Annex K – THRUST 6 – NG-NRMM VERIFICATION AND VALIDATION

Note: This Annex appears in its original format.

Thrust 6: NG-NRMM Verification and Validation

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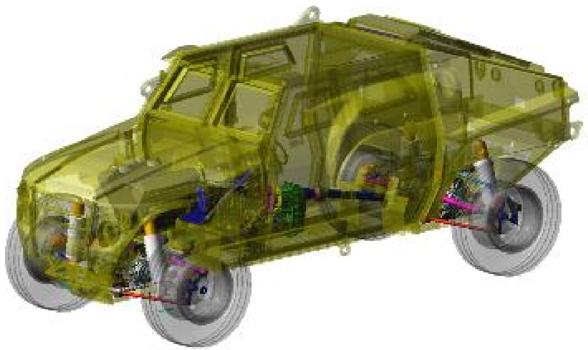
Outline of Vehicle Verification and Validation

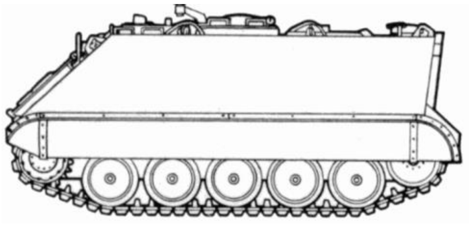
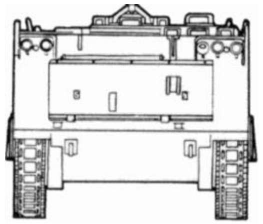
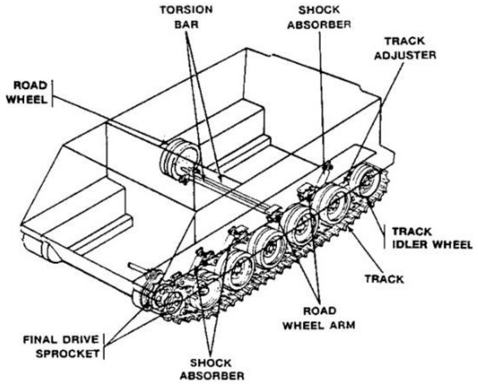
- AVT 248 - Tracked Vehicle Benchmark & Conclusion (Preparatory Work to the CDT)

- CDT 308 NG-NRMM Verification and Validation
  - Automotive Test
    - Calibration with Test Data
    - Dynamics Tests
  - Soft Soil Test
    - Fine Grain Sand Wet
    - Fine Grain Sand Dry
    - Coarse Grain Sand Dry
  - Mobility Traverse
  - Conclusions

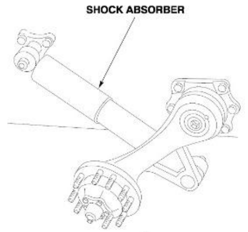


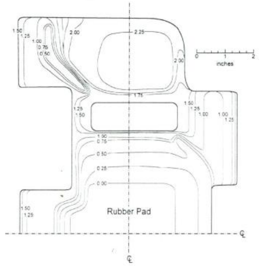
Tracked Vehicle Mobility Benchmark (AVT 248)

- Tracked Vehicle Platform
  - M113, 9 Ton Test Weight
  - Single Pin Track
    - 63 Links Left, 64 Links Right
  - Benchmark Assumed Drivetrain:
    - 200 HP Total @ sprockets
    - Max Speed: 40 mph
  - Suspension properties:
    - All defined by Benchmark Documents:
      - Torsion Bar Stiffness
      - Jounce and Rebound Limits and Stiffness
      - Damping Characteristics

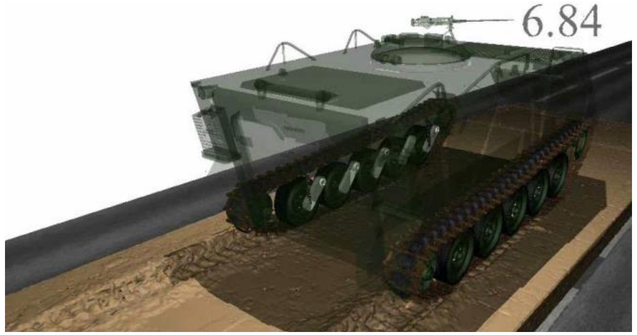




http://afvdb.50megs.com/usa/m113.html

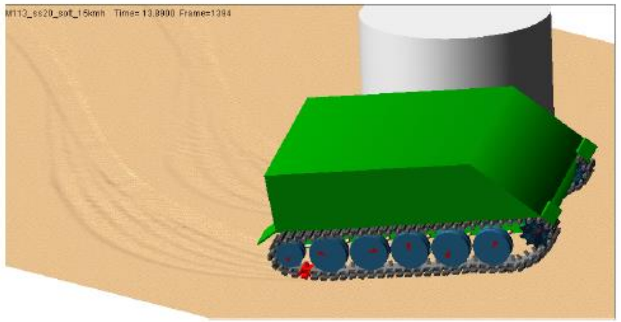




Tracked Vehicle Benchmark Documents



IVRESS, Tracked on Soft Soil



ADAMS, Tracked on Soft Soil

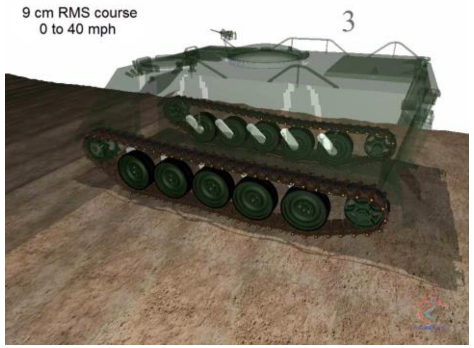
Tracked Vehicle NG-NRMM Demonstration

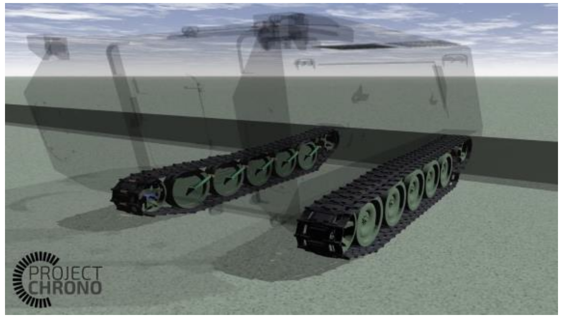
- NG-NRMM Simulation Maturity Scale:

1. **DEMONSTRATION:** *Demonstration of a correct implementation of a theoretically and conceptually consistent model.*
2. **PARAMETER SENSITIVITY DEMONSTRATION:** *Verification that performance change with a change in system parameter such as GVW or terrain deformability is consistent with theory and physics principles*.
3. **INDEPENDENT USER VERIFICATION:** *Independent user demonstration and correlation to vendor results*
4. **CROSS CODE VERIFICATION:** *Cross verification with another accepted mobility simulation code*
5. **CALIBRATION**: *Calibration to a real vehicle test data set*
6. **VALIDATION:** *Blind correlation to a real vehicle test data set*
7. **PARAMETER VARIATION VALIDATION:** *Blind correlation to a real vehicle test data set with a change in system parameter(s).*

- Tracked Vehicle Platform

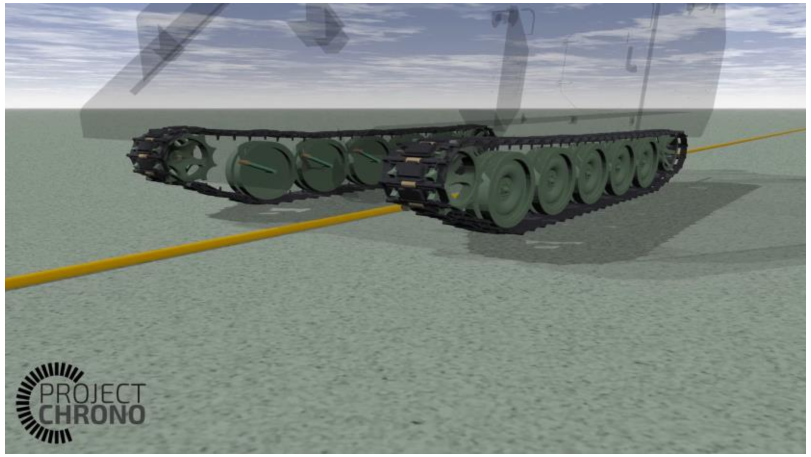
Software Developer	Country	Software
Advanced Science and Automation Corporation	USA	**IVRESS/DIS**
University of Wisconsin – Madison	USA	**Chrono**
MSC Software	USA	**ADAMS**
Vehicle Systems Development Corporation	CAN	**NTVPM/NWVPM**
FunctionBay	ROK	**RecurDyn**

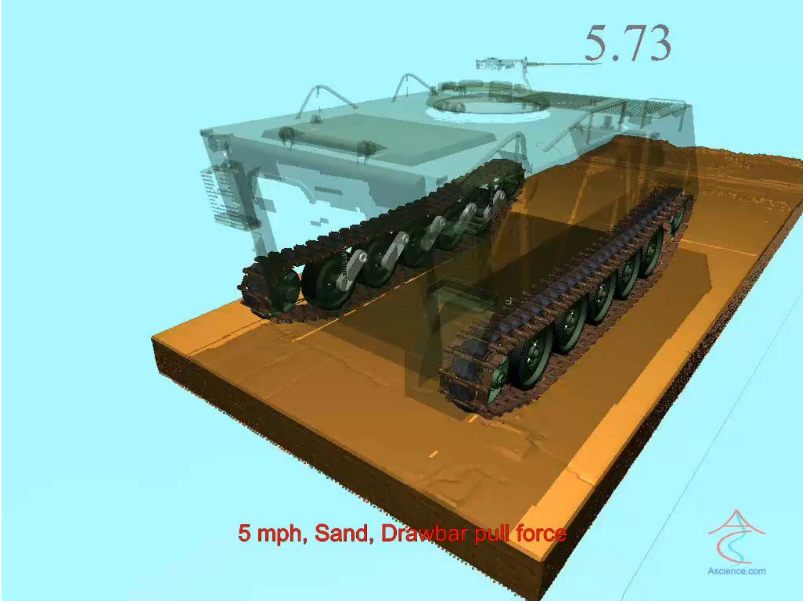




Simulation Events

- **Steering Performance,** including **Wall-to-Wall (WTW)** turn radius in accordance with AVTP 03-30, **Steady State cornering, (SSC)** per SAE J266 and SAE J2181 , and **Double Lane Change (DLC)** (paved and unpaved) based in AVTP 03-160W
- **Side Slope Stability (SSS),** guided by TOP 2-2-610 [9], including maneuver on paved and unpaved surfaces
- **Straight Line Acceleration (SLA)** based on TOP 2-2-602 and **Grade Climbing** with TOP 2-2-610 as a general guideline, including paved and soft soil (Variable Sand Slope)
- **Ride Quality** (**RMS 6Watt Absorbed Power and 2.5G Half-Round Limit Speeds**) outlined by TOP 1-1-014
- **Obstacle Crossing**, based on TOP 2-2-611, including steps, gaps, and NRMM standard suite of positive and negative trapezoids
- **Off-road Trafficability** including single and multi-pass soil strengths, **Drawbar Pull** in accordance with TOP 2-2-604 as a general guideline and **Motion Resistance**
- **Closed Loop Traverse** including speed made good and fuel economy in partial agreement with AVTP 03-10





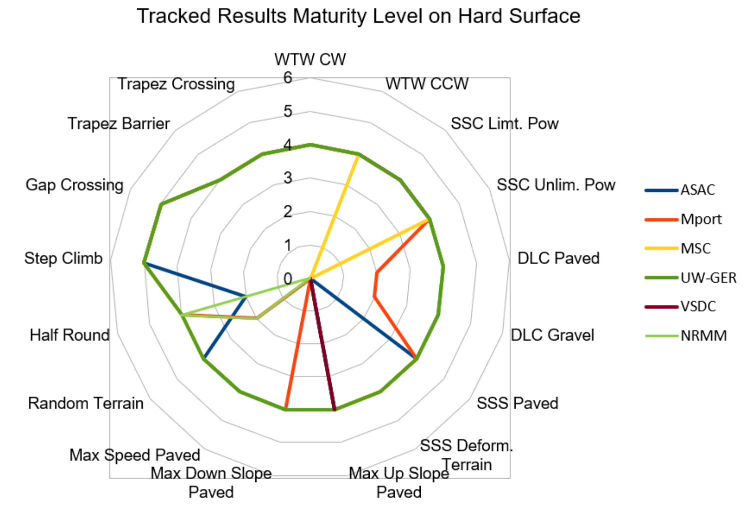
Tracked Vehicle Results

Industry Level Maturity:

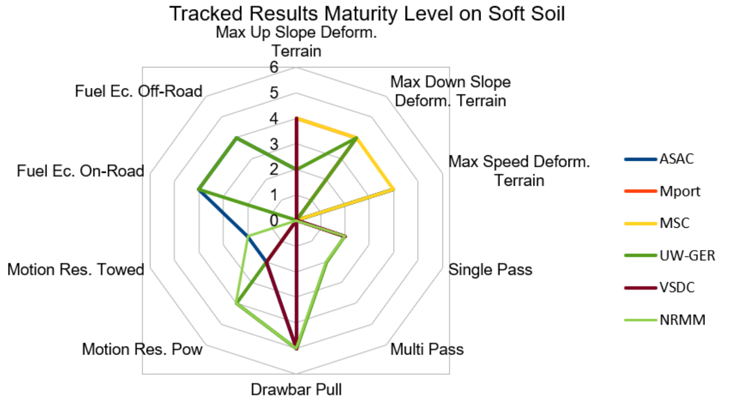
	Max Possible Ranking Score	Max Achievable Maturity Level	Industry Achieved Maturity
Total score	88	4.11	3.89
Score Hard Surface	59	4.10	4.10
Score Soft Soil	29	4.14	3.29

Participant Level Performance

	Participant/Vendor					
SIMULATION EVENTS	NRMM	A	B	C	D	E
Total	44%	67%	58%	49%	89%	9%
Score Hard Surface	50%	81%	78%	71%	92%	0%
Score Soft Soil	32%	40%	20%	7%	85%	27%



- **Tracked Vehicle Conclusions (Limited Test Data)**
  - Hard Surface Events Performed Well in Dynamic Simulations
  - Soft Soil Events Were Less Familiar to Most Participating Software Developers
  - Soft Soil Simple Terramechanics in Dynamic Simulations a Challenge among Participants
    - Multi-pass Effects



CDT 308 NG-NRMM Verification and Validation

AUTOMOTIVE TESTS

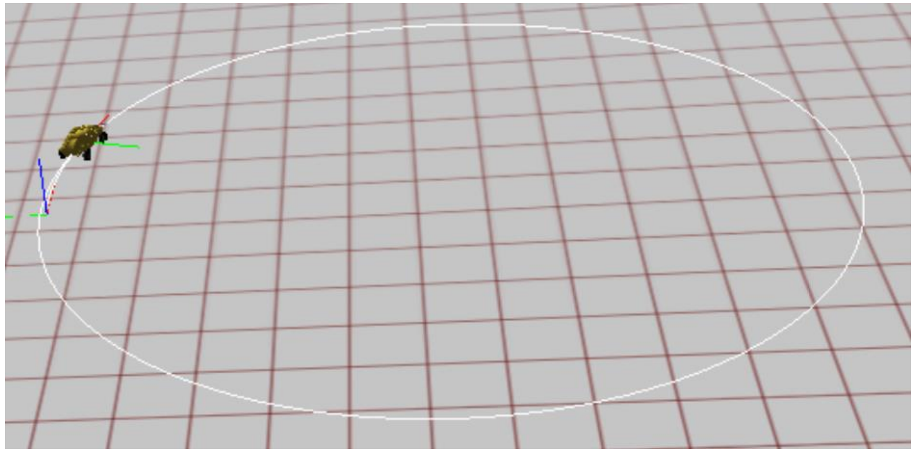
Wall To Wall Turn Radius

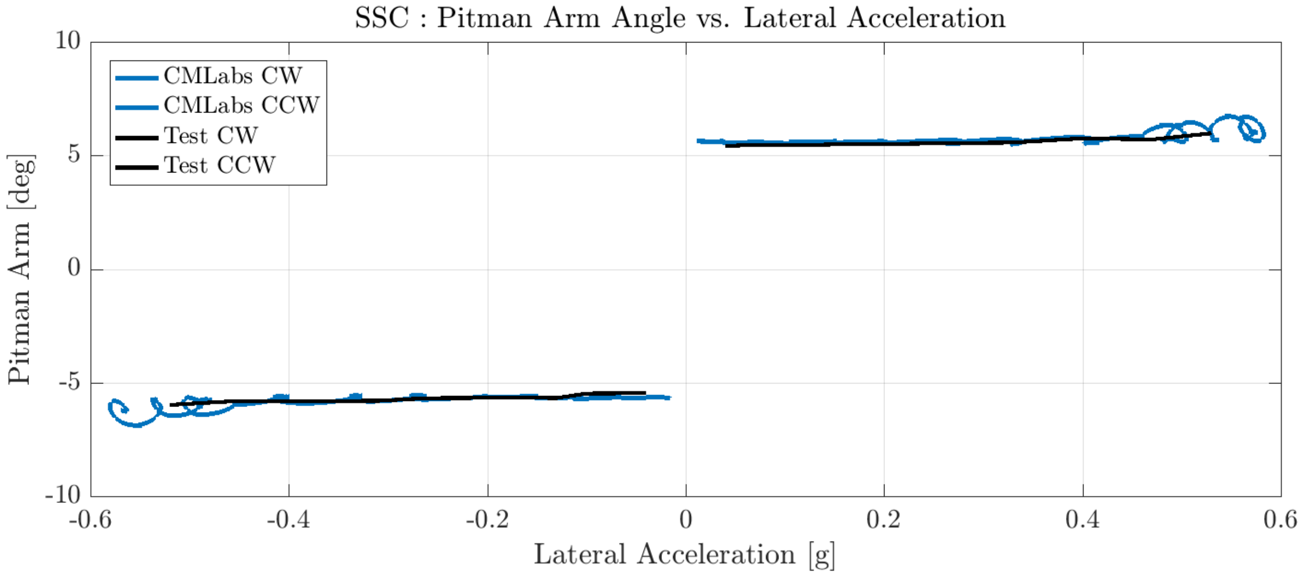
- Determine Minimum Turning Radius
- Capture Asymmetric Steering
- Test Steering Linkage Implementation
- Test of Steering Hard Stops

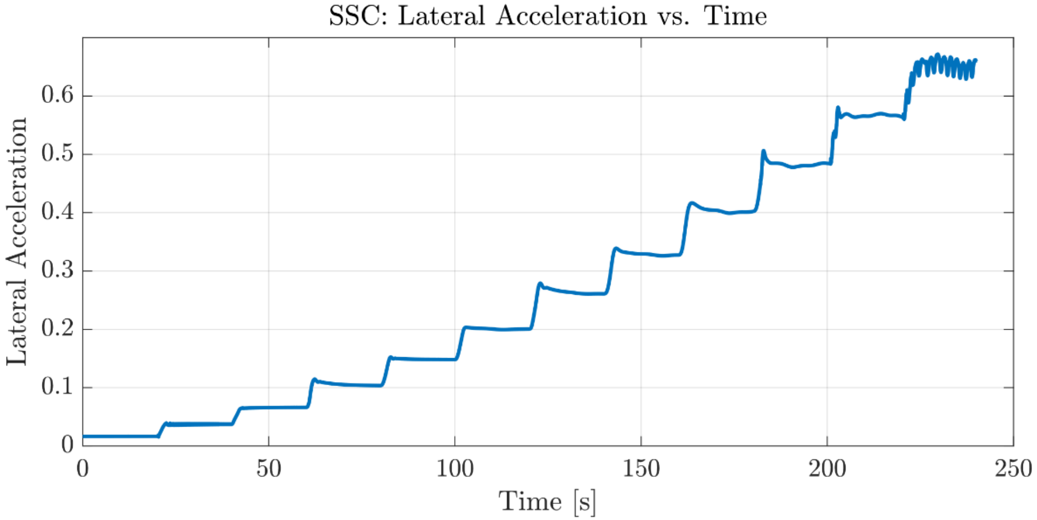
Vendor	CW [m]		CCW [m]	
TEST	T1: 15.51	Avg: 15.58	T1: 15.54	Avg: 15.48
	T2: 15.58		T2: 15.51	
	T3: 15.58		T3: 15.42	
	T4: 15.58		T4: 15.45	
ASAC	14.90		14.90	
MSC	15.27		15.32	
CMLabs	15.10		14.8	
AU	15.1		15.1	

Steady State Cornering

- Determine Vehicle Oversteer/Understeer Behavior
- Constant 30 Meter Turn Radius
- Incremental Steps of Constant Vehicle Speed

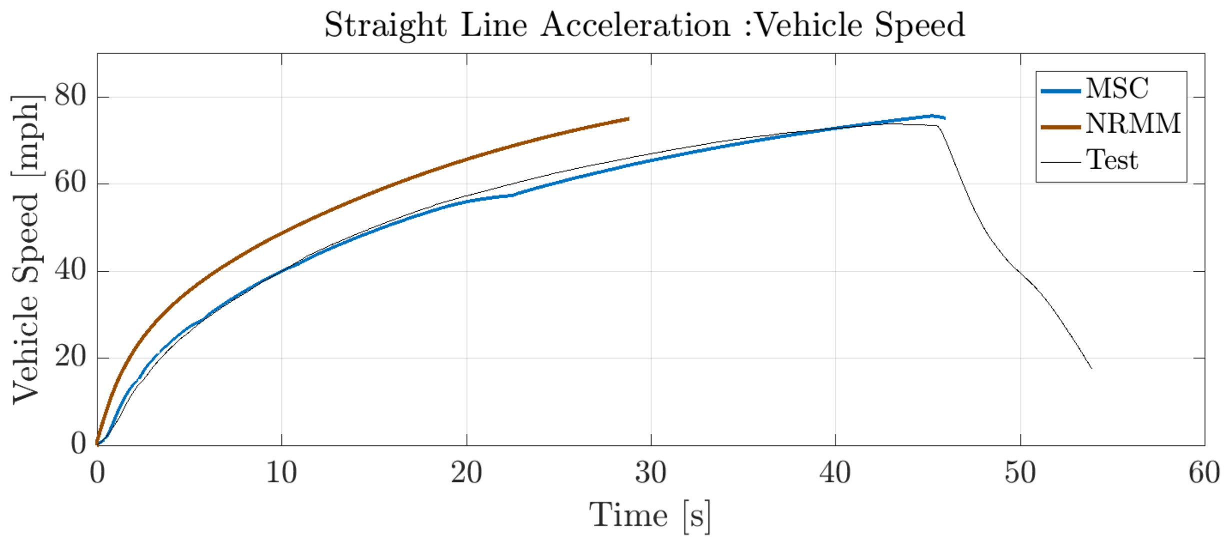


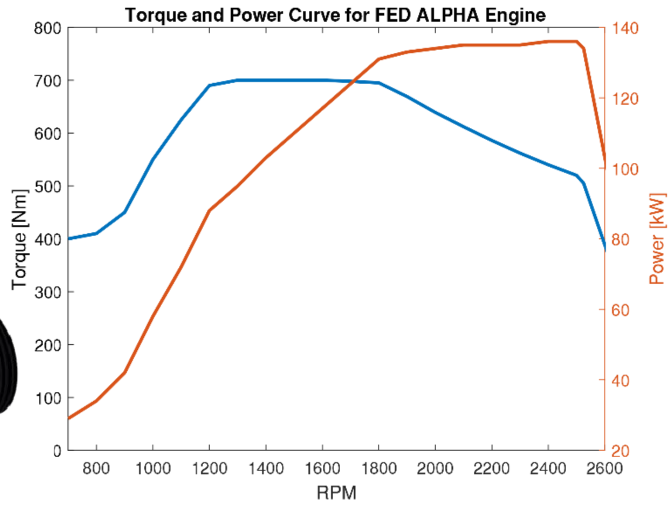


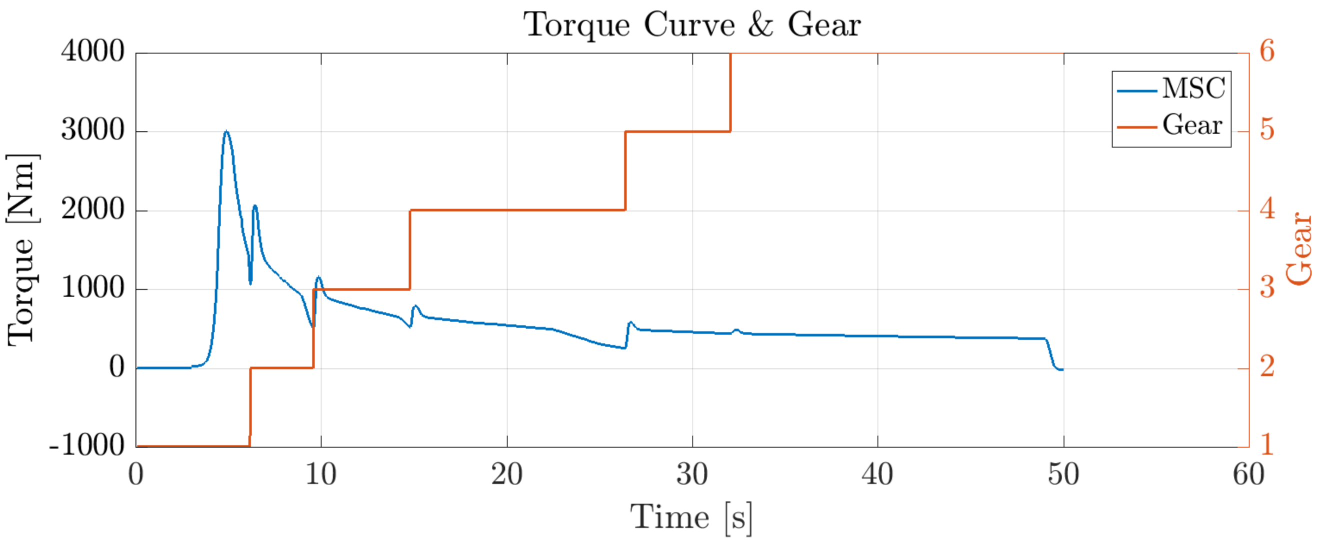


Straight Line Acceleration

- Test Engine and drivetrain implementation
- Test of Engine Torque Curve
- Implementation of Wind/Rolling resistance
- The main result is Speed vs. Time







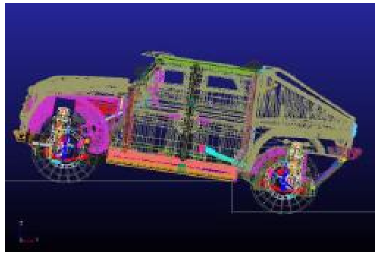
V-Ditch

Determine Go/No-Go: V-ditch

Determine Go/No-Go: Step Incline

Vertical Step

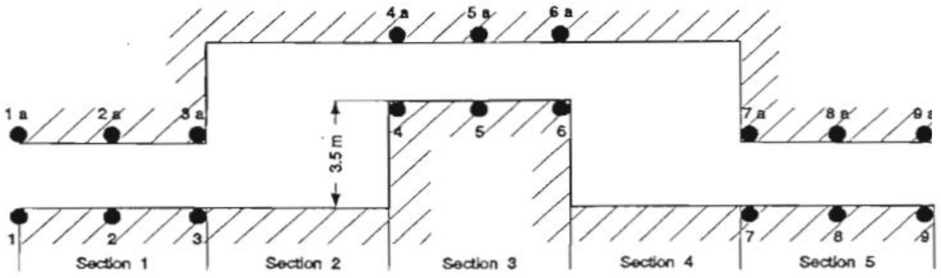
Software Developer	Go/No-Go
TEST	Go
ASAC	Go
MSC	Go
CMLabs	Go
AU	Go
NRMM	Go



Software Developer	12”	18”	24”
TEST	Go	No-Go	No-Go
ASAC	Go	No-Go	No-Go
MSC	Go	No-Go	No-Go
CMLabs	Go	No-Go	No-Go
AU	Go	No-Go	No-Go
NRMM	Go	No-Go	No-Go

Double Lane Change: Calibration

- Calibration test done at 30 mph
- Verify lateral and roll dynamics
- Software Developers Had Access to Test Data



Lane – change track dimensions

Section 1 : Length = 15 m
Width = 1.1 . vehicle width + 0.25 m

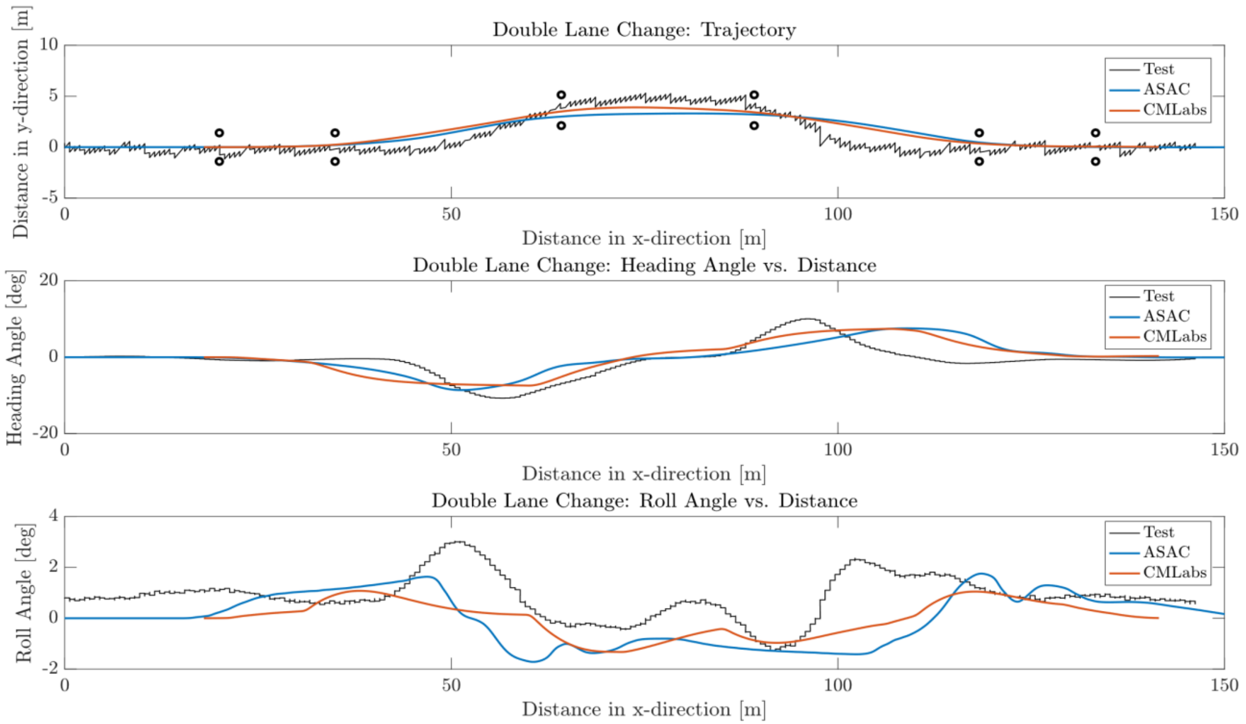
Section 2 : Length = Overall length of vehicle*) + 24 m

Section 3 : Length = 25 m
Width = 1.2 vehicle width + 0.25 m

Section 4 : Length = Overall length of vehicle + 24 m

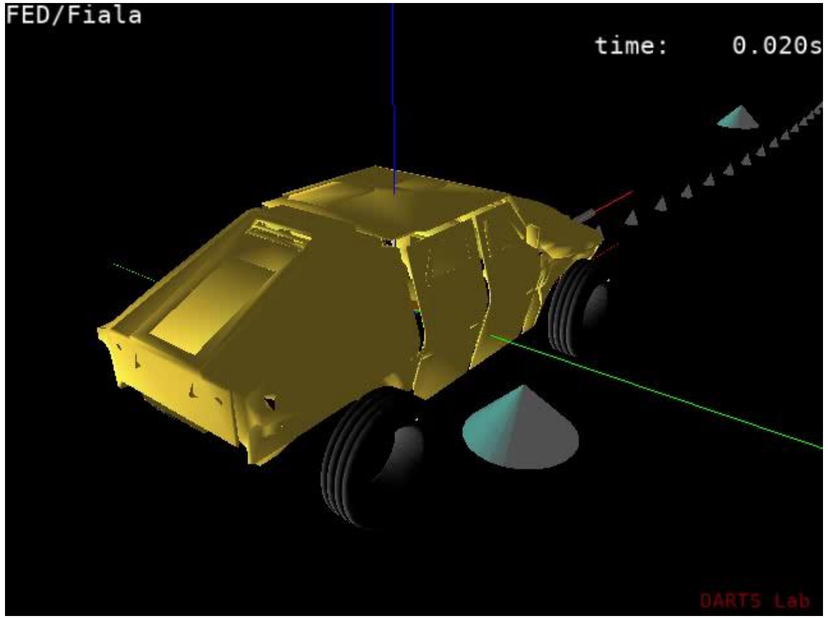
Section 5 : Length = 15 m
Width = 1.1 . vehicle width + 0.25 m

*) Overall length of vehicle, measured at 0.50 m from the ground.



Double Lane Change (DLC), Max Speed

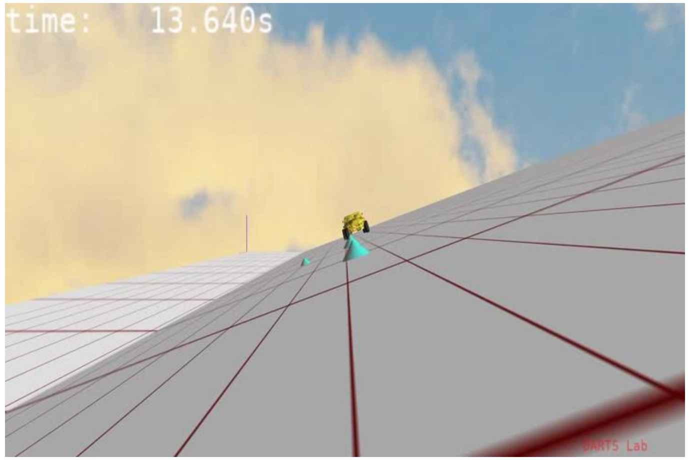
- Closed Loop Control Necessary
- Software Developers Used Their Own Path Generator and Driver Model



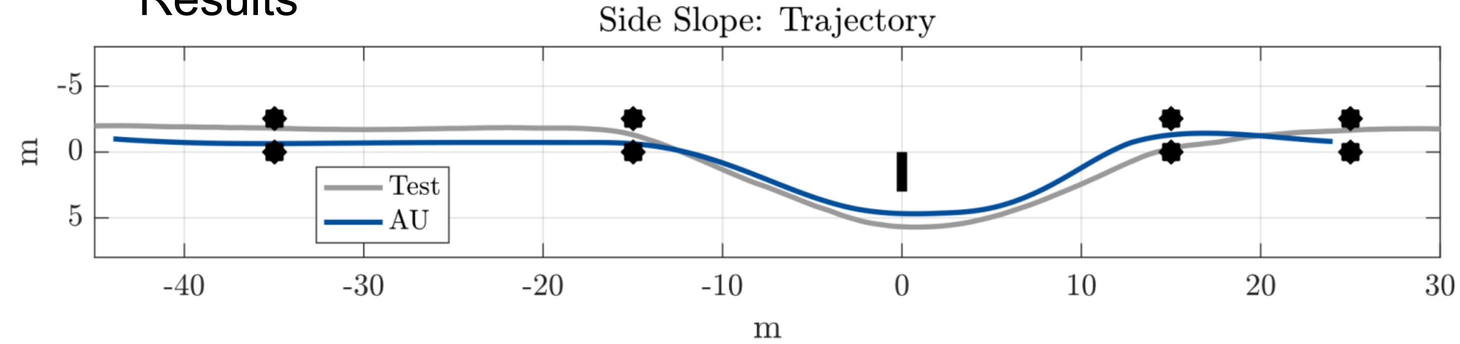
Vendor	Speed DLC RTF Paved, mph	Speed DLC LTF Paved, mph
ASAC	49	49
MSC	44	44
CMLabs	50	50
AU	42	42

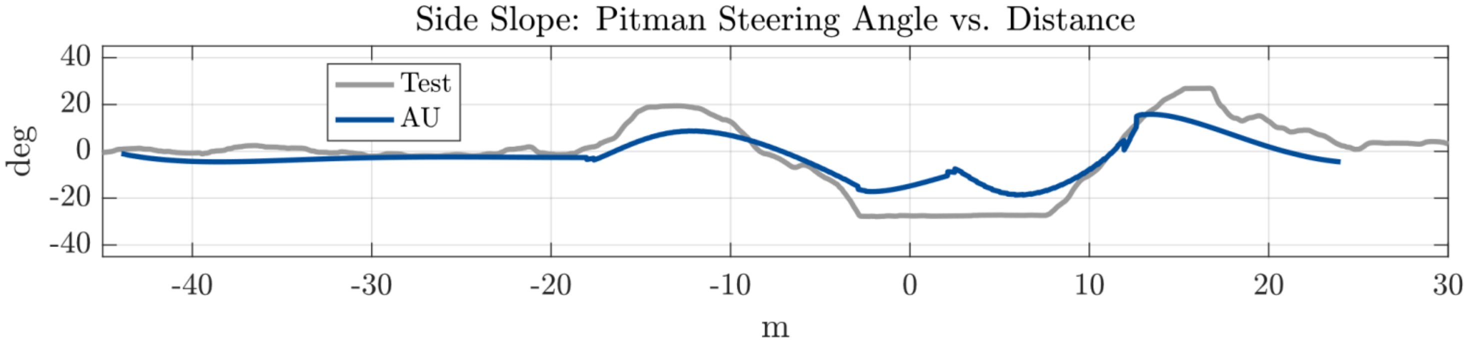
Vendor	Speed DLC RTF Gravel, mph	Speed DLC LTF Gravel, mph
ASAC	43	44
MSC	40	40
CMLabs	41	41
AU	34	34

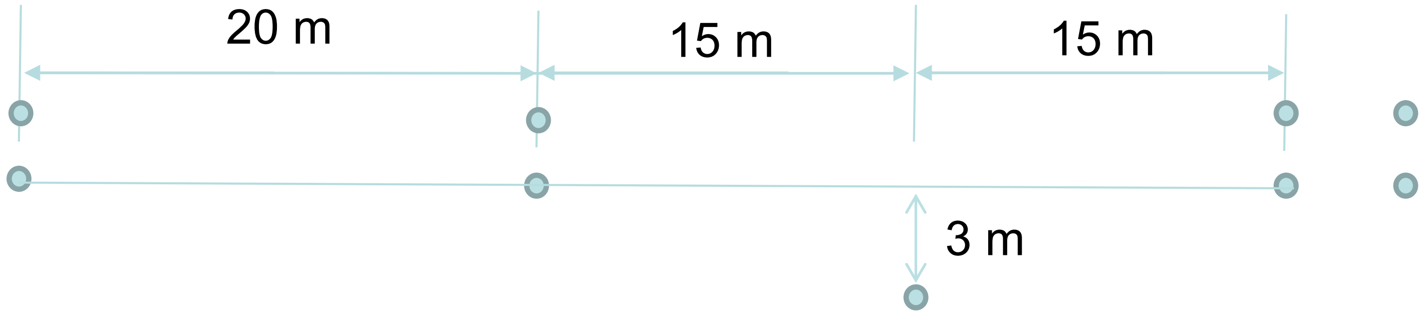
Side Slope Obstacle



Results

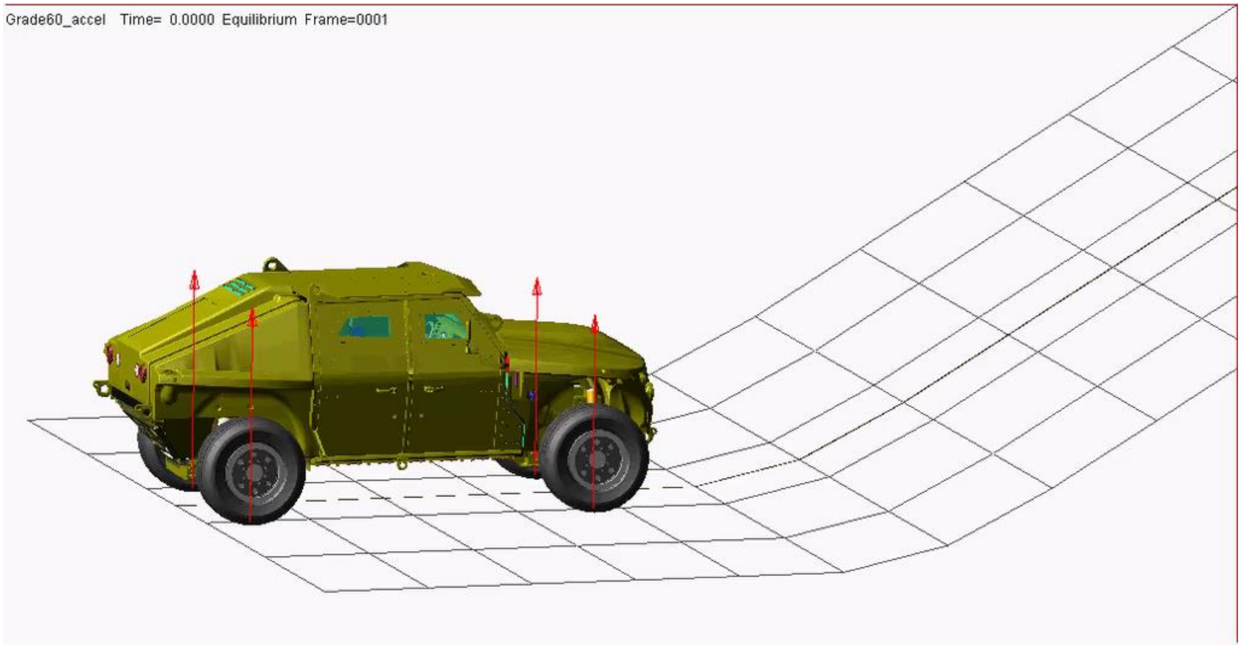






60% Grade, Paved

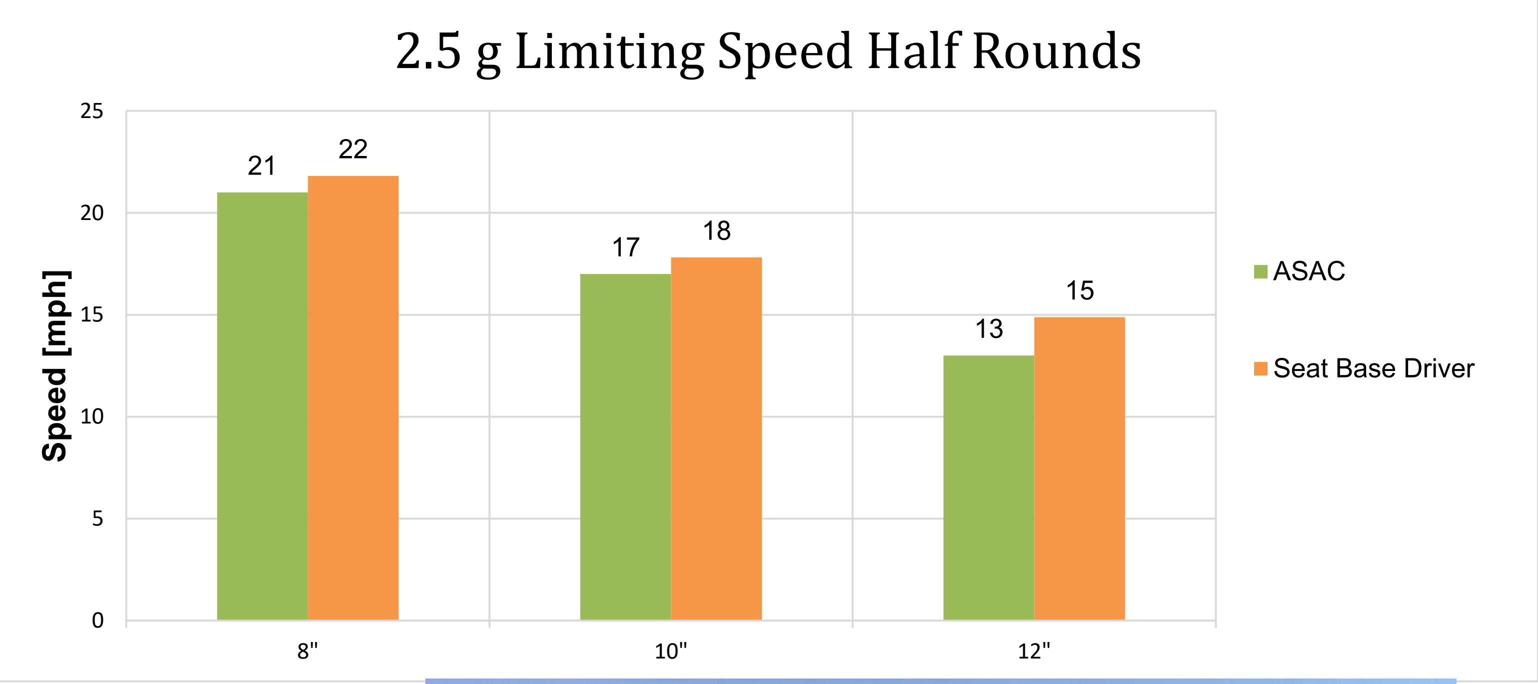
- The Objective in Simulation is to Determine Go/No-Go
- Real Test has Additional Objectives such as Parking Brake Performance, Fluid Leakage etc.

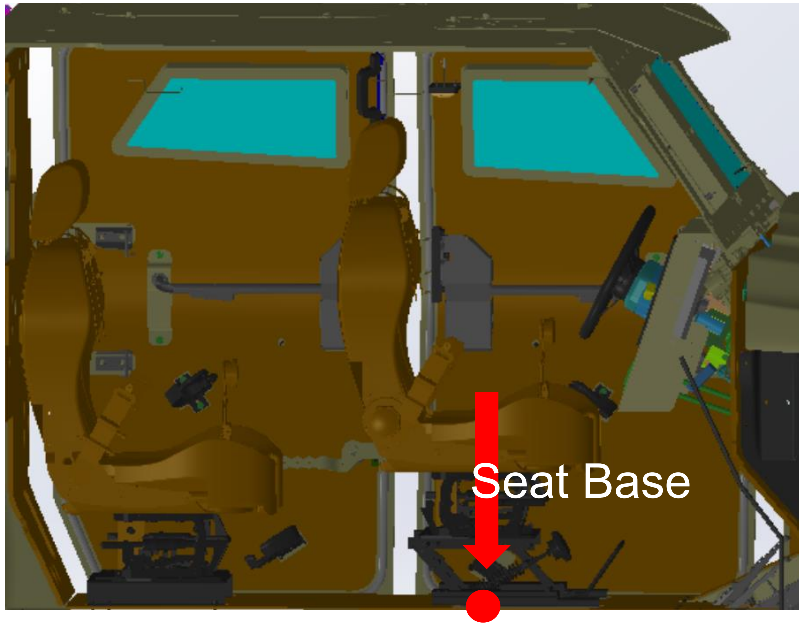


Vendor	Go/No-Go
TEST	Go
ASAC	Go
MSC	Go
CMLabs	Go
AU	Go
VSDC	Go
NRMM	Go

Half Round Test (4”, 8”, 10”, 12”)

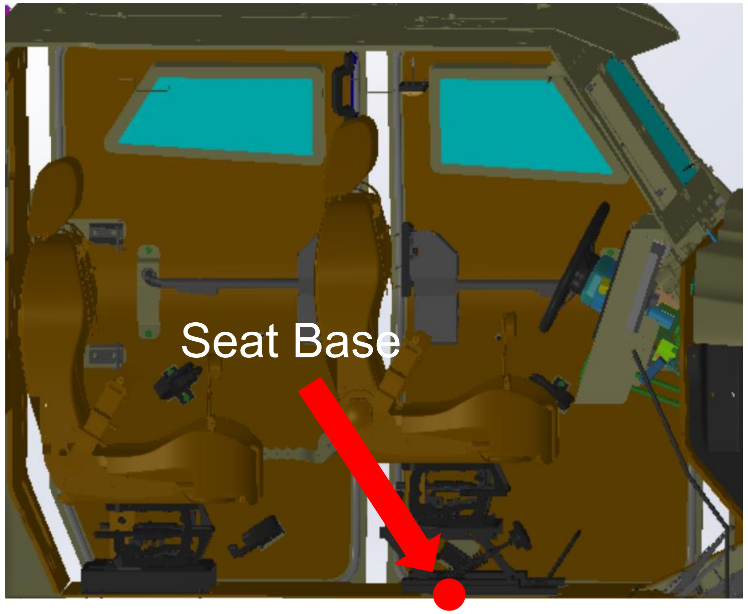
- Locate 2.5g Seat Base Vertical Acceleration Limiting Speed
- Incremental Step of Constant Vehicle Speed
- 4” No Limiting Speed

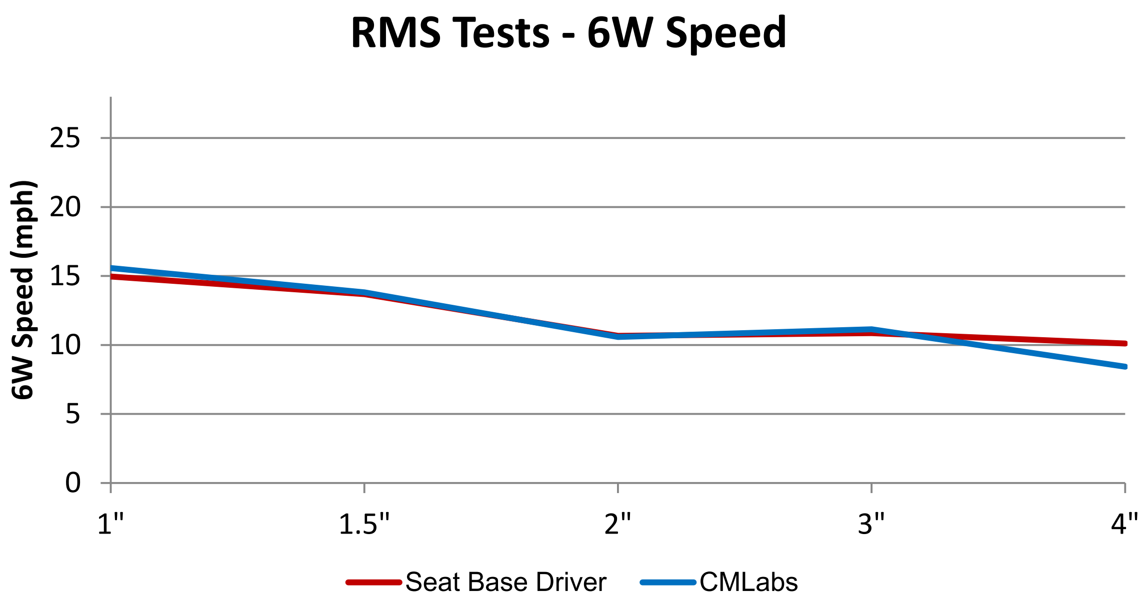




RMS Symmetric: Absorbed Power

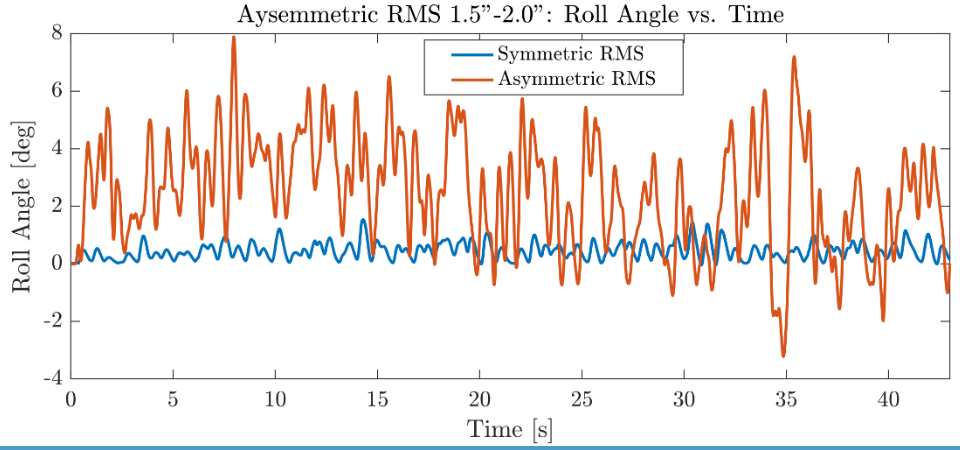
- Characterize the ride quality of the vehicle.
- The Result is the Vehicle Speed that Produces 6 Watt Absorbed Power for each RMS Course.
- The data is measured from the driver seat base location

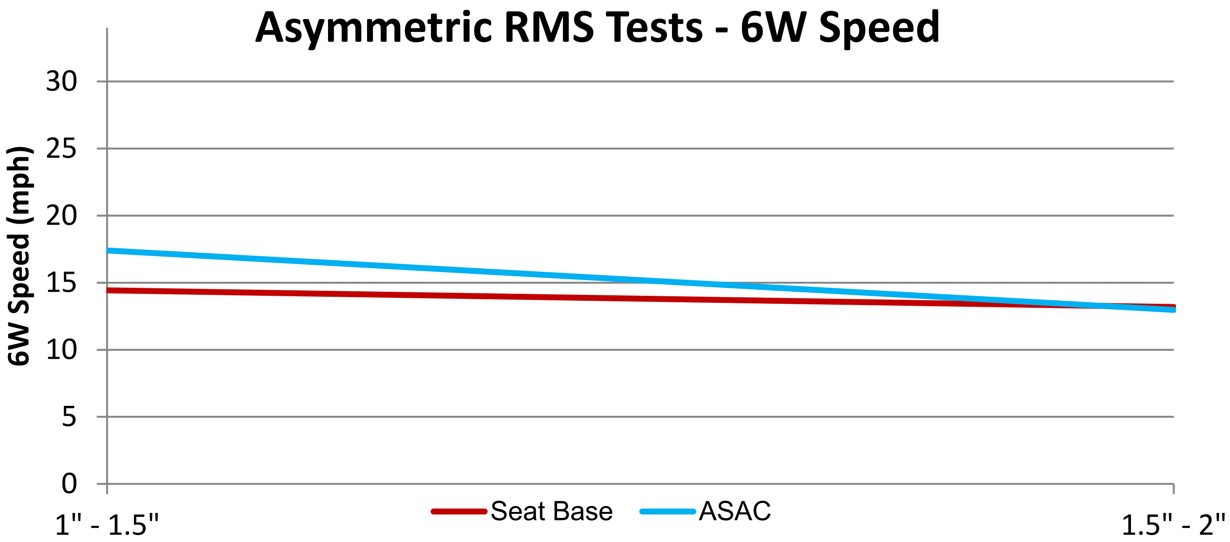




RMS Asymmetric: Absorbed Power

- Characterize the ride quality of the vehicle.
- The Result is the Vehicle Speed that Produces 6 Watt Absorbed Power for each RMS Course.
- Roll Dynamics, Stab bar is Exercised
- The data is measured from the driver seat base location





Summary, Automotive Events

Test	NRMM	NG-NRMM	Comments
Wall To Wall	✘	✔	No 3D Steering Mechanism in NRMM
Steady State Cornering	✘	✔	No Steering, Load Transfer Capability in NRMM
Straight Line Acceleration	✘	✔	NRMM over-predicts acceleration performance
V-Ditch	✔	✔	
Step Incline (12”,18”,24”)	✔	✔	
Double Lane Change (Paved and Gravel)	✘	✔	No Steering, Roll and Lateral Dynamics in NRMM
Side Slope Obstacle Avoidance	✘	✔	No Steering and Lateral Load Transfer in NRMM
60 % Grade Paved	✔	✔	
Half Round (4”, 8”, 10”, 12”)	✔	✔	
Symmetric RMS (1”,1.5”,2”,3”,4”)	✔	✔	
Asymmetric RMS (1”-1.5”, 1.5”-2”)	✘	✔	No Roll Dynamics in NRMM

Soft Soil Tests

Soft Soil Performance Prediction is Influenced by Larger Variation in Soil Constituents and Conditions than Hard Surface Tests

"Initial agreement between the measured and calculated values deviated by about 25 percent, but nevertheless they allow an estimate to be made with reasonable accuracy."

W. Sohne, Agricultural Engineering and Terramechanics, Journal of Terramechanics, Vol. 6, No. 4, pp. 9-30, 1969

- Soft Soil Properties
  - Lab Test
    - Tri-axial Test
    - Shear Box
    - Additional GeoTech Tests
  - Bevameter Test
    - Maximum Soil Shear Stress
    - Individual Tests for
      - Bearing Capacity (Pressure / Sinkage)
      - Shear Stresses (Shear / Displacement)
  - Cone Penetrometer
    - Force vs. Penetration Depth
    - Bearing and Shear Stress are Mixed

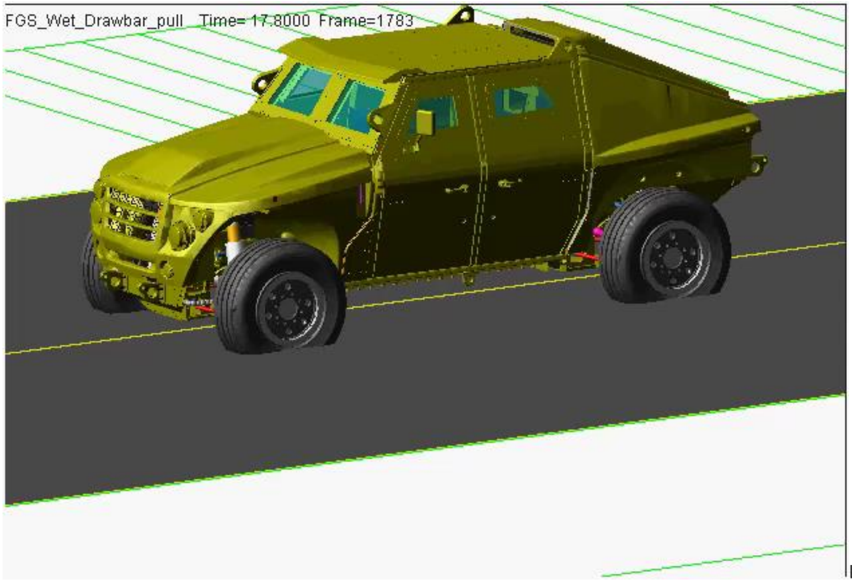
Drawbar Pull

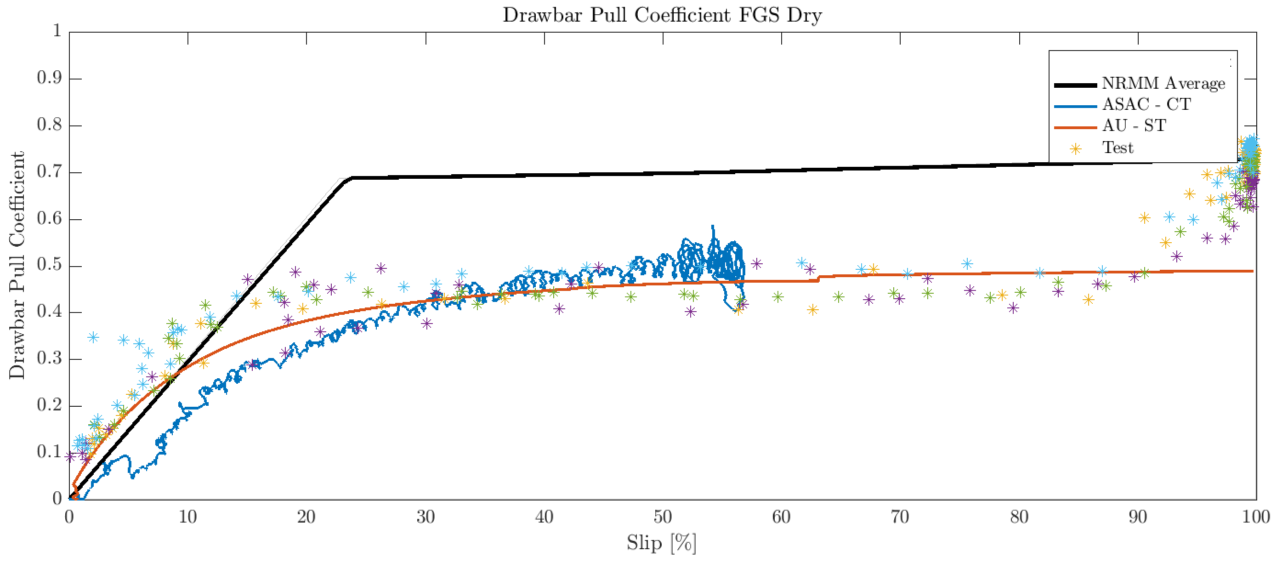
- Determine Drawbar Pull in Different Soil Types
- Vehicle Enter Test Area at Low Speed. Towed Vehicle Increases Drawbar by Braking
- Test is Completed at 100% Slip
  (Vehicle Immobilized)
- NRMM based on Cone Index (CI)

SOIL TYPE	CI
Fine Grain Soil Dry	255 - 298
Fine Grain Soil Wet	06 - 30
Coarse Grain Sand Dry	126 - 300

Drawbar Pull

- **Simulation Set Up**
  - Software Developers have Different Implementations of the Test
  - Vehicle Initial Speed 1 m/s
  - Throttle Applied While Drawbar Pull Force Ensures Constant Speed
  - At Max Slip in Lowest Gear (60%) Towed Vehicle Slowly Decelerates to Generate 100% Slip

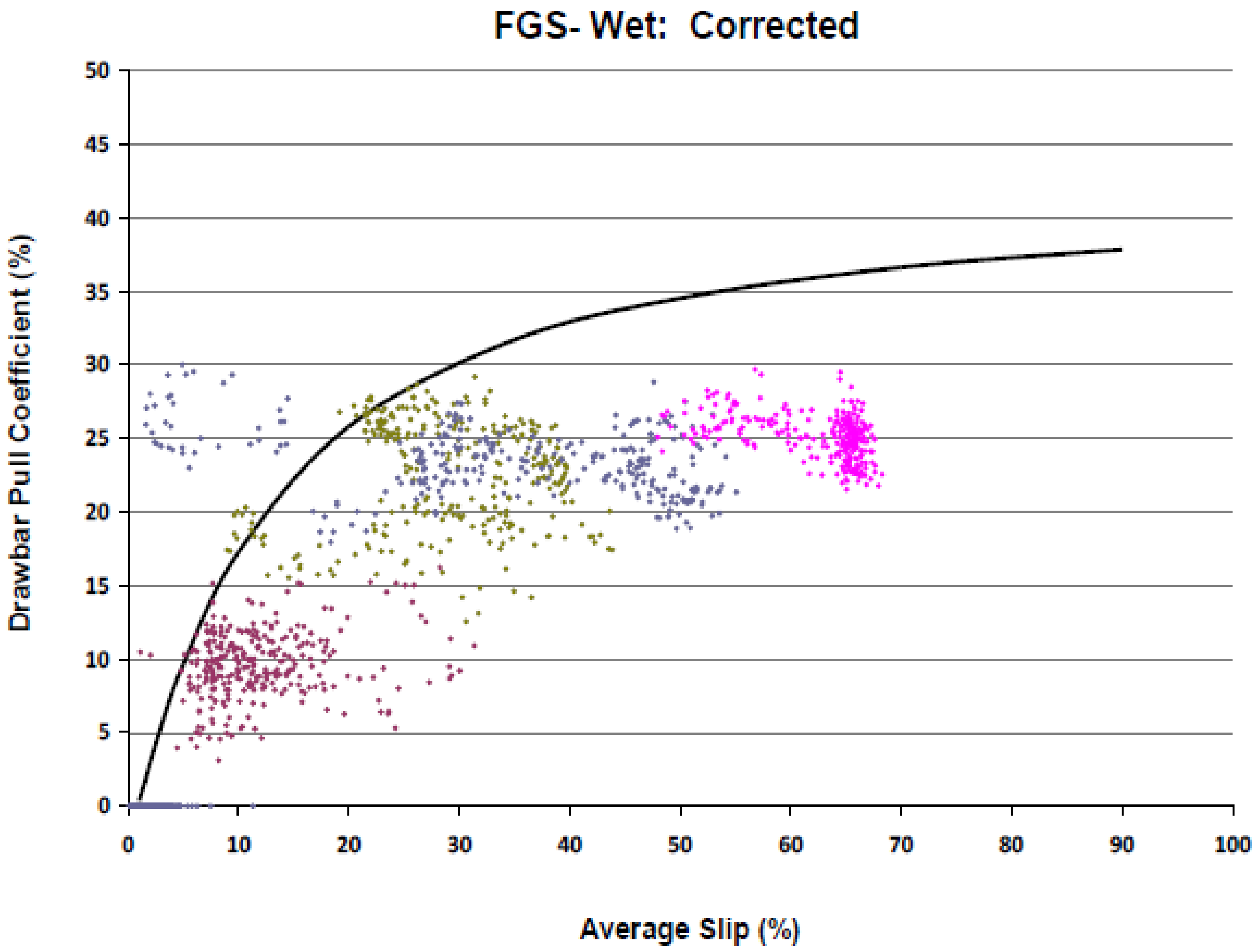




Drawbar Pull

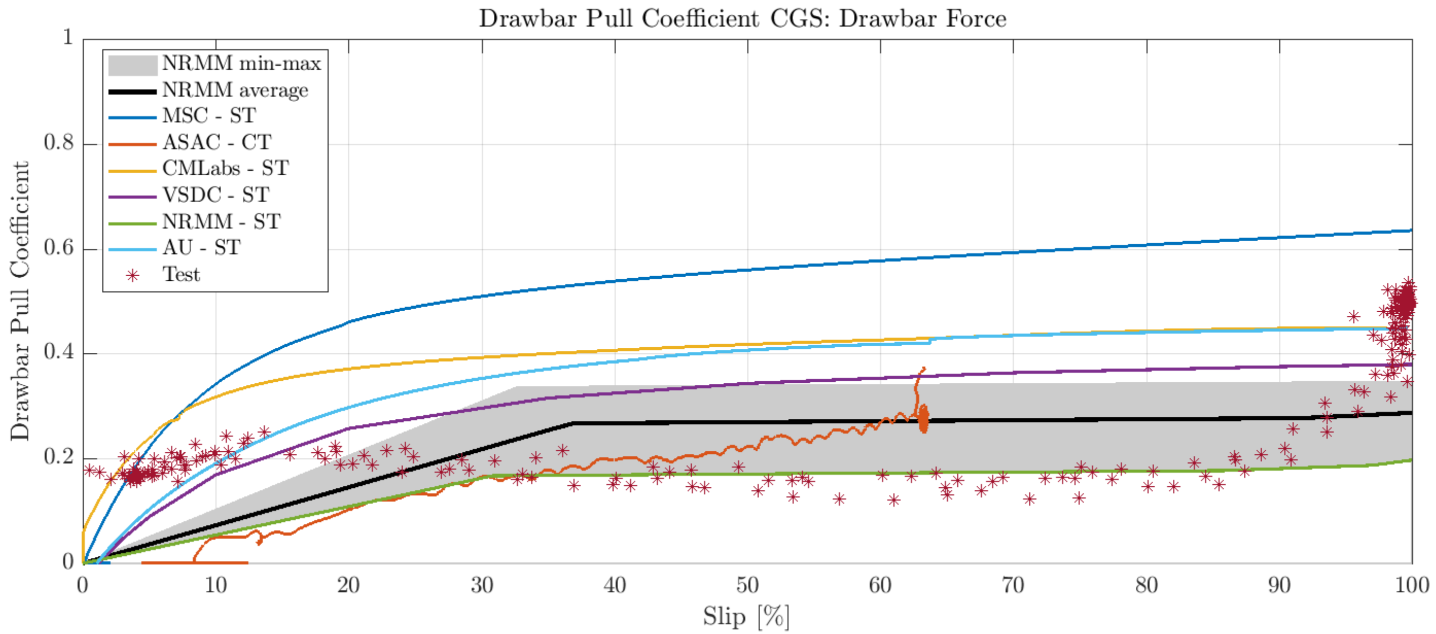
- **FGS Wet**
  - ➢ NRMM Under-Predicts the Soil Performance
  - ➢ NG-NRMM Over Predicts Soil Performance with Simple Terramechanics
  - ➢ NG-NRMM Follows Trend With Complex Terramechanics performs well for Low Slip

- **VSDC Requested Steady State DP Test**
  - ➢ Steady State is a condition for DP
  - ➢ KRC Completed a Second set of Tests with Near Steady State Conditions
  - ➢ VSDC Submitted new Results with this Data Set



Drawbar Pull – Coarse Grain

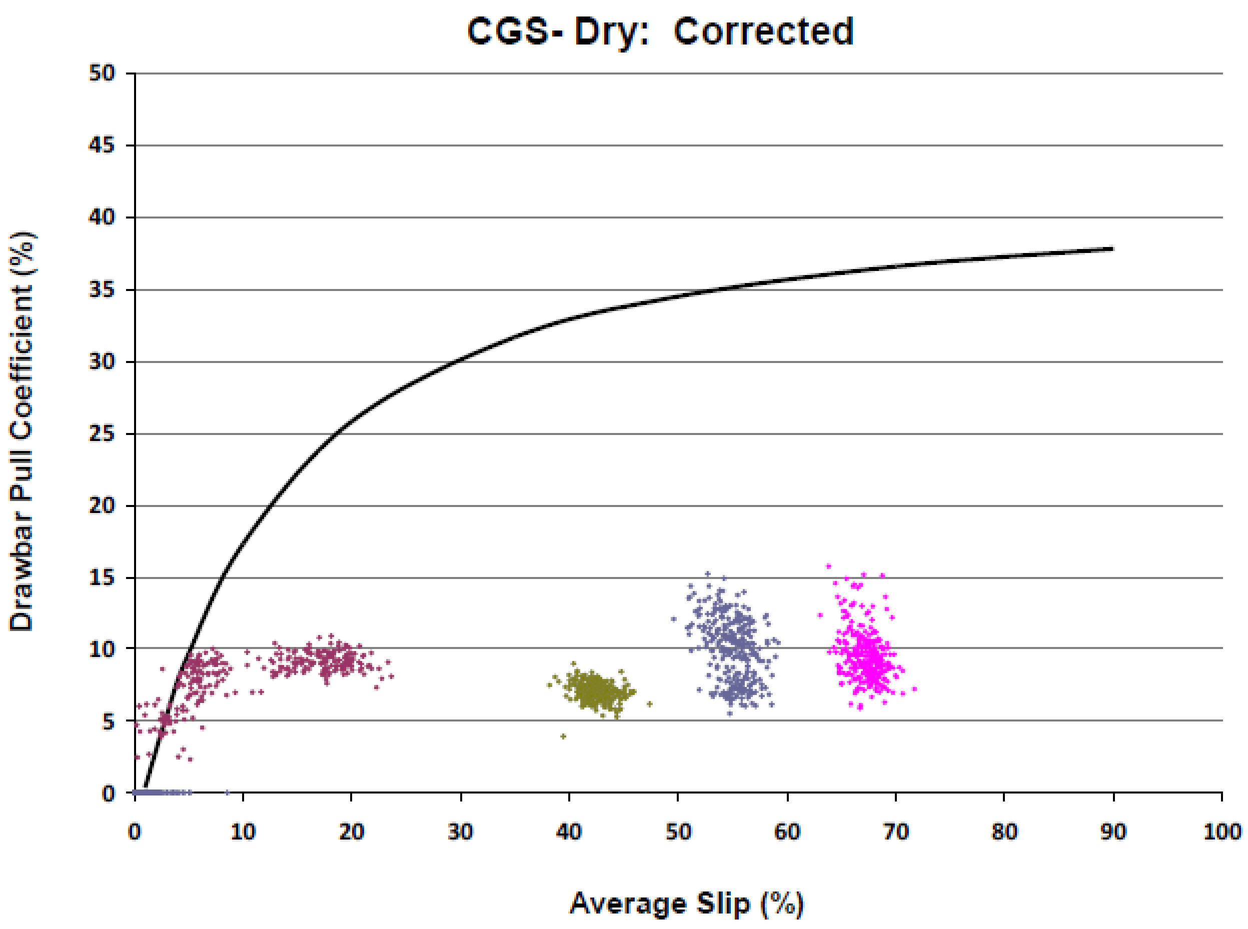
- **Complex vs. Simple Terramechanics**
  - 100% Slip in CT is needed
  - General ST Over-Estimates Coarse Grain Sand Performance



Date	Soil	Test	Average Rut Depth Range (cm)	VSDC Predicted Rut Depth Range (cm)
5-June-18	Coarse-Pit	Drawbar	[9 , 10]	3.7
5-June-18	Fine Grain Wet	Drawbar	[14 , 15]	[14.7 , 15.8]
5-June-18	Fine Grain Dry	Drawbar	[3 , 4]	[5.2 , 6]

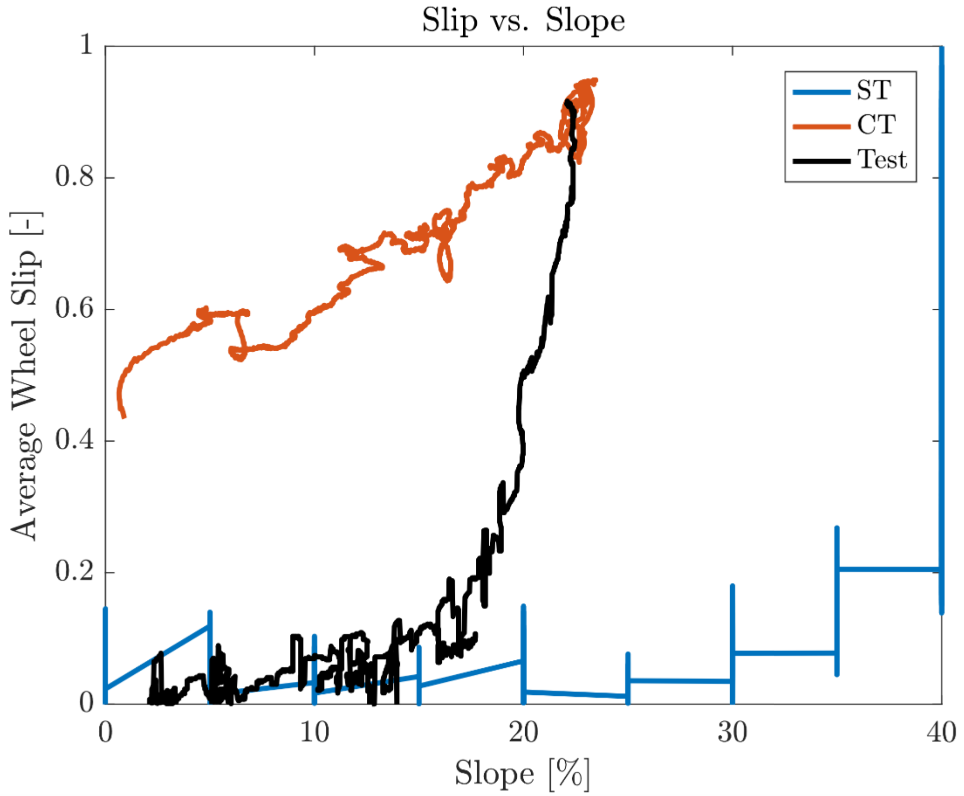
Drawbar Pull – Coarse Grain Sand

- **Drawbar Pull, Second Set of Tests**
  - ➢ Different Day, Different Moisture
  - ➢ "Steady State" Conditions
    - ➢ Different Soil Moisture Content
    - ➢ Inertia Correction Yields Minor Effect
  - ➢ Software Developers Primarily Used First Set of Drawbar Pull Tests



Variable Grade Sand Slope (Max 30%)

- Test Determines Max Slope
- Slope Design, 5% Grade Increment
- Simple Terramechanics Over-Predicts on Slope



Vendor	Max Sand Grade Limit %
TEST	18.5%
ASAC	15% - 23%
MSC	30%
CMLabs	30%
AU	30%
VSDC	30%
ZAF	20%%
NRMM	11.9% - 23.9%

Comparing Computation Time

- Simple Terramechanics
  - ➢ Fast Computation Time
- Complex Terramechanics
  - ➢ Long Computation Time

Computation Time Comparison: ST vs. CT *

Soft Soil Test	Simple Terremechanics		Complex Terramechanics	
	Simulation Time	Wall Clock Time	Simulation Time	Wall Clock Time
DBP FGS Dry	35 sec	17 sec	40 sec	43hrs
DBP FGS Wet	22 sec	1 min	8 sec	4hrs

** Results Reported are All from Different Vendors*

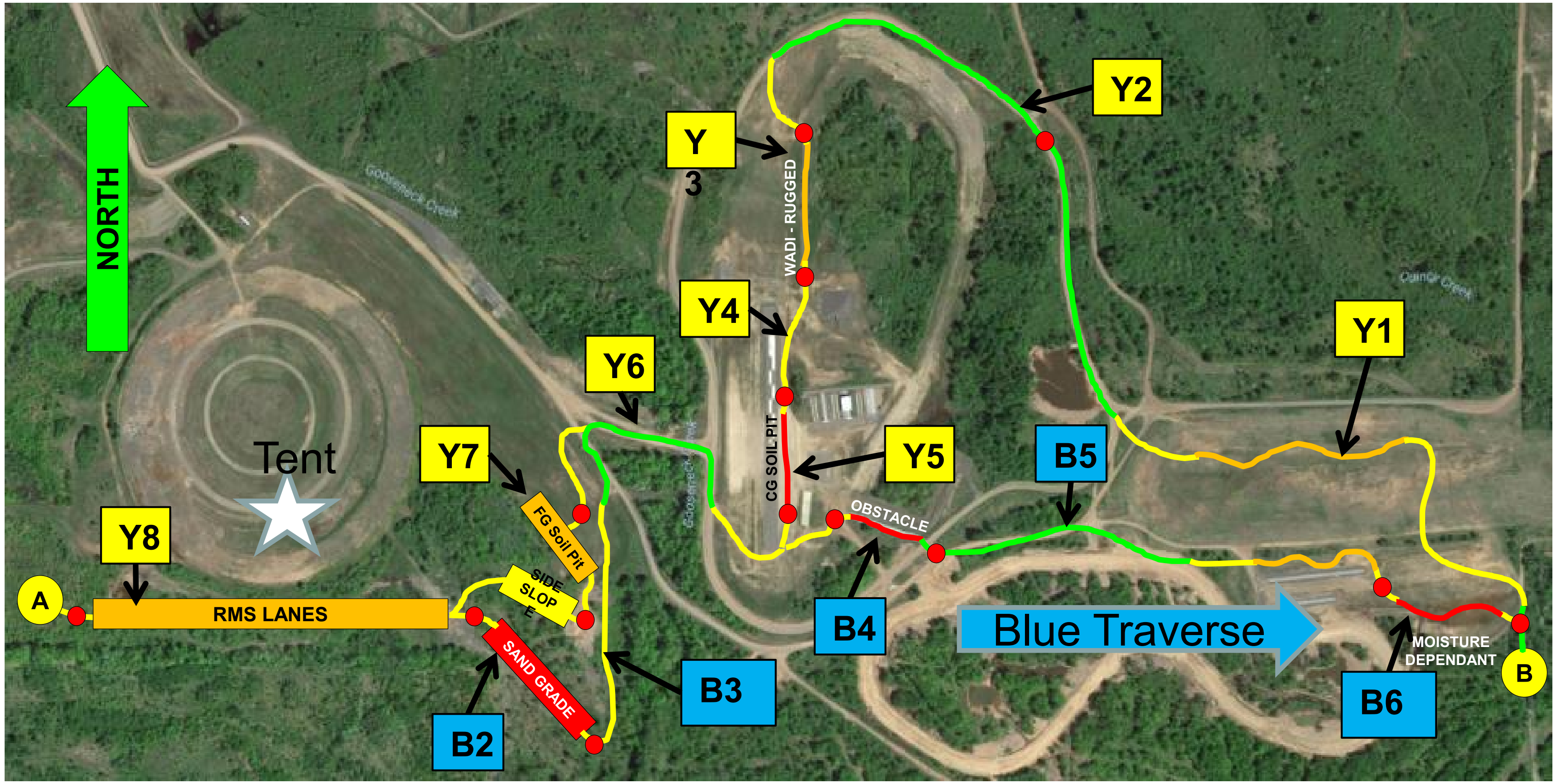
Summary, Soft Soil Events

Test	NRMM	NG-NRMM	Comments
Drawbar Pull, Fine Grain Soil – Dry	✘	✔	NRMM Over-Predicted
Drawbar Pull, Fine Grain Soil – Wet	✔	✔	
Drawbar Pull, Coarse Grain Soil - Dry	✘	✘	ST and CT Performed Reasonable NRMM Performed Reasonable
Variable Grade Sand Slope, 2NS - Dry	✘	✔	CT – Slip high NRMM Large Variation on Min Max

- **Soft Soil Mobility Prediction NG-NRMM in Comparison to NRMM:**
  - NG-NRMM Predicted Drawbar Pull for Fine Grain Wet and Dry. NRMM predicted Drawbar Pull on Fine Grain Wet only.
  - Coarse Grain Sand Drawbar Pull not successfully Predicted by both NG-NRMM and NRMM.
  - NG-NRMM Predicted Slope with both ST and CT. High Slip was noted for CT. NRMM showed Large Variation in Grade Prediction
  - CT and one ST Software Developer Demonstrated Multi-Pass Effects

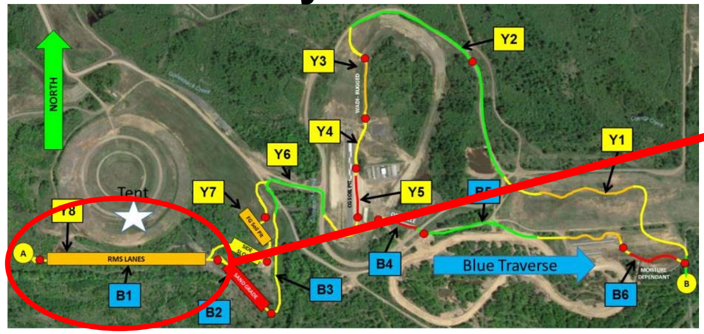
Mobility Traverse

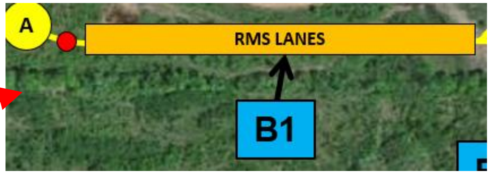
Cooperative Demonstration of Technology (CDT) – Mobility Traverse Map

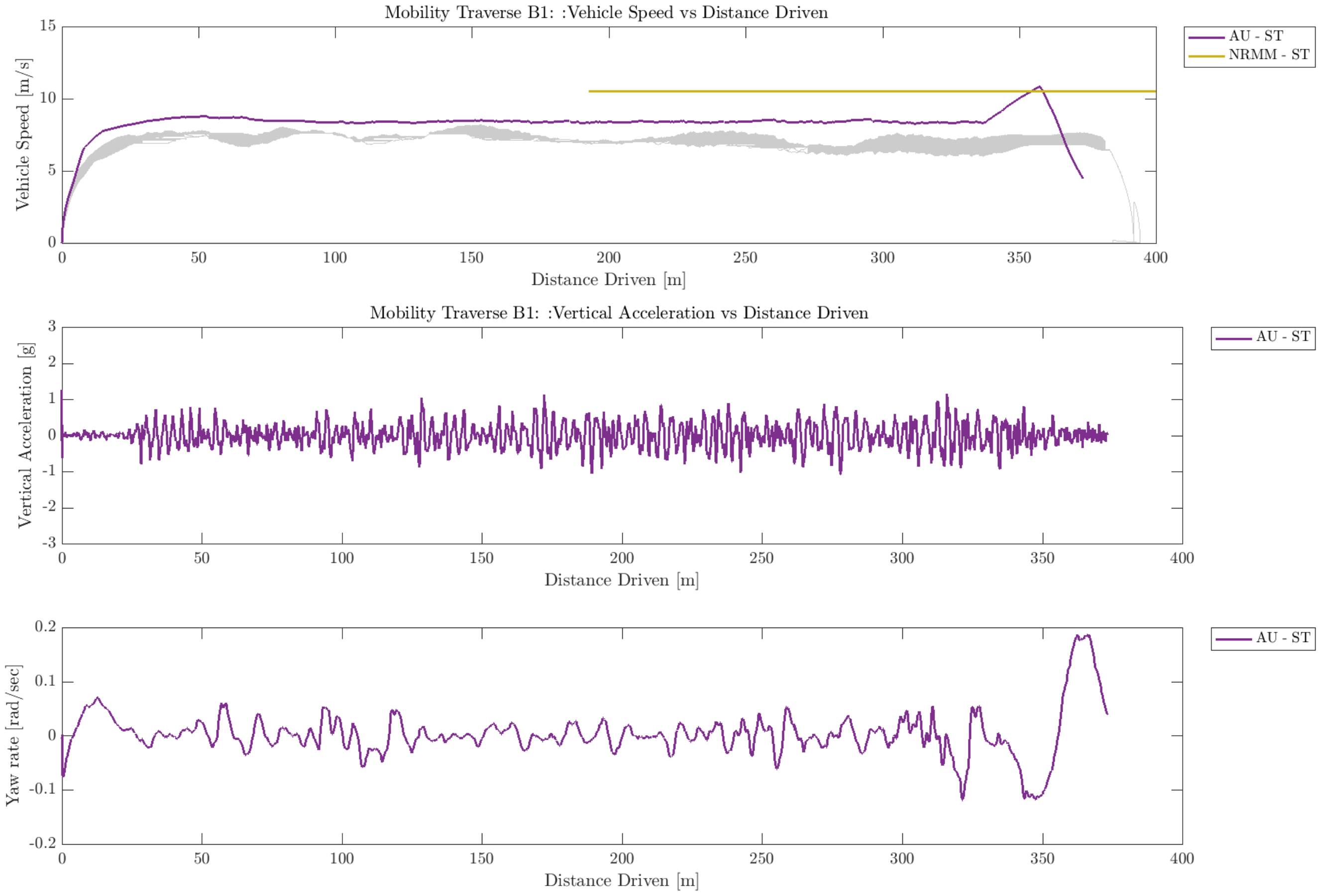


Approximately 1 mile by ½ mile Rectangle

