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OUTLINE

- ANALYSIS CONSTRAINTS
- WHY ITS AN ISSUE
- ACCELEROMETER GEOMETRY
- NORMAL ACCELEROMETER VALUES
- INFLUNCE OF COLLECTION SPEED
- WHAT CAN WE DO?
  - AS OPERATORS
  - AS EQUIPMENT DESIGNERS

CONDITIONS

1. SINGLE AXIS ACCELEROMETER

2. ACCELEROMETER AXIS & LASER AXIS ARE PARALLEL

CURVE & HILL PROBLEM- IT'S TYPICALLY *NOT:*

A PROBLEM OF GEOMETRY

RIDE PROFILE is measured perpendicular to the average pavement grade - not to the horizon
(*EVEN IF A HORIZON PROJECTION IS USED – 10% GRADE = only 0.5% ERROR*)

As long as the sensors are within 3 degrees of perpendicular to the pavement
(van axles within 6" of average grade)

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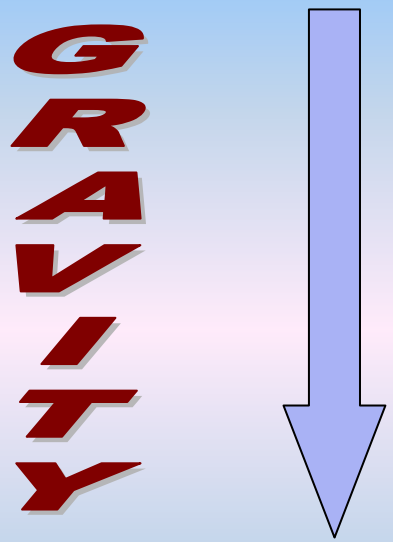
IF ITS NOT THE GEOMETRY

WHAT'S THE CAUSE of the PROBLEM?

The ANSWER IS IN THE ACCELEROMETER

BIGGEST ACCELERATION



32.17 Ft. / sec^2

THE PROBLEM

with

HILLS & CURVES:

ANGULAR CHANGE

of the

ACCELEROMETER

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Causes of Angle Change

VEHICLE PITCH

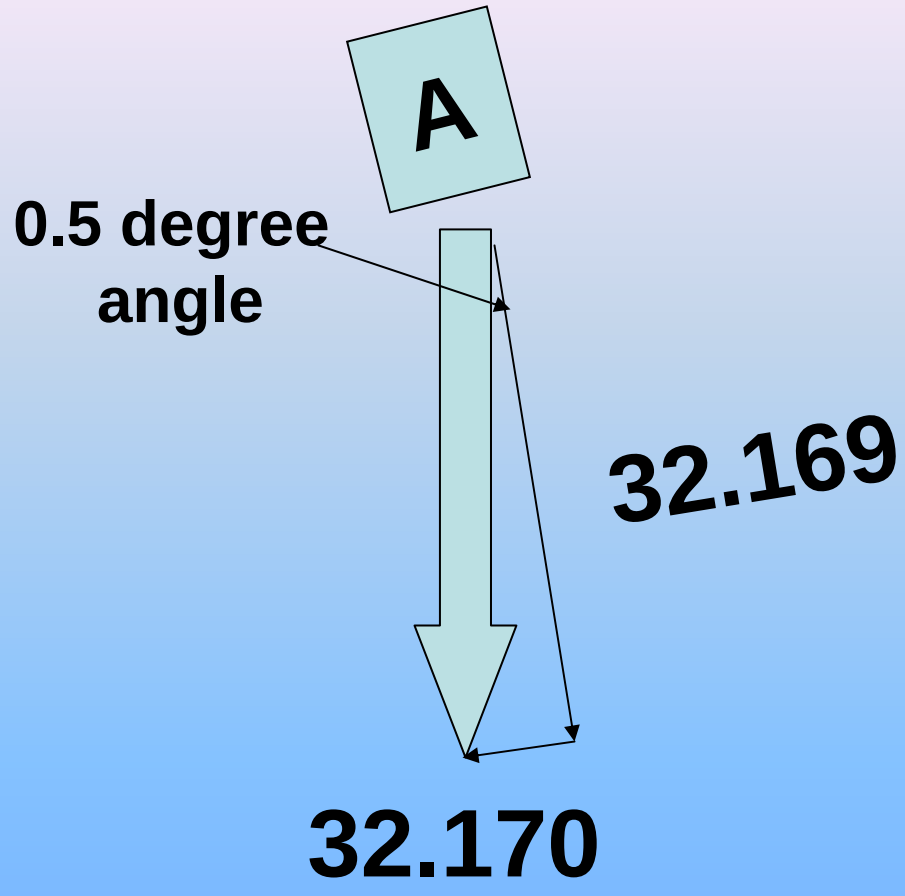
GRADE CHANGE

HARD BRAKING/ACCELERATION

VEHICLE ROLL

ROUNDING CURVES

INTERNAL WEIGHT SHIFT



Difference = 1 mg

RELATIVE MAGNUTUDE

ACCELEROMETER ERROR (1mg)

