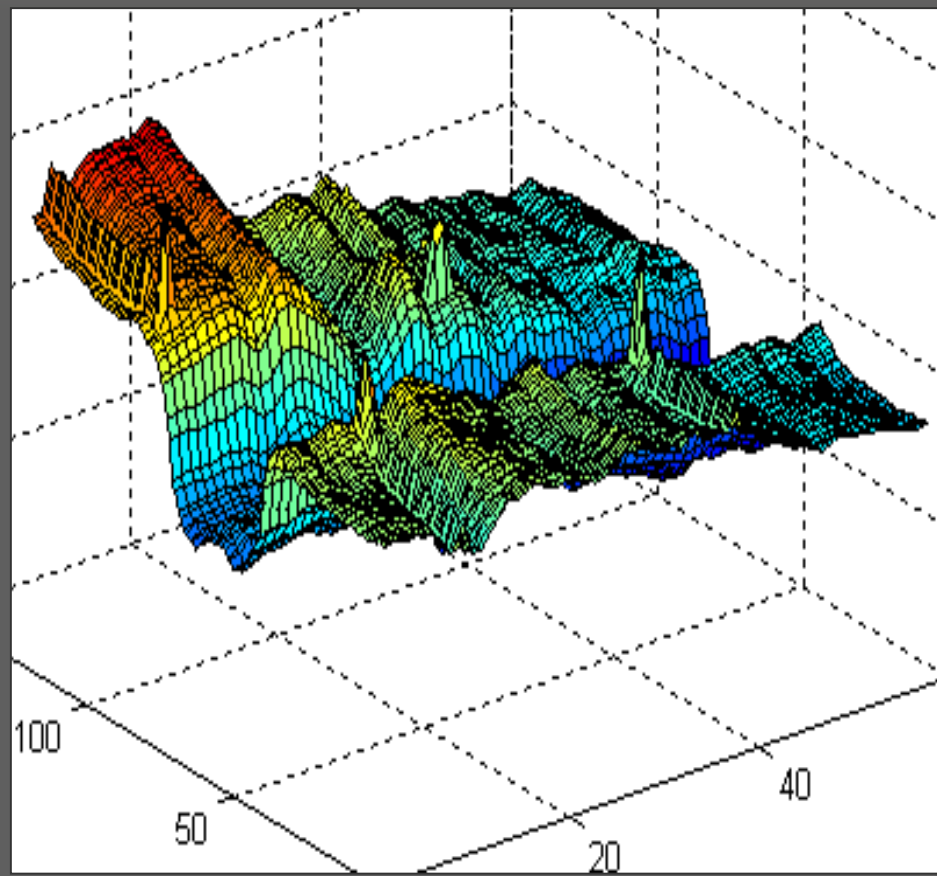
Avg. Rut- 10.0 mm 18000 Passes **Avg. Rut- 5.0 mm**

Modified vs. Unmodified Rut Progression

Track 4A (Unmodified)



Track 1B (Modified)

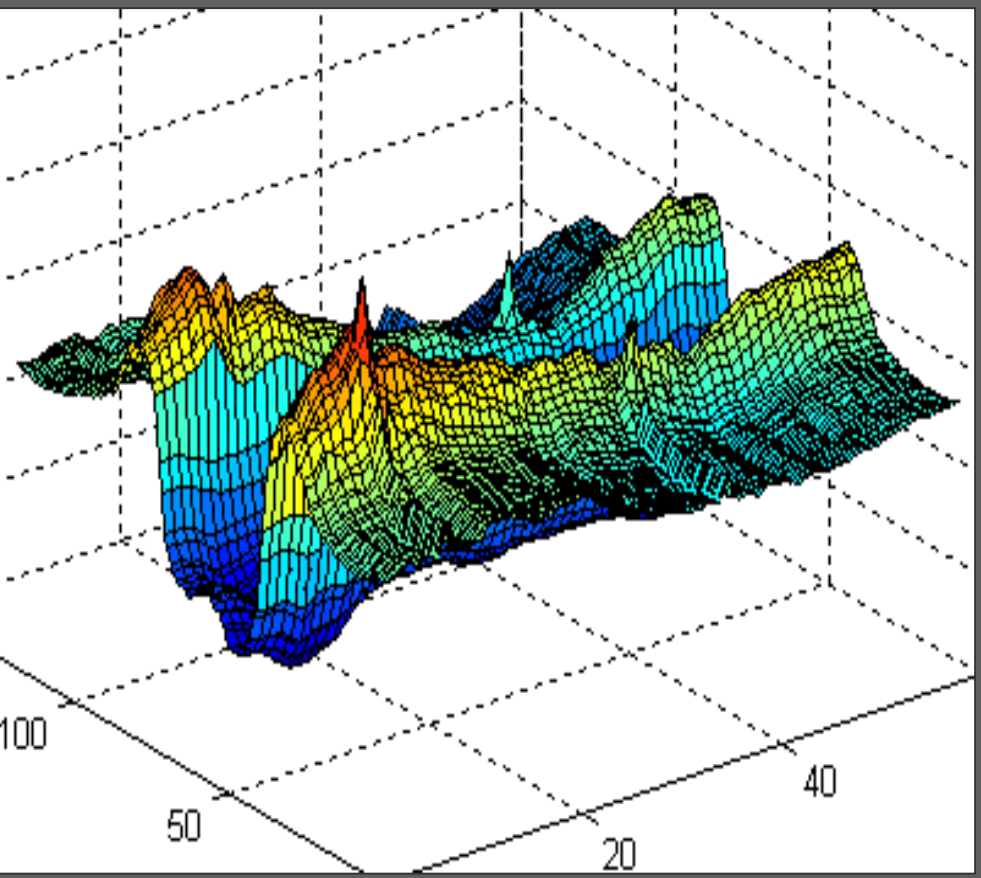


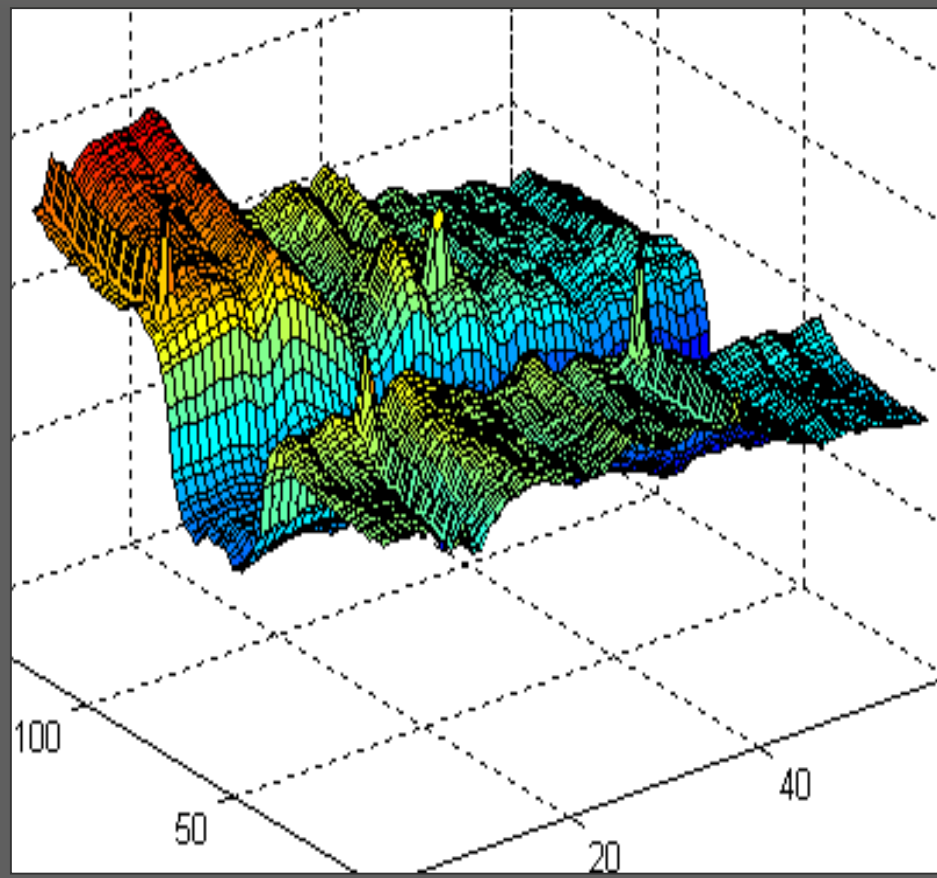
Avg. Rut- 10.3 mm 20000 Passes **Avg. Rut- 5.1 mm**

Modified vs. Unmodified Rut Progression

Track 4A (Unmodified)

Track 1B (Modified)

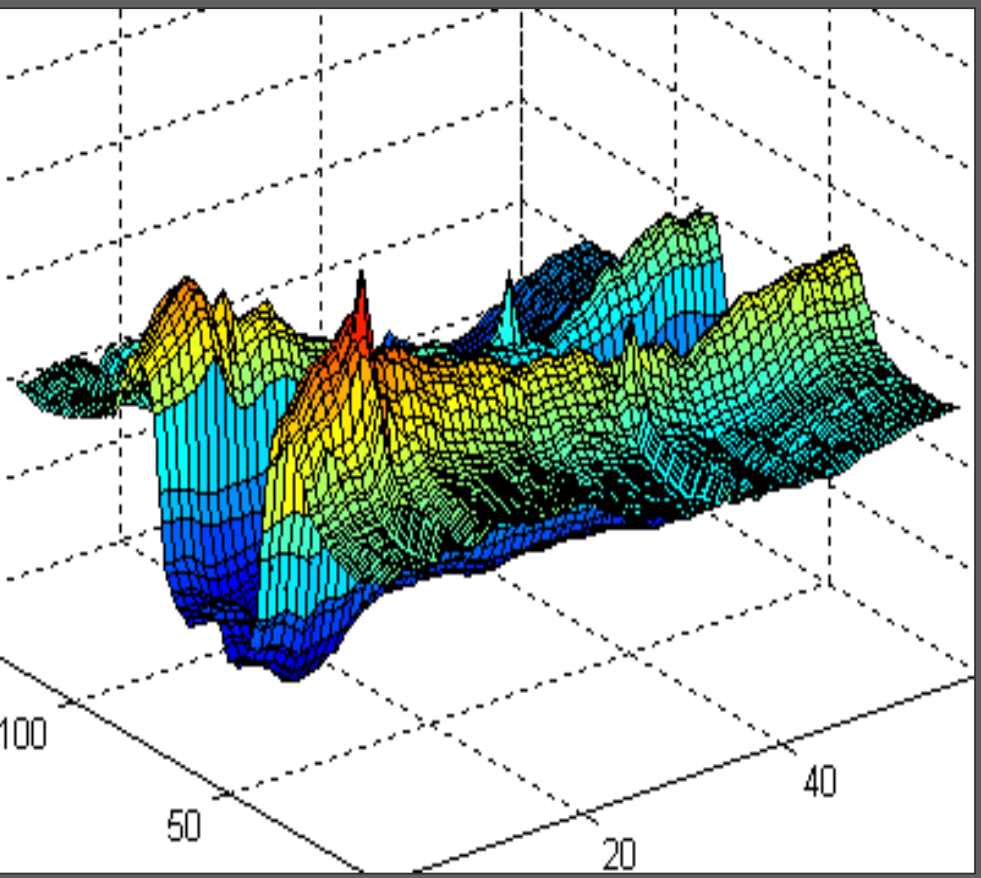




Avg. Rut- 10.9 mm 24000 Passes **Avg. Rut- 5.3 mm**

Modified vs. Unmodified Rut Progression

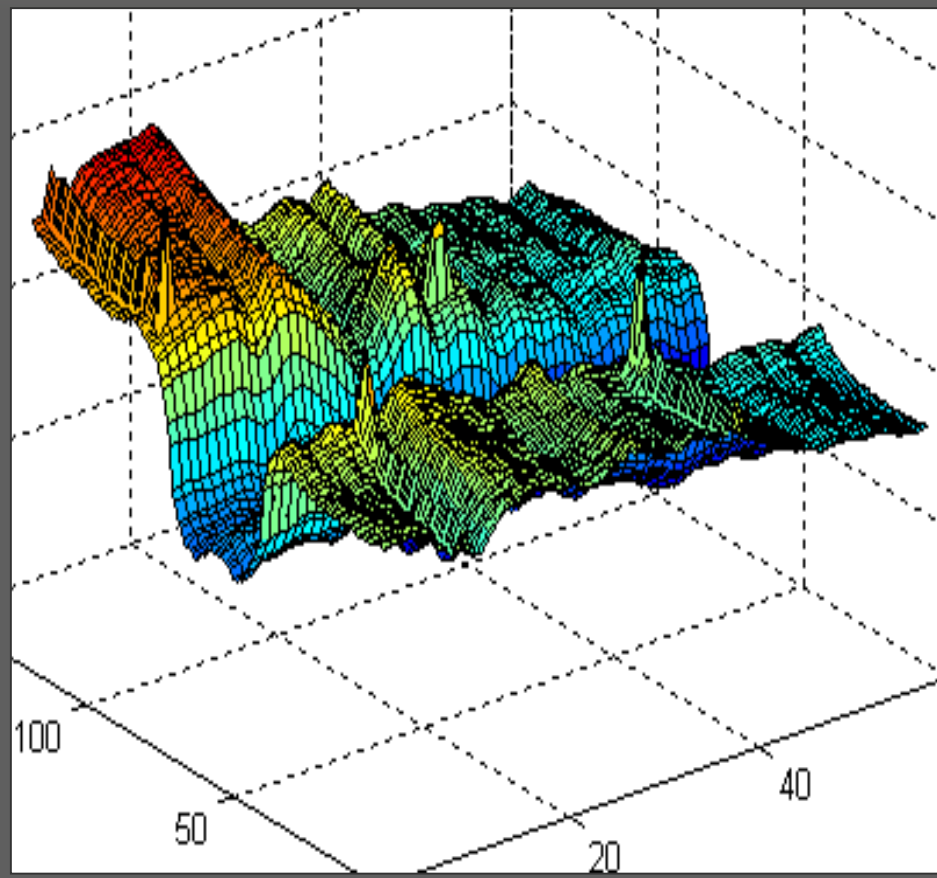
Track 4A (Unmodified)



Avg. Rut- 11.5 mm

28000 Passes

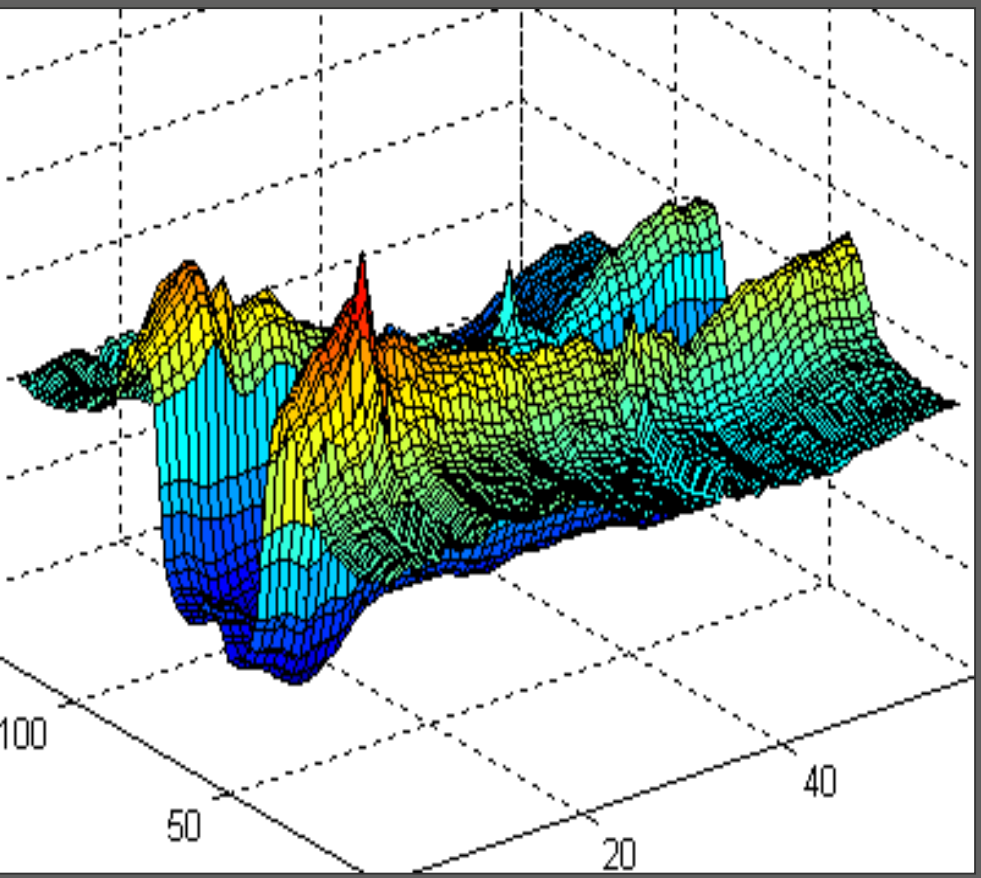
Track 1B (Modified)



Avg. Rut- 5.4 mm

Modified vs. Unmodified Rut Progression

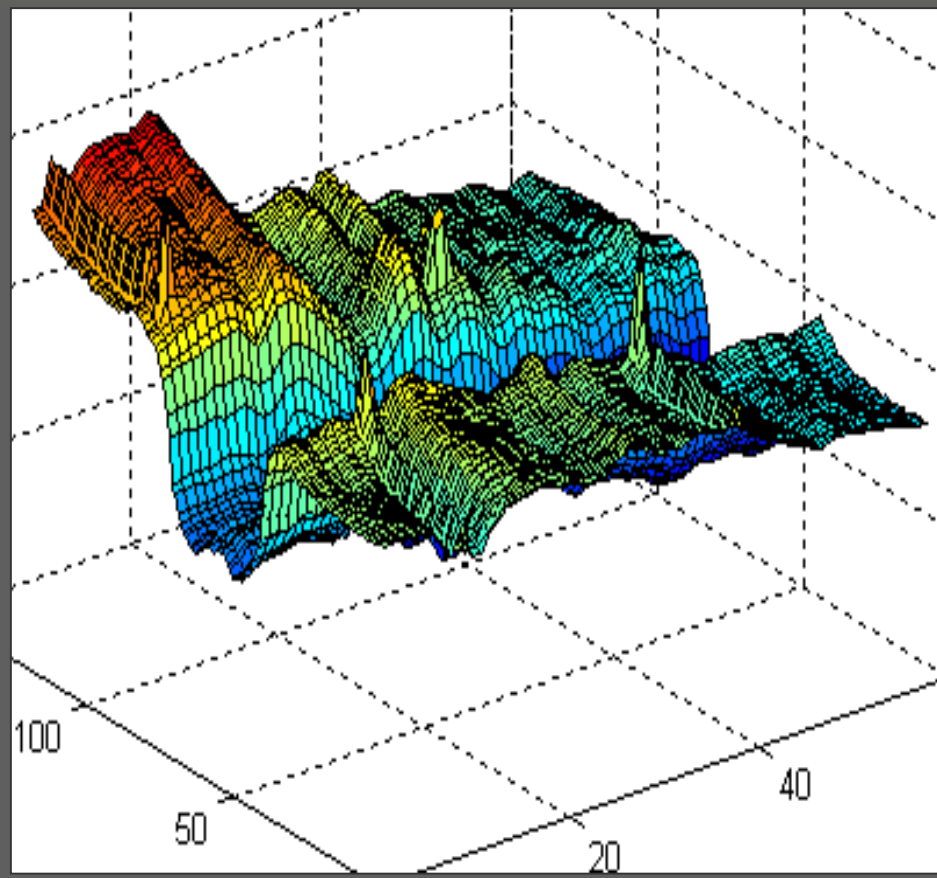
Track 4A (Unmodified)



Avg. Rut- 12.0 mm

32000 Passes

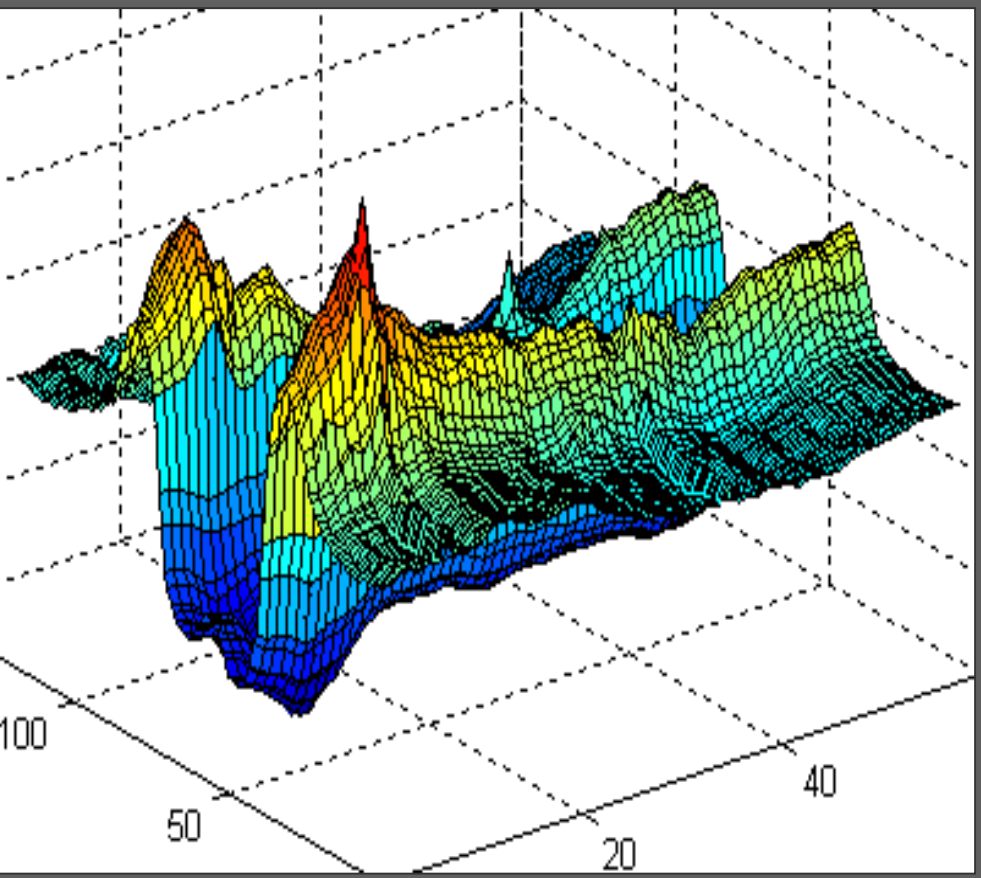
Track 1B (Modified)



Avg. Rut- 5.6 mm

Modified vs. Unmodified Rut Progression

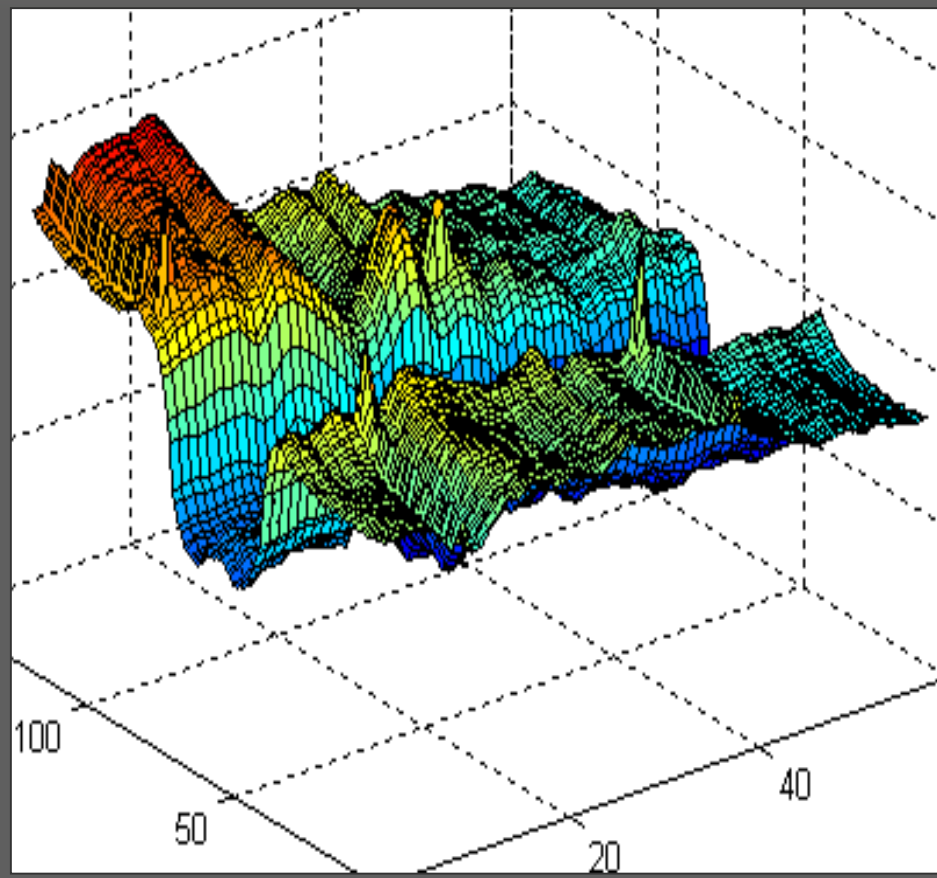
Track 4A (Unmodified)



Avg. Rut- 13.6 mm

50000 Passes

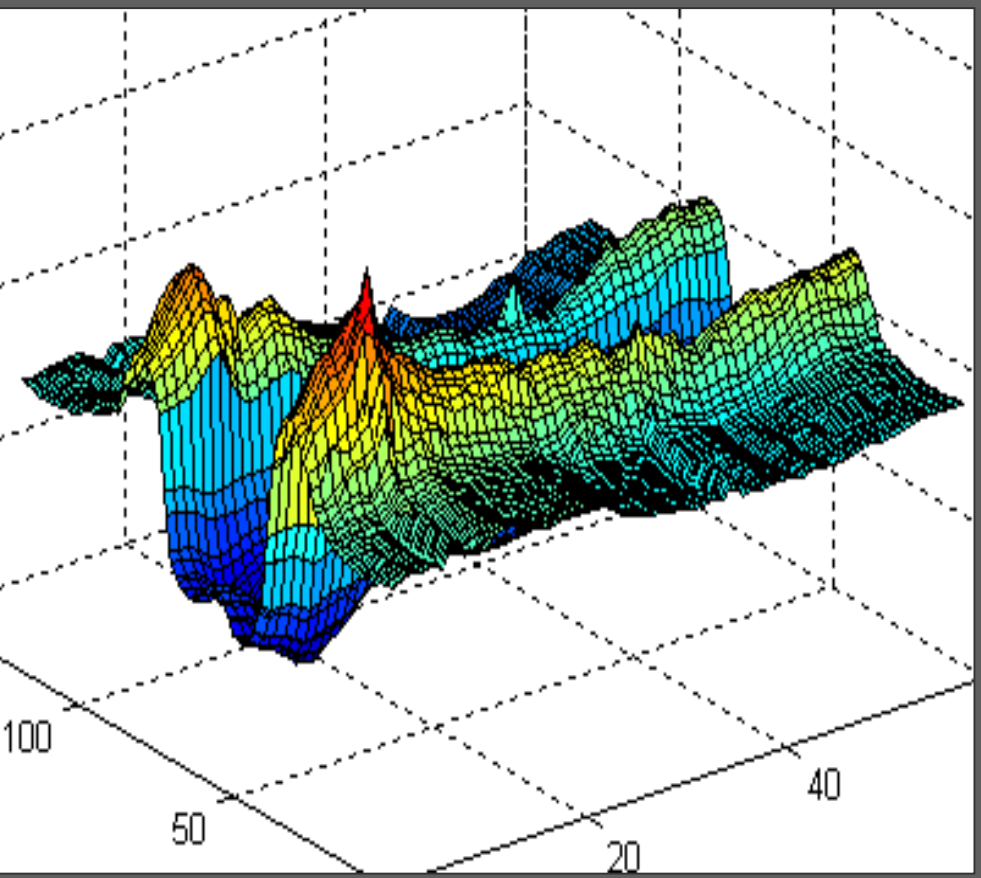
Track 1B (Modified)



Avg. Rut- 6.2 mm

Modified vs. Unmodified Rut Progression

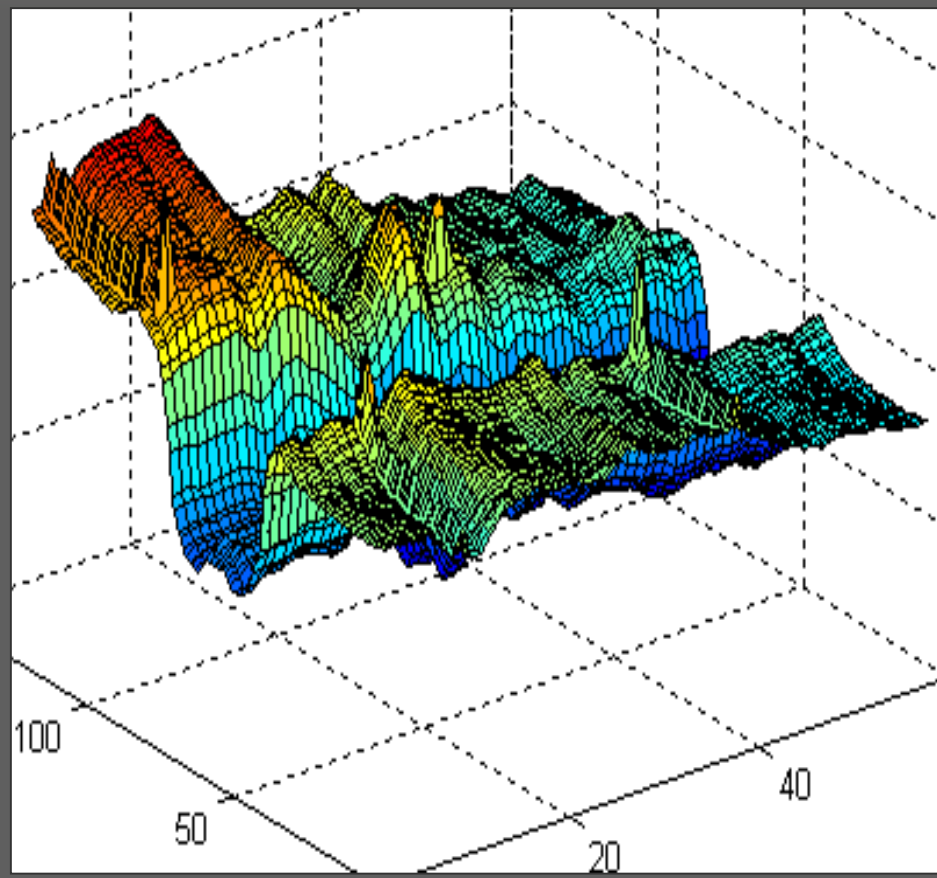
Track 4A (Unmodified)



Avg. Rut- 14.1 mm

55000 Passes

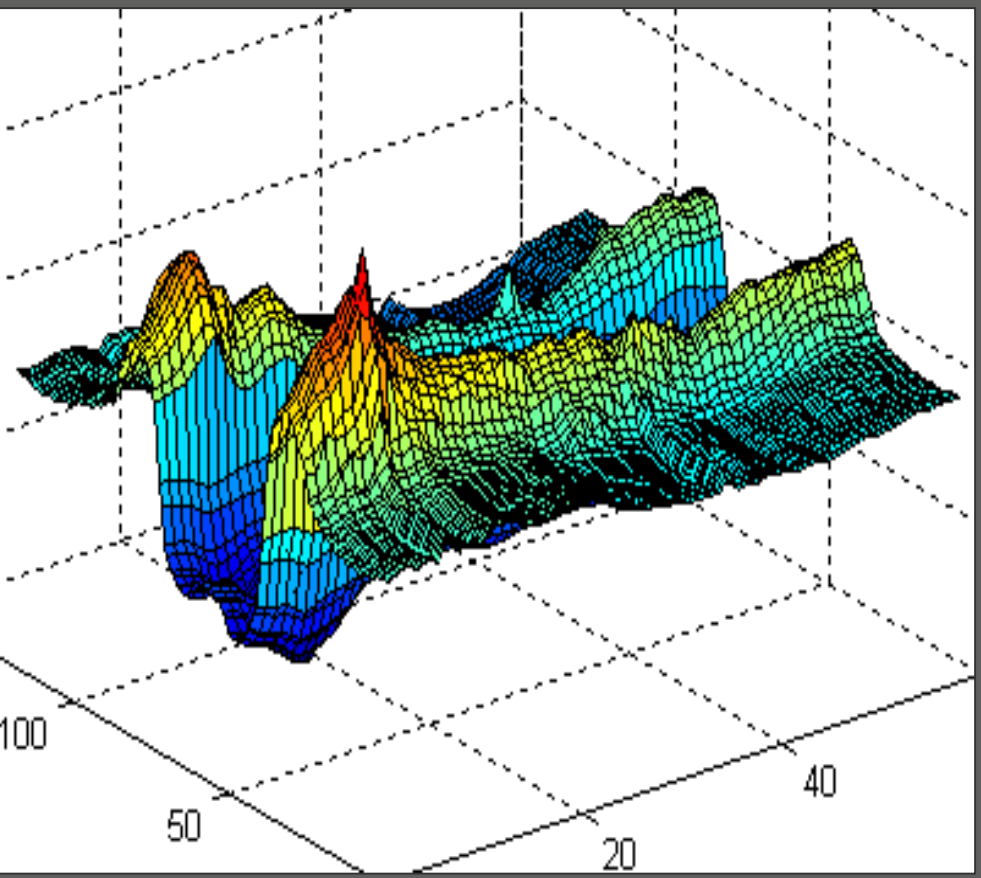
Track 1B (Modified)



Avg. Rut- 6.3 mm

Modified vs. Unmodified Rut Progression

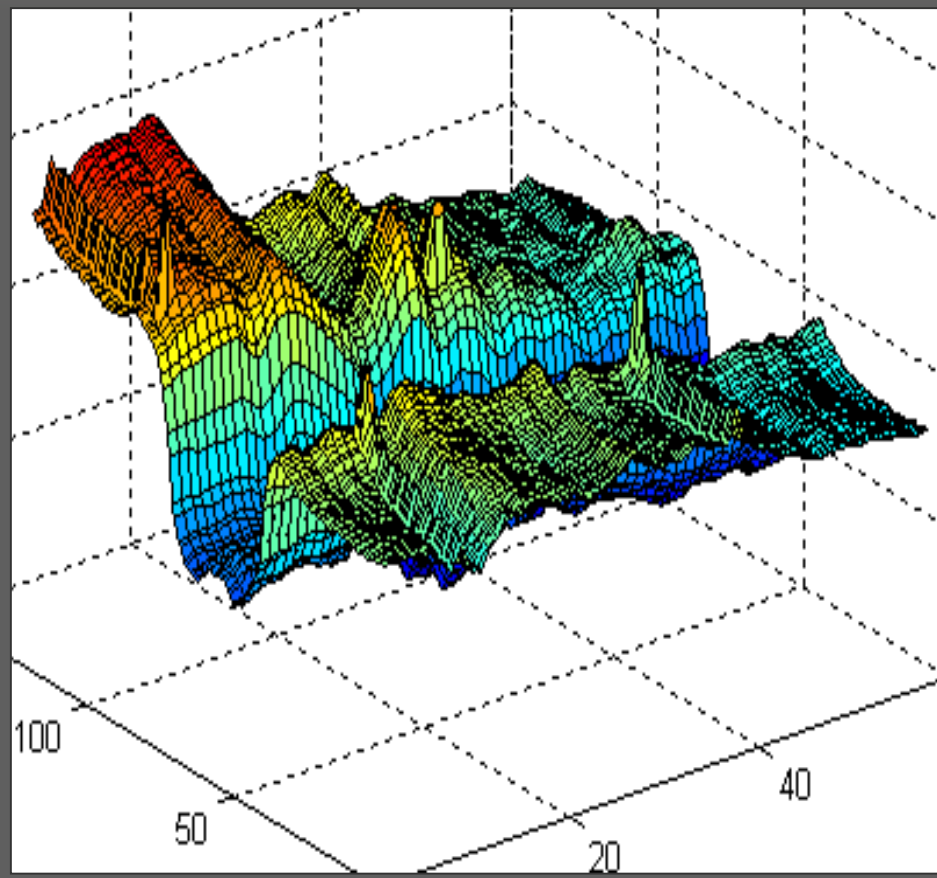
Track 4A (Unmodified)



Avg. Rut- 14.6 mm

60000 Passes

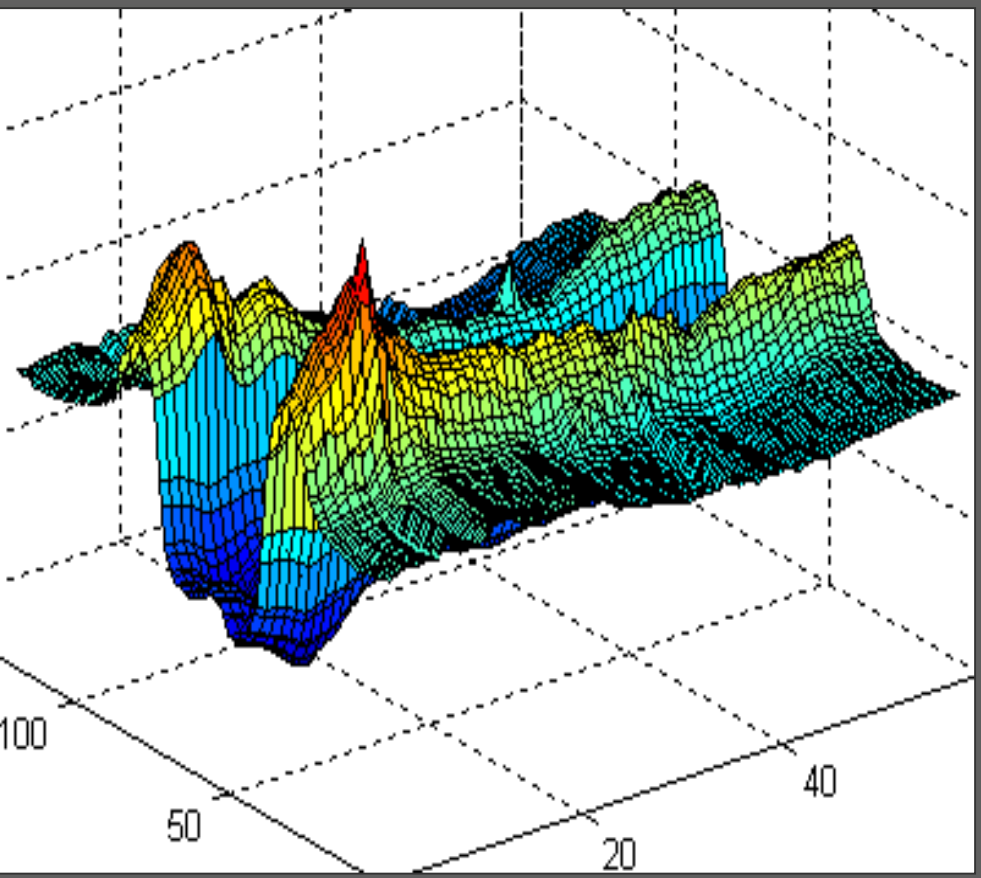
Track 1B (Modified)



Avg. Rut- 6.5 mm

Modified vs. Unmodified Rut Progression

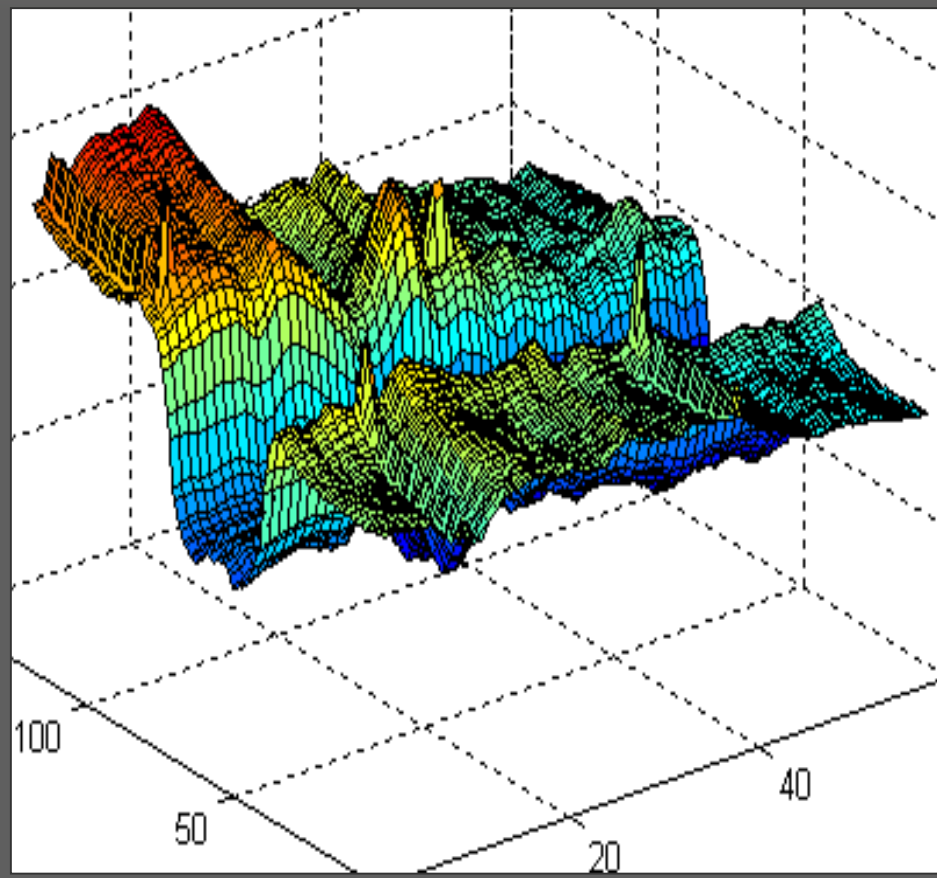
Track 4A (Unmodified)



Avg. Rut- 15.0 mm

65000 Passes

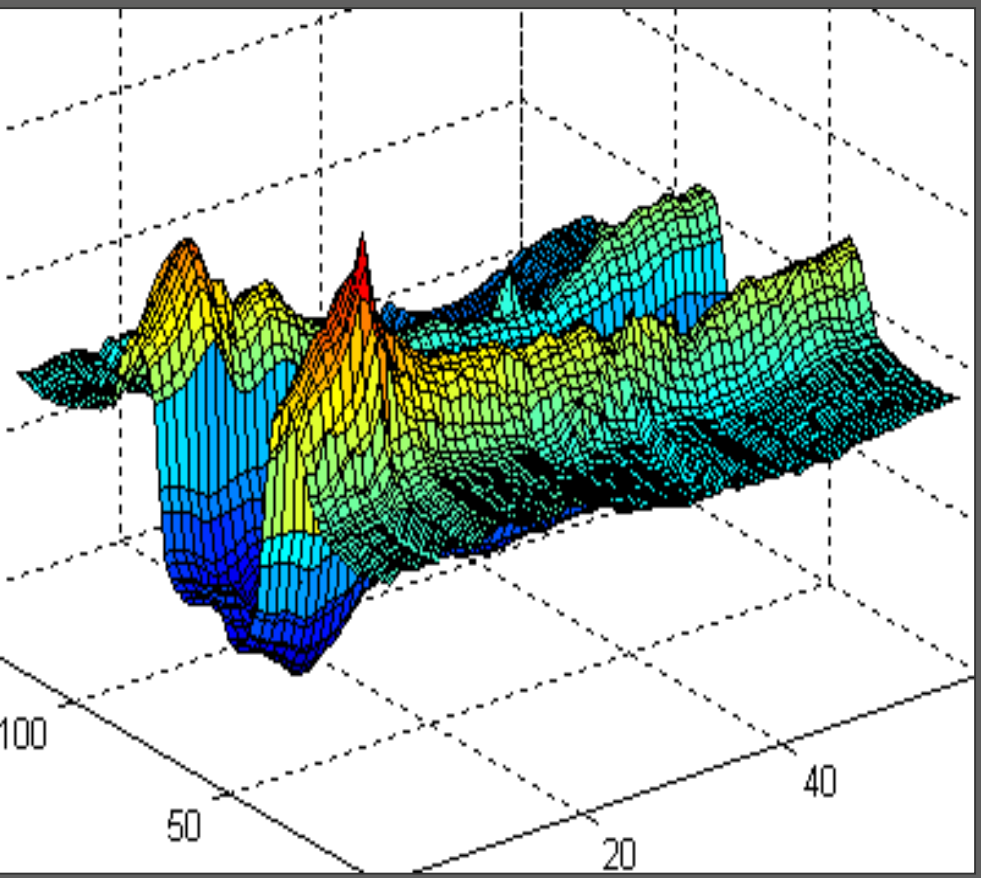
Track 1B (Modified)



Avg. Rut- 6.6 mm

Modified vs. Unmodified Rut Progression

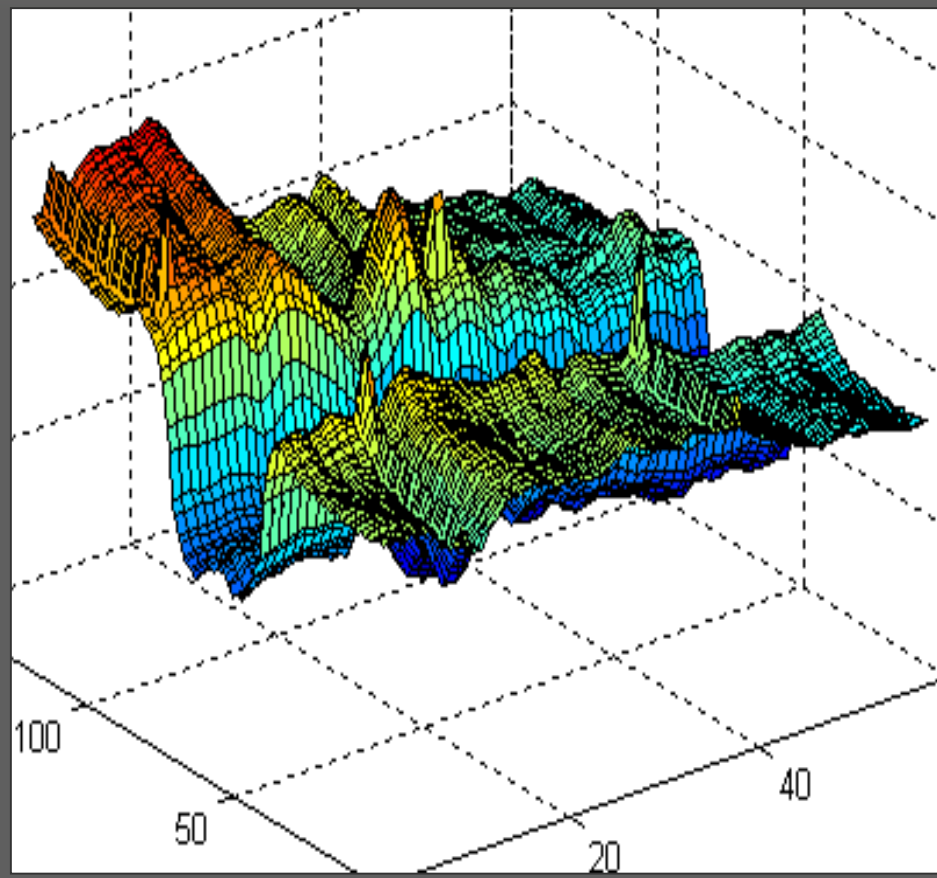
Track 4A (Unmodified)



Avg. Rut- 15.3 mm

70000 Passes

Track 1B (Modified)



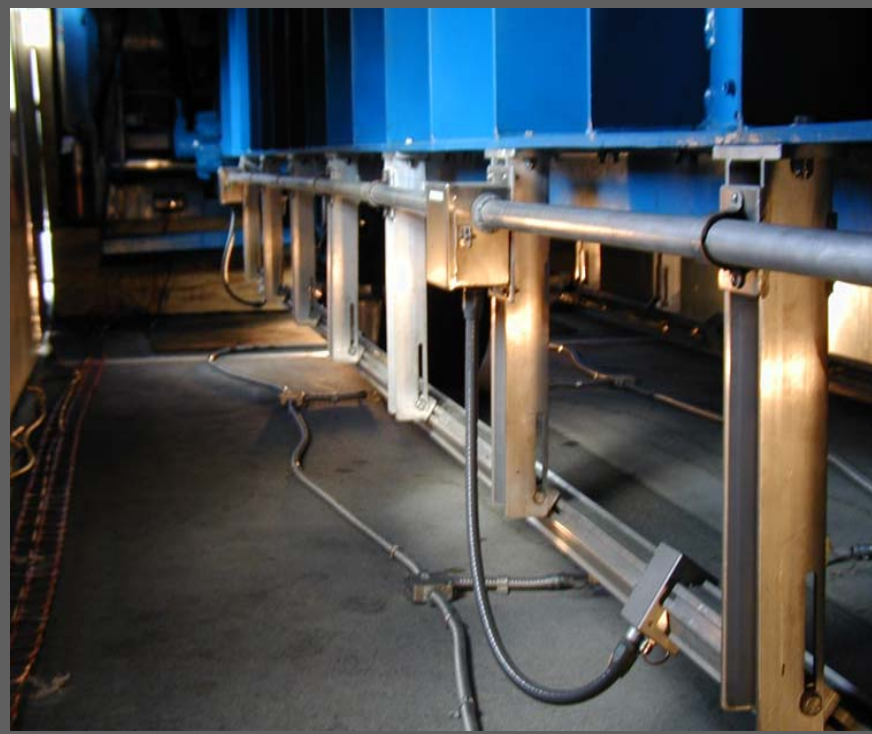
Avg. Rut- 6.7 mm

ENVIRONMENTAL CHAMBER

- 2” thick Styrofoam w/ aluminum sheeting
- Windows & doors provided
- Easily removable

HEATING SYSTEM

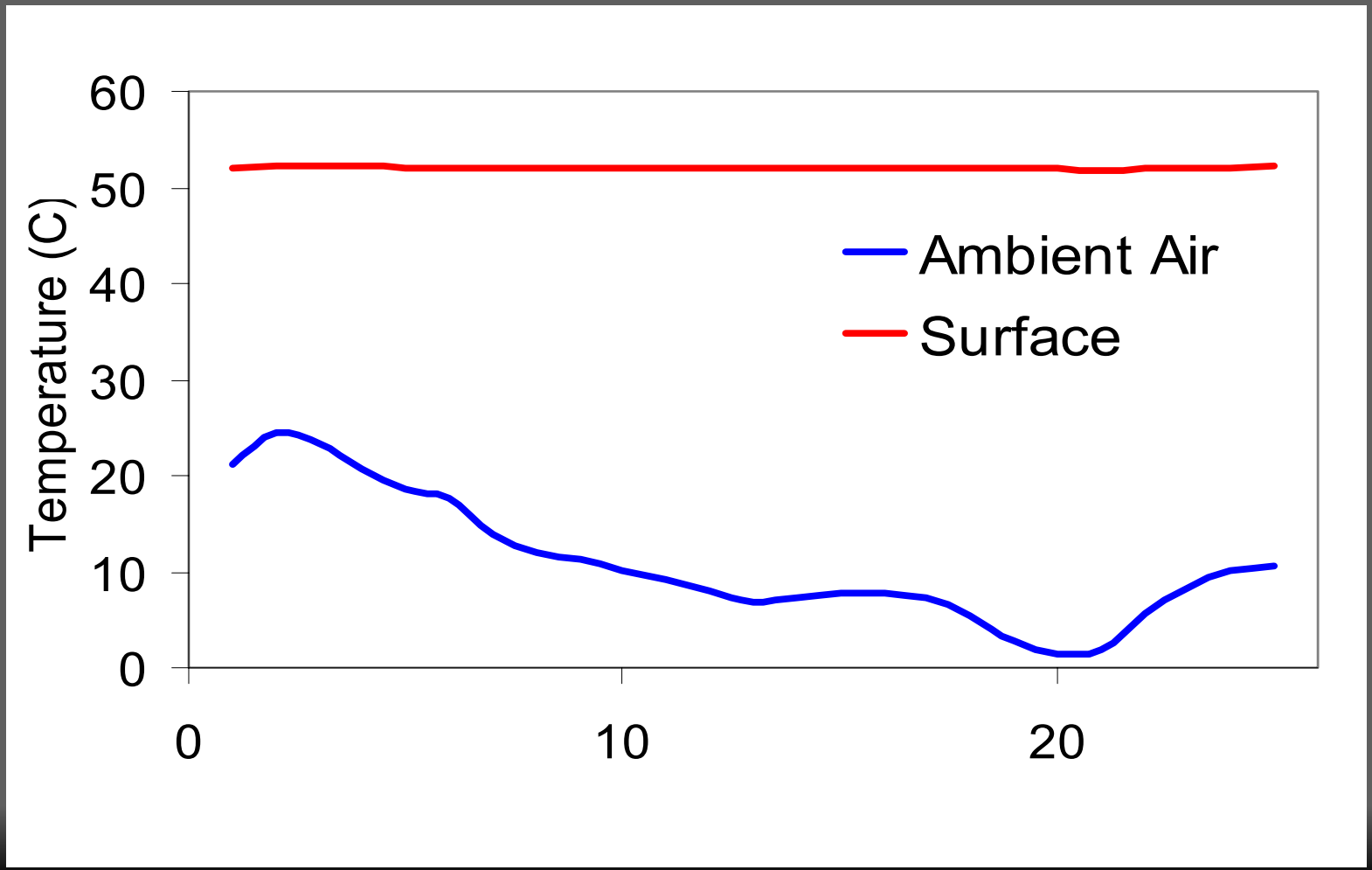
- 6 elements, 9 ft long, attached to HVS test beam & moving transversely with beam.
- Independently controlled to provide 6 heating zones.
- Powered by 480 VAC, rated at 7,500 Watts each, 65 Amp total current draw.



Heater Control Unit

- 6 independent microprocessor controllers.
- Input either from front panel inputs or remotely via PC.
- Control unit mounted on HVS superstructure.

SYSTEM PERFORMANCE



INITIAL EXPERIMENTS

SBS modifier

Binders:

- PG 67-22
- PG 76-22

SP 12.5 fine graded mixes

Concrete Test Tracks

INSTRUMENTATION

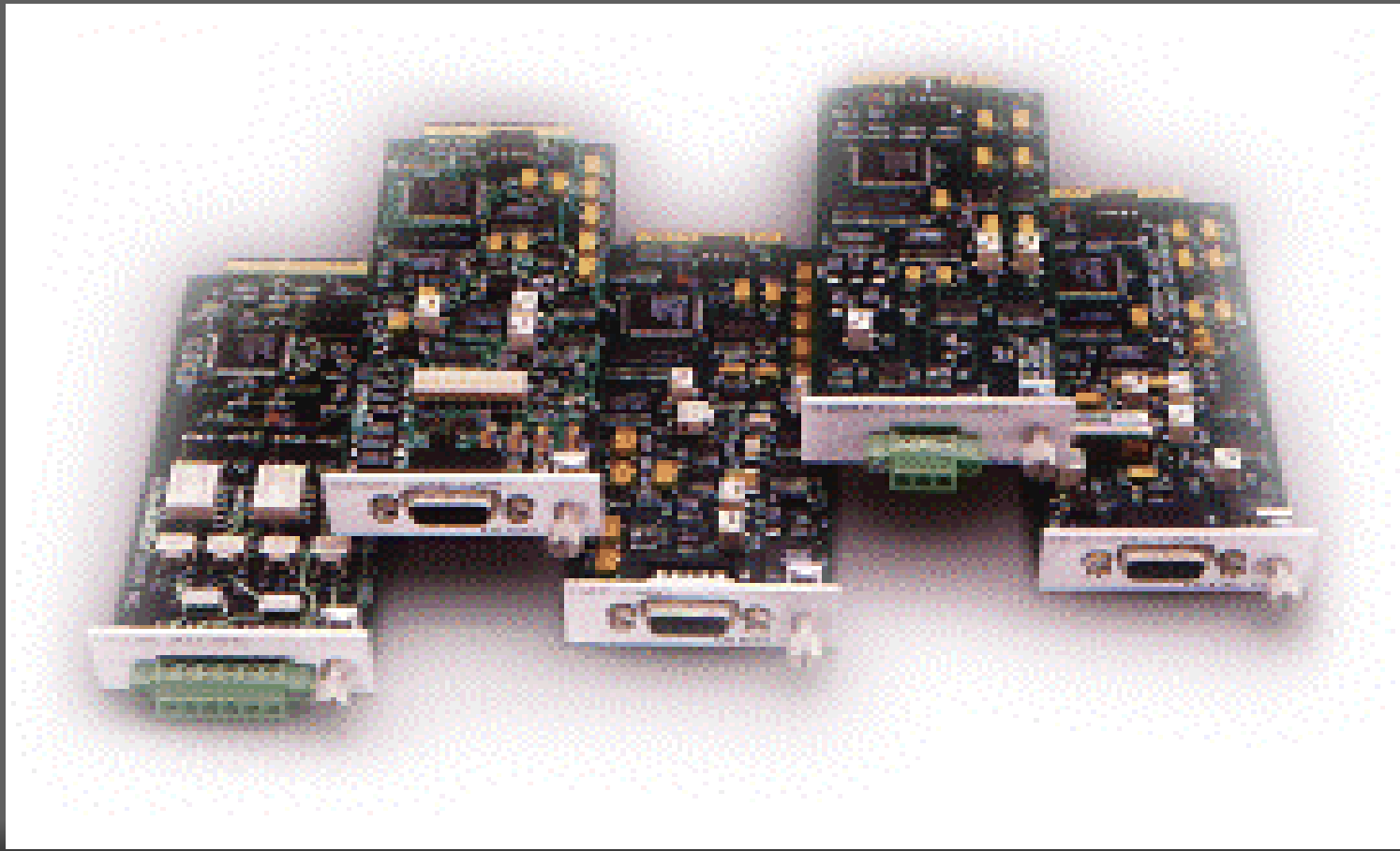
External Data Acquisition System

- **Vishay Micro-Measurements Model 6100 Scanner**
  - Sample rate of up to 10K samples/second /channel
  - 20 available channels providing 200,000 samples/sec total throughput
  - Uses any combination of input cards for
    - Strain, Temperature, Displacement, Piezoelectric, Digital I/O, Digital/Tachometer

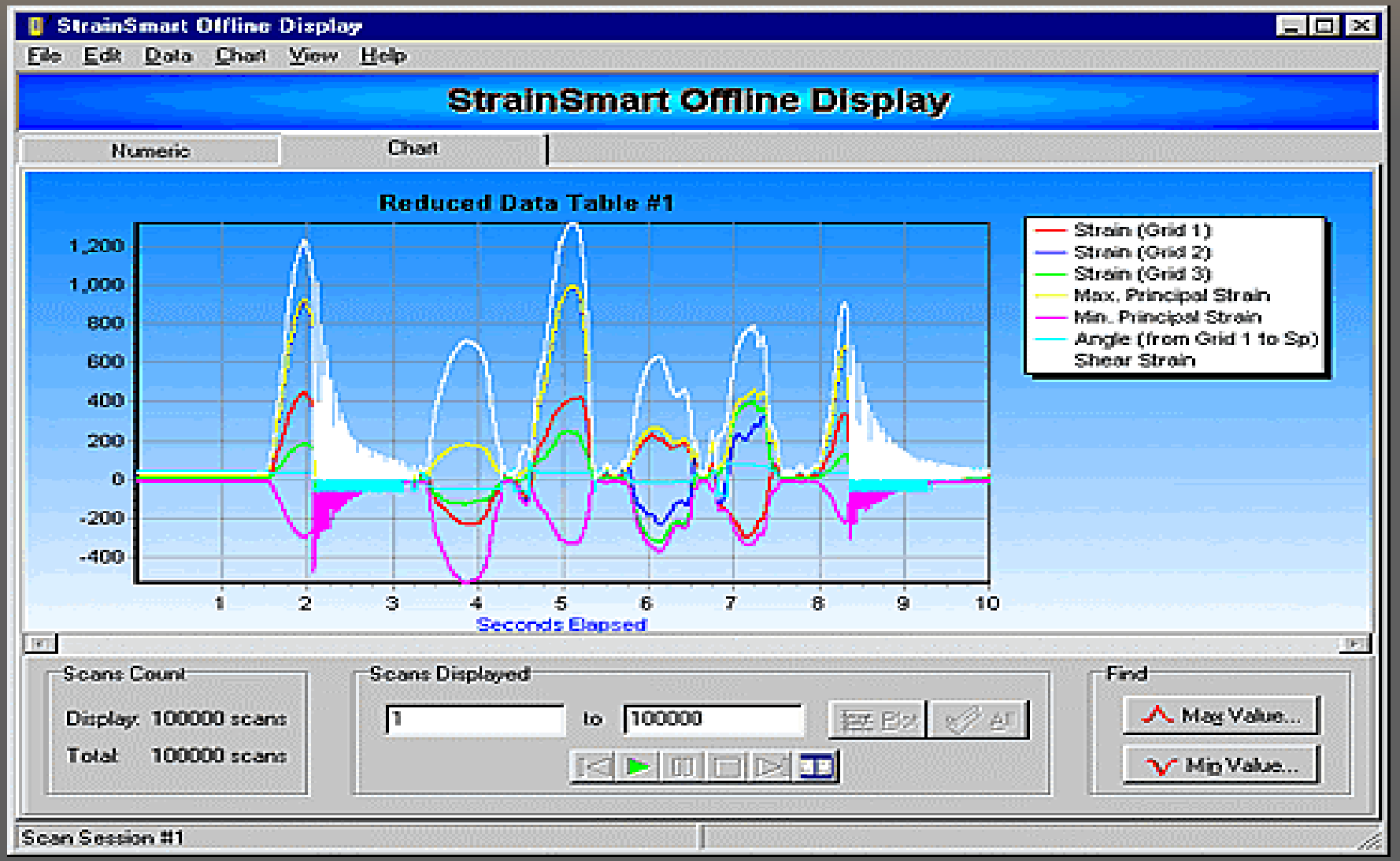
Vishay Model 6100 Scanner Front Panel

Vishay Model 6100 Scanner
Rear Card Deck

Vishay Input Cards



StrainSmart Display



Pavement Structure Instrumentation

- Strain Gages
- Thermocouples
- Displacement Transducers

Tokyo Sokki Strain Gage KM-100-HAS

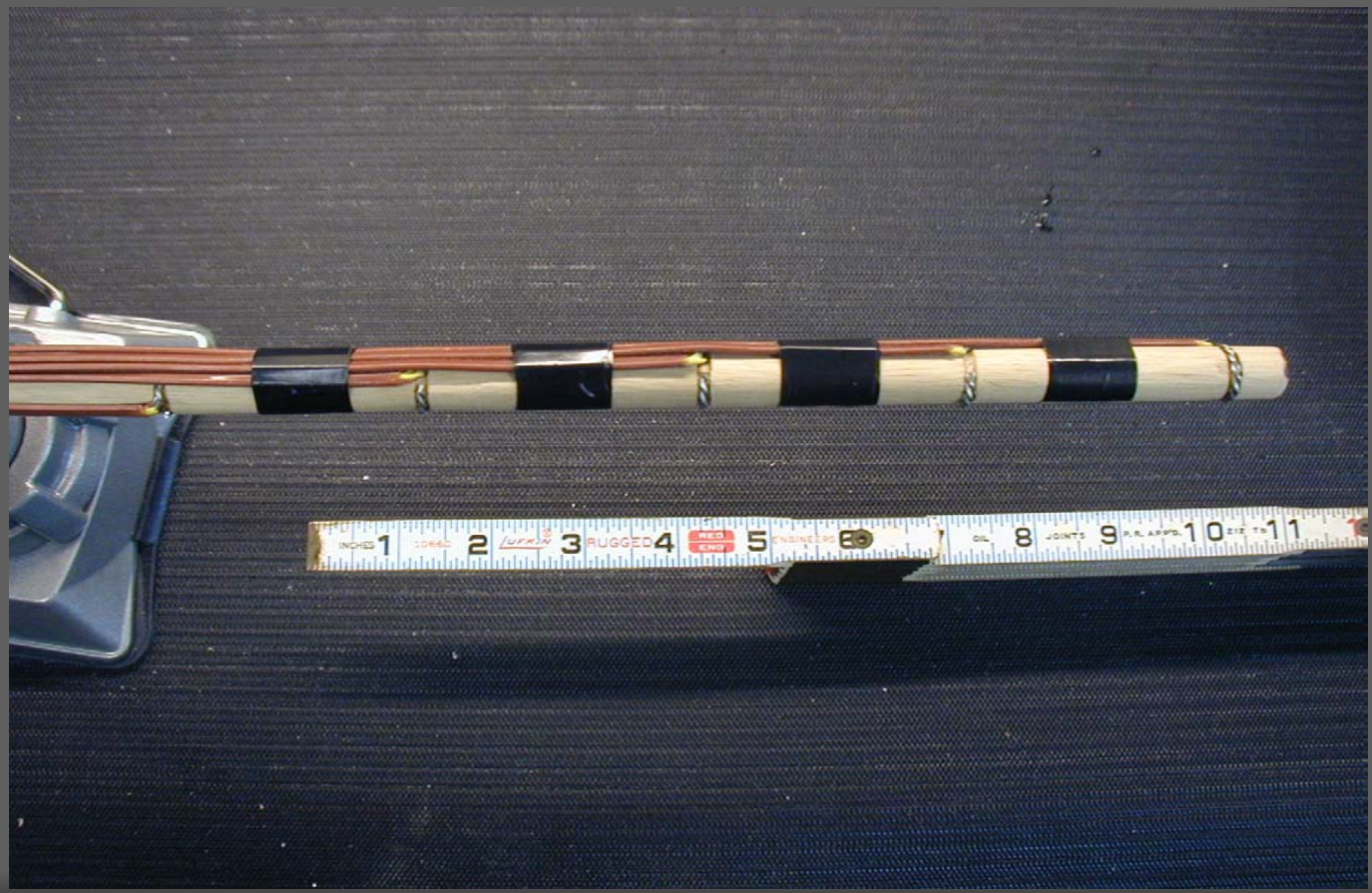
Evolving Thermocouple Installation Methods

- K-Type Thermocouple Sensors.
- Measured at surface, 50 mm and 100 mm deep.
- Initially used three, single point probe units
- Time consuming installation

Single Point System

Current Thermocouple System

Rigid Pavement Thermocouples



Displacement Sensors

EGP-Series Strain Gage - Concrete

Placement of strain gages

Portable Data Acquisition System

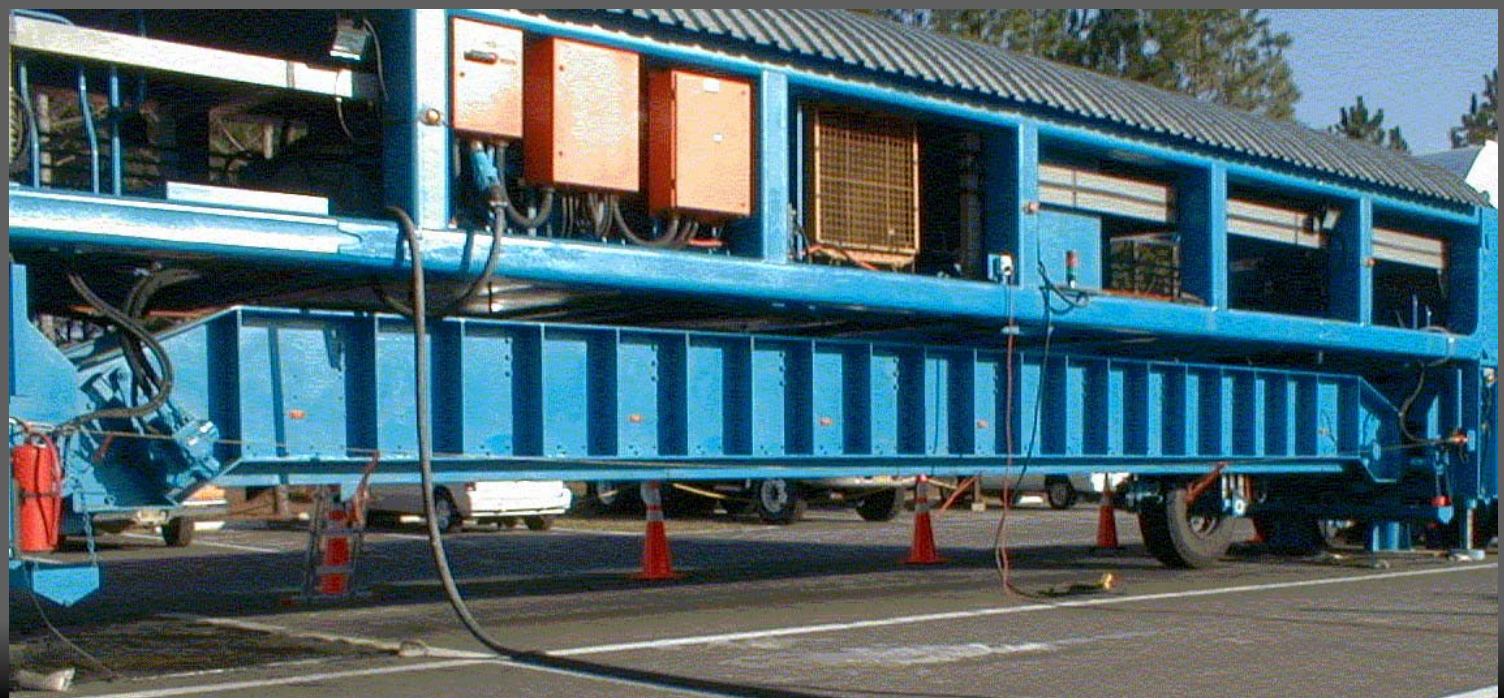
FINDINGS

LOADING CONFIGURATION ASSESSMENT

- Good Year G165 super-single tire
- Tire load of 9000 lbs
- Test speed of 8 mph
- Tire pressure of 112 psi

UNI-DIRECTIONAL LOADING

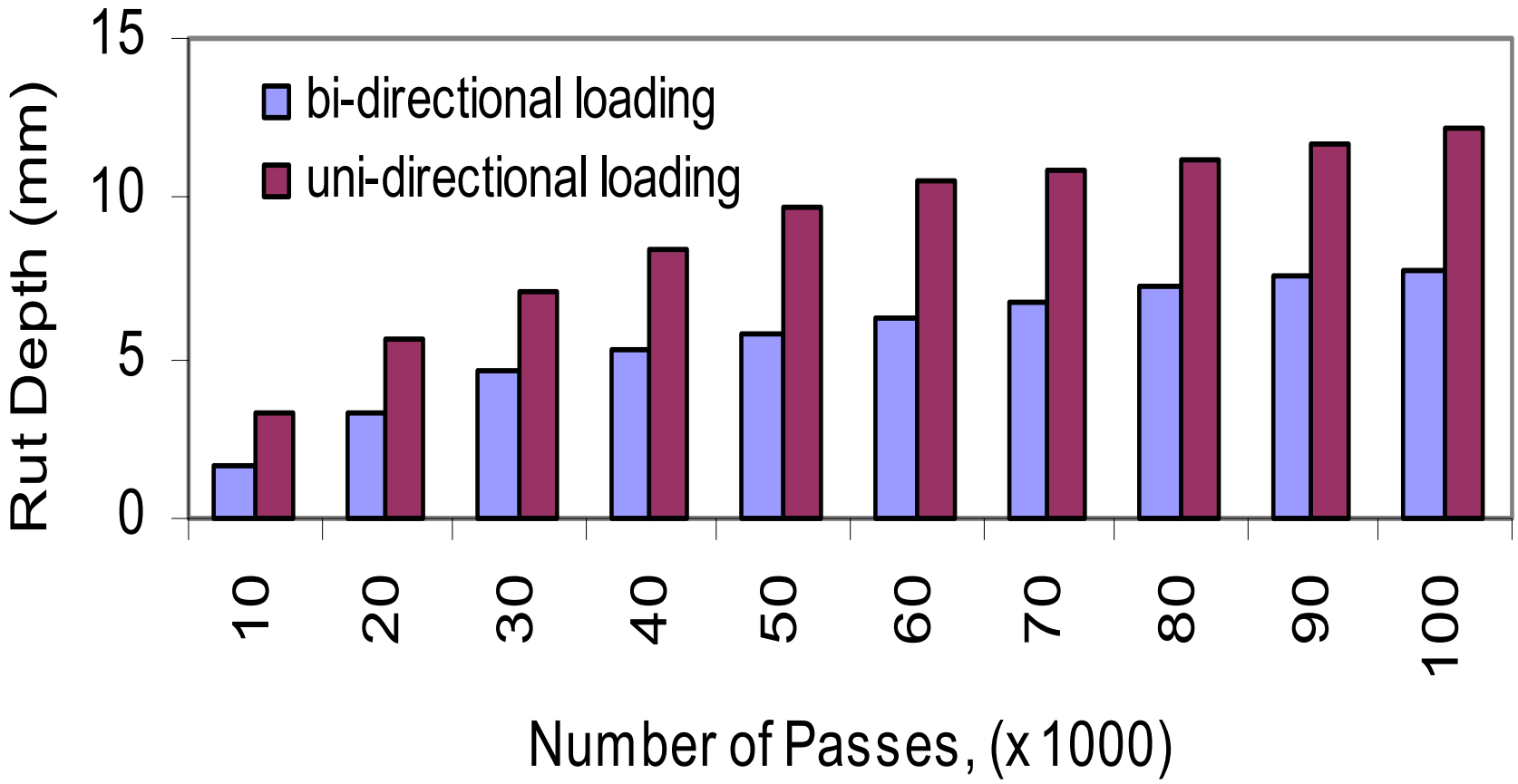
BI-DIRECTIONAL LOADING



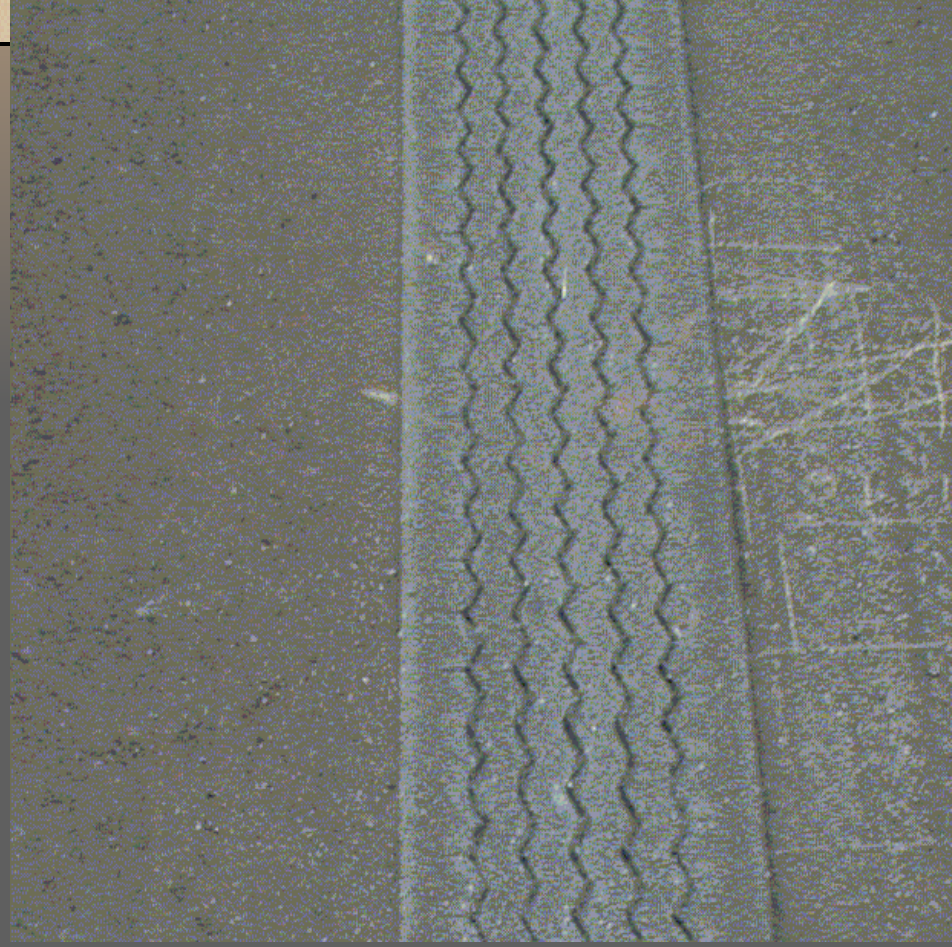
UNI-DIRECTIONAL w/ WANDER

BI-DIRECTIONAL w/ WANDER

RUT DEPTH – NO WANDER



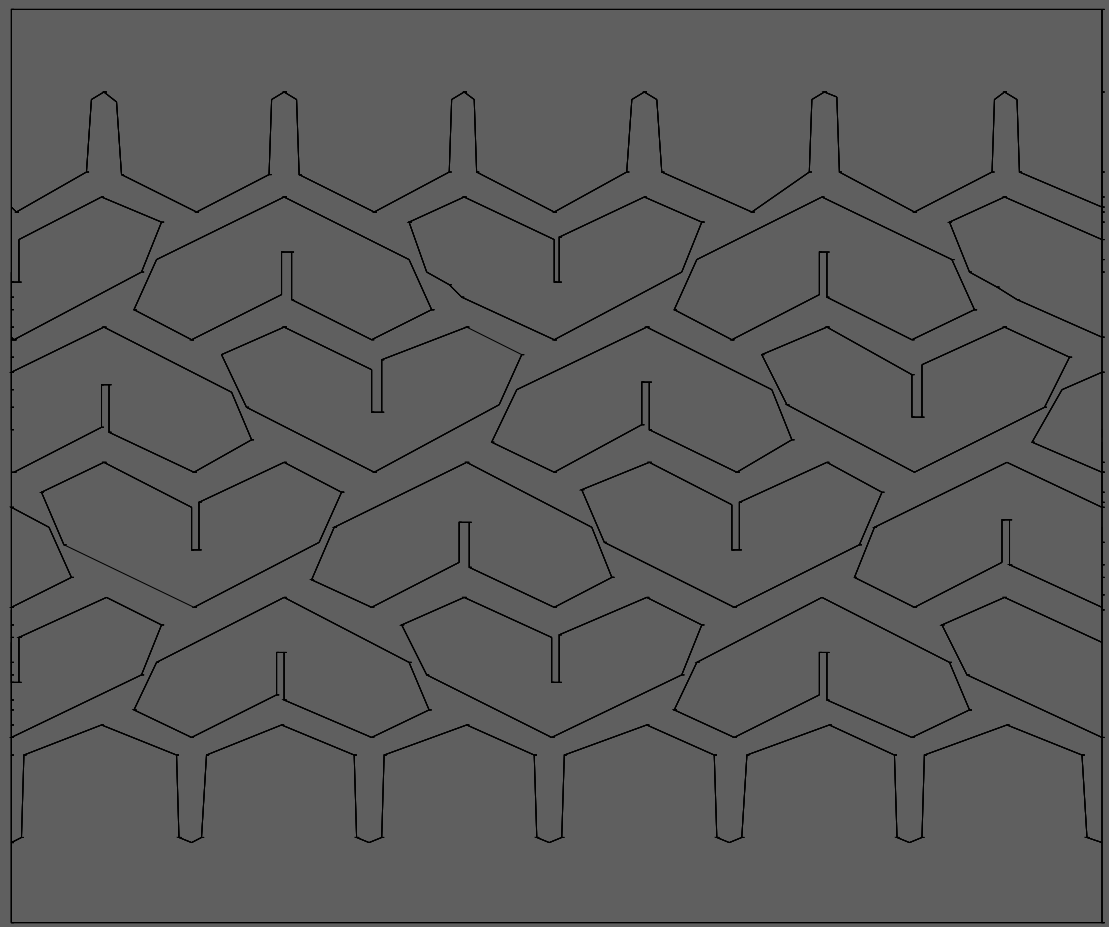
RUT ILLUSTRATIONS



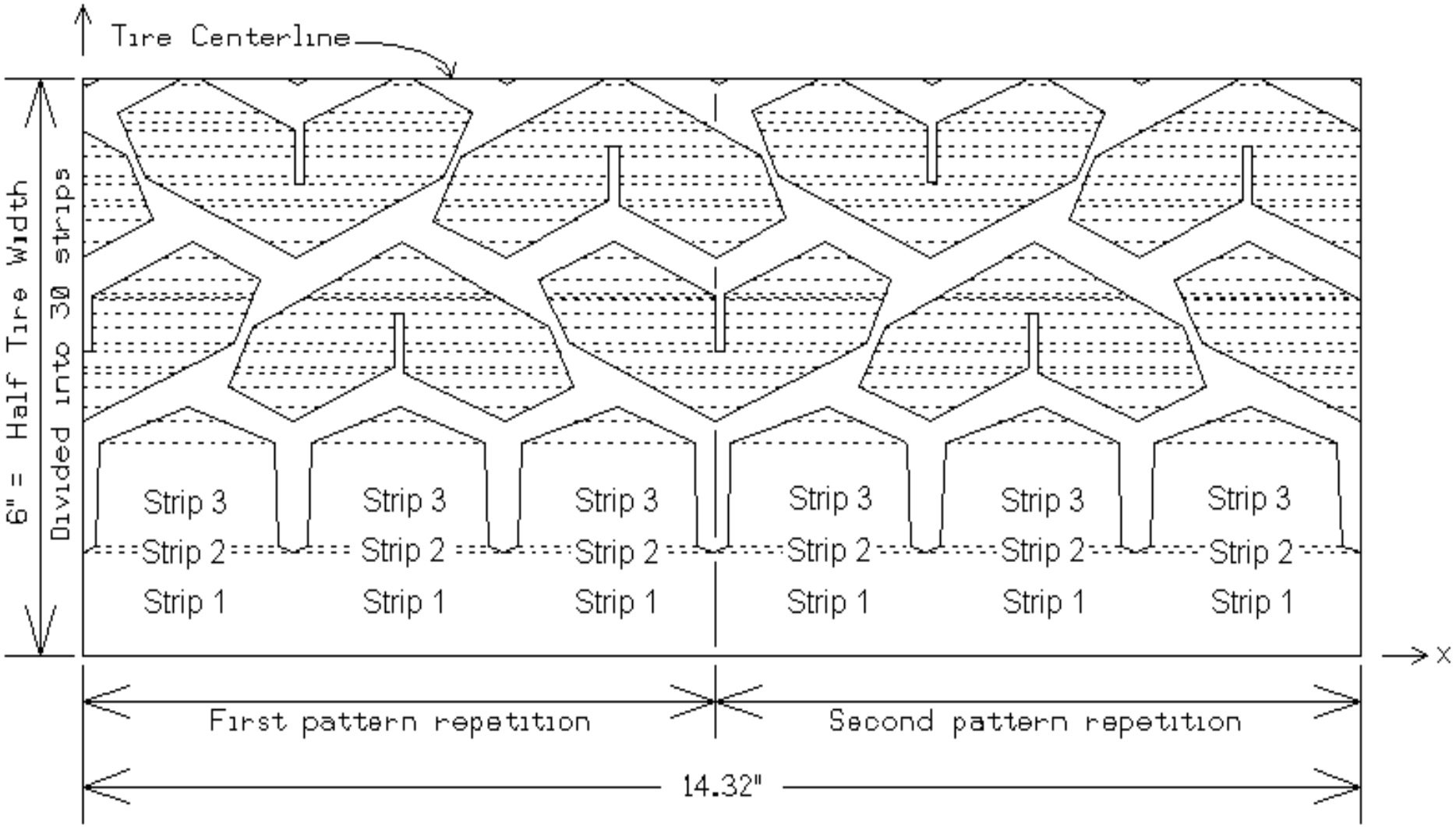
- Bi-Directional, No Wander (above)
- Uni-Directional, No Wander (Left)

RUBBER BUILD-UP

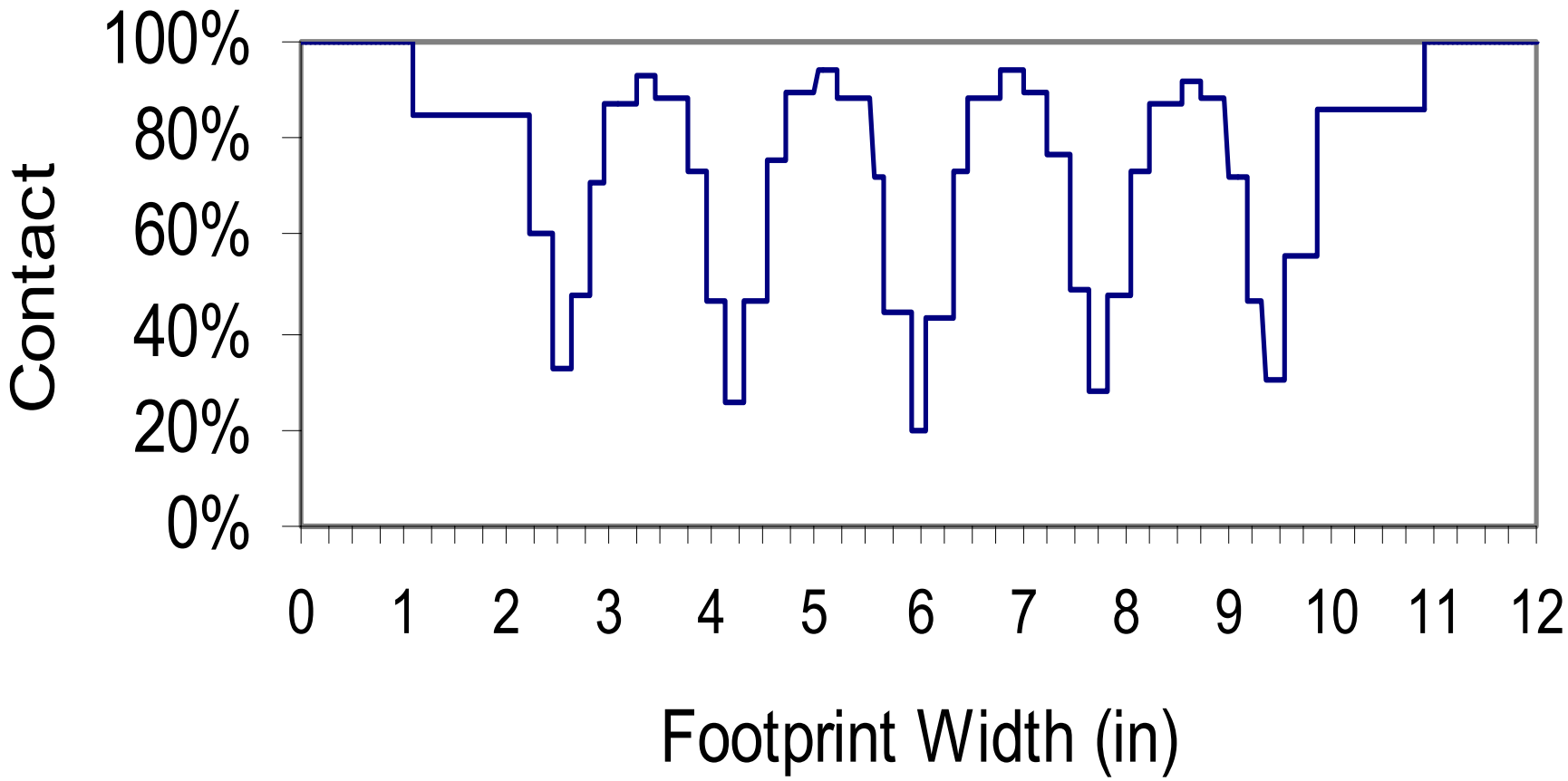
TIRE TREAD PATTERN



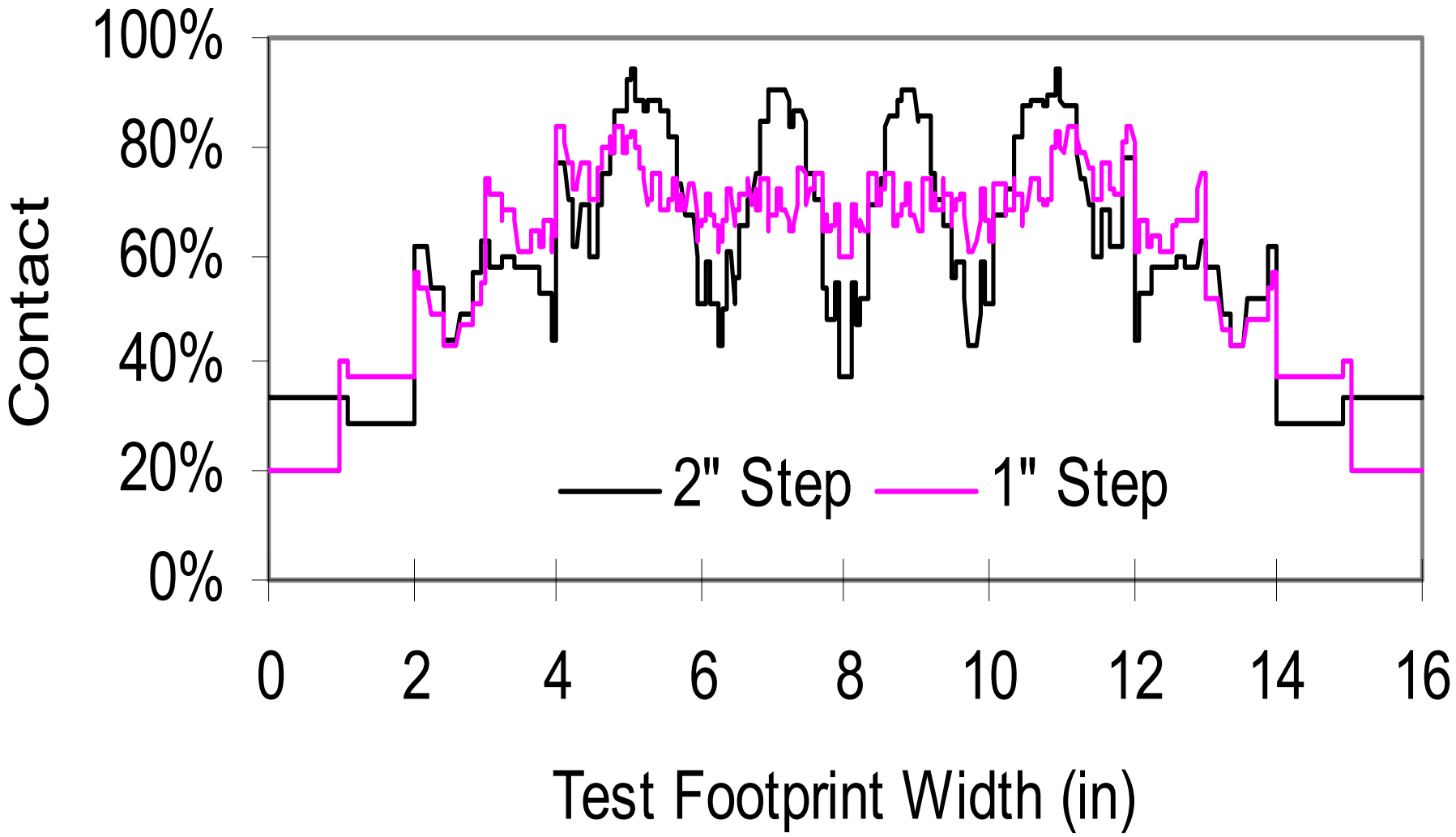
TIRE TREAD STRIPS



% TIRE CONTACT



% CONTACT - 2" VS. 1" STEPS

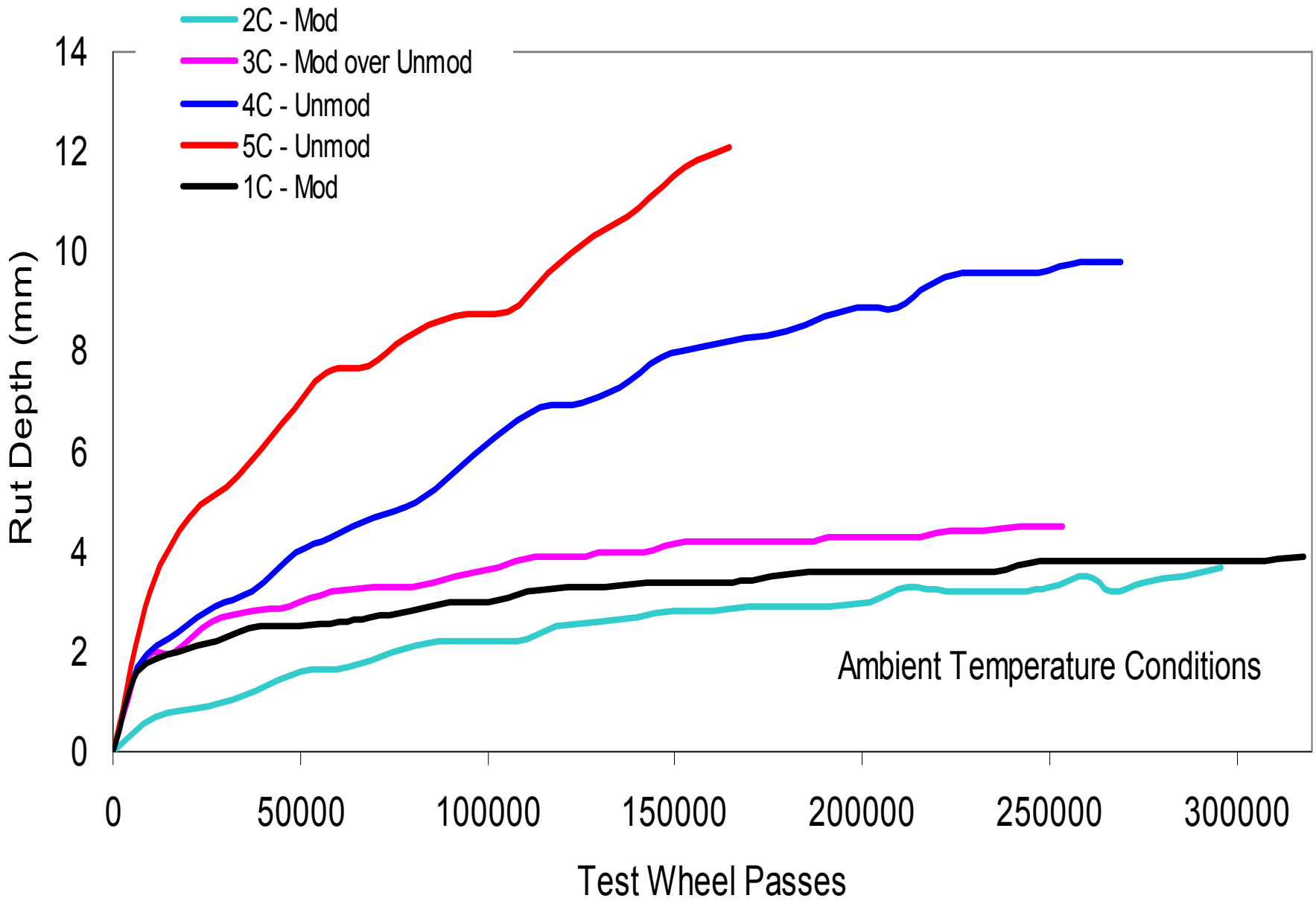


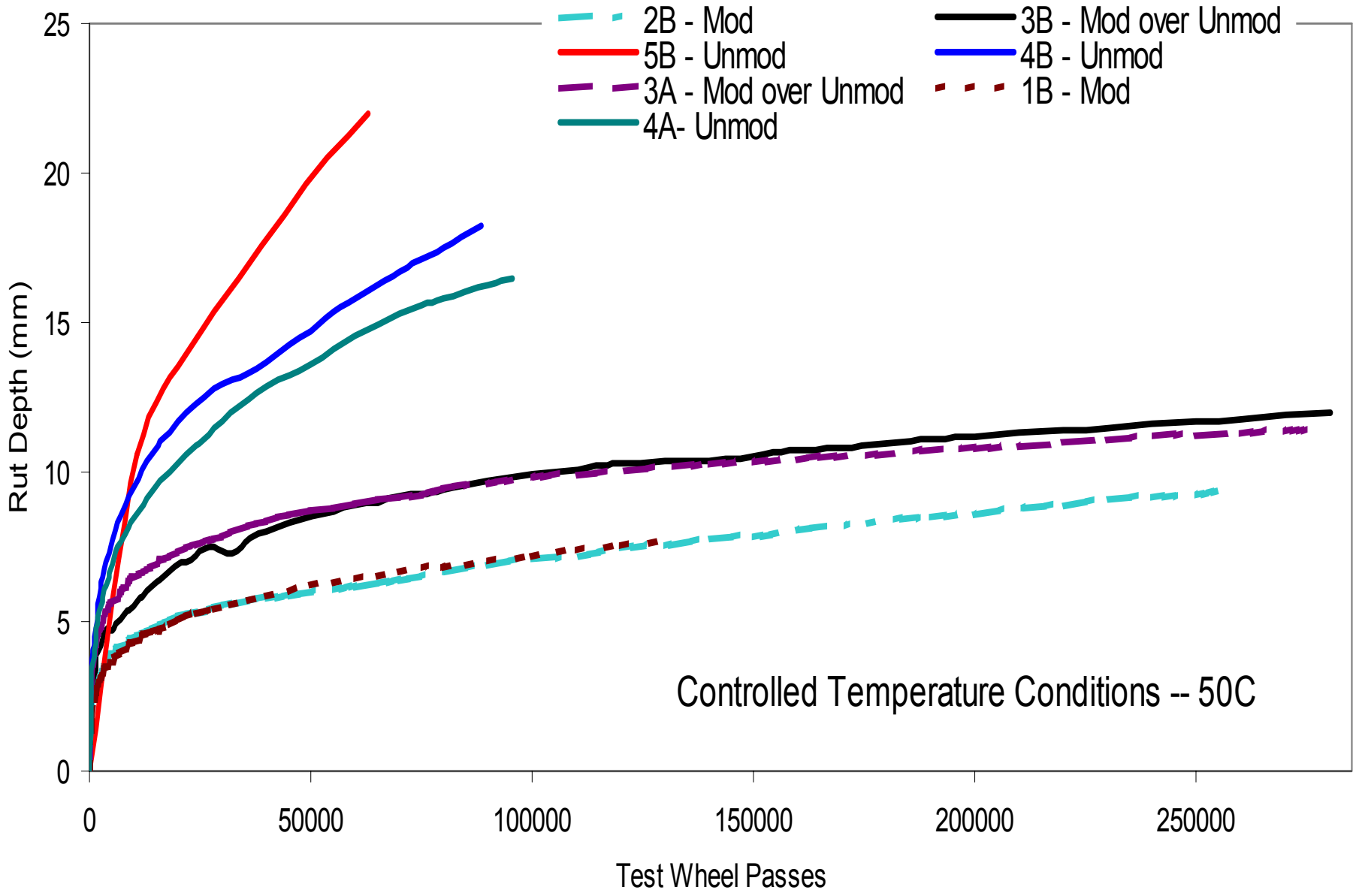
FINDINGS

- W/o wander, uni-directional - rut developed at rate of 65% greater per-pass basis.
- W/o wander, uni-directional mode placed considerable wearing forces. As much as 25% of tread depth worn away at very localized locations.
- Uni-directional loading, pattern matched very closely the general tire tread pattern.

FINDINGS (Con't)

- W/ wheel wander, wander increments differently affected the tire-pavement contact.
- Importance of using both wheel wander & appropriate wander incremental step.
- It is recommended that, in order to determine an appropriate loading configuration, a thorough pavement-tire tread investigation be conducted any time the tire brand and/or type is changed.


2C - Mod
3C - Mod over Unmod
4C - Unmod
5C - Unmod
1C - Mod
Rut Depth (mm)
0
2
4
6
8
10
12
14
0
50000
100000
150000
200000
250000
300000
Test Wheel Passes
Ambient Temperature Conditions


2B - Mod
3B - Mod over Unmod
5B - Unmod
4B - Unmod
3A - Mod over Unmod
1B - Mod
4A- Unmod
Rut Depth (mm)
0
5
10
15
20
25
0
50000
100000
150000
200000
250000
Test Wheel Passes
Controlled Temperature Conditions -- 50C

PERFORMANCE-TO-DATE

- Testing initiated in October 2000.
- Over 5 million loaded passes to date.
- 1.5 hours average daily “down” time for scheduled preventative maintenance.
- Overall, very pleased with the reliability.

WEBSITE LINKS

- http://www11.myflorida.com/statematerialsoffice/PavementEvaluation/APT/aptresearch.htm
- http://www11.myflorida.com/statematerialsoffice/PavementEvaluation/PavPerf/experimentalprojects


QUESTIONS???
FLORIDA
DEPARTMENT OF TRANSPORTATION
STRUCTURAL MATERIALS
RESEARCH
Florida Department of
Transportation
State Materials Office
PAVEMENT
PERFORMANCE
SOILS