Vs

ROUTINE

ROUGHNESS MEASUREMENTS

ROUGHNESS SIMULATION ASSUMPTIONS

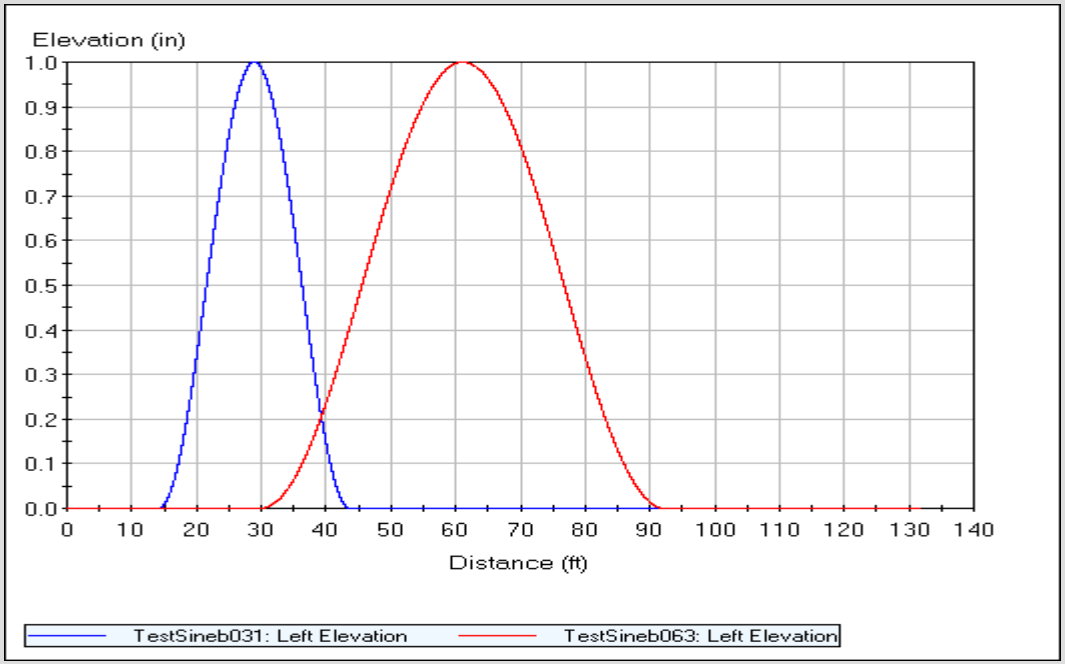
NO SUSPENSION MOVEMENT

NO TIRE COMPRESSION

ALL ENERGY AT THE TEST WAVELENGTH

HUMPS ARE IN 33% OF THE PAVEMENT

SINE WAVE HUMPS



Blue - 31 ft. ---- IRI = 203

Red - 63 ft. ---- IRI = 79

63 FOOT Sine Roughness Hump

Measured at 50 ft/sec constant vehicle speed (30 MPH)

Vert.def. = {sin[(5.03*t)-1.5708]+1}/2 where t = time in hump

Max velocity = roughly 0.8 in/sec
Max acceleration = roughly 1.3 in/sec^2

Translates into ~ 0.1 ft/sec^2 = 0.003 g's or 3 mg's

BOTTOM LINE

The possible error signal and the typical roughness measurements *can* be of **SIMILAR MAGNITUDE**

PROFILE MEASUREMENTS ARE WAVELENGTH DEPENDENT

Roughness

1.0 to 200 FEET long

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Grade

OVER 200 FEET LONG

SPEED MATTERS

Typical Equipment Requirements

Minimum operating speed of 20mph (30ft/sec)

Collecting 60% amplitude data @ 300 ft wavelength

Imply

Roughly 15sec decay rate in the derived elevation

ACTIONS of OVER 30 sec ARE *NOT* a PROBLEM

DISTANCE MATTERS

Typical FILTRATION

Collecting 60% amplitude data @ 300 ft wavelength

Implies

AFTER 600 FT. INTO A FEATURE,

(Constant Curve or Grade)

THE OUTPUT IS NOT AFFECTED

SO WHAT DO WE DO?

MINIMIZE:

1. **THE SIZE of the CHANGE**
2. **THE RATE of CHANGE**

GOOD COLLECTION GUIDELINES:

SIZE of CHANGE:

1. IF YOU CAN FEEL IT – IT'S TOO BIG!

(A 1 inch VEHICLE LEAN is OVER 0.5 DEGREES)

INSTALL BIG ROLL BARS

RATE of CHANGE:

IDEALLY STAY:

1. **On a constant grade for MORE than 30sec. or over 600 ft.**
2. **In a constant curve radius for the same period**

CURVES

VEHICLE *ROLL* IS MAIN ISSUE

DRIVE AS *SLOWLY* AS POSSIBLE

CONSISTENT WITH:

1. **SAFETY**
2. **MINIMUM PROFILER SPEED**

SMOOTH DRIVING IS THE KEY

DRIVE WITH *RAW EGGS* BETWEEN:

1. *YOUR FEET & the PEDLES*
2. *YOUR FINGER TIPS & the WHEEL*
3. *YOUR "CHEEKS" & the SEAT*

THE FUTURE?

PITCH & ROLL COMPENSATION

ALTERNATE VERTICAL MOTION DETECTOR

Other New Technology


QUESTIONS?

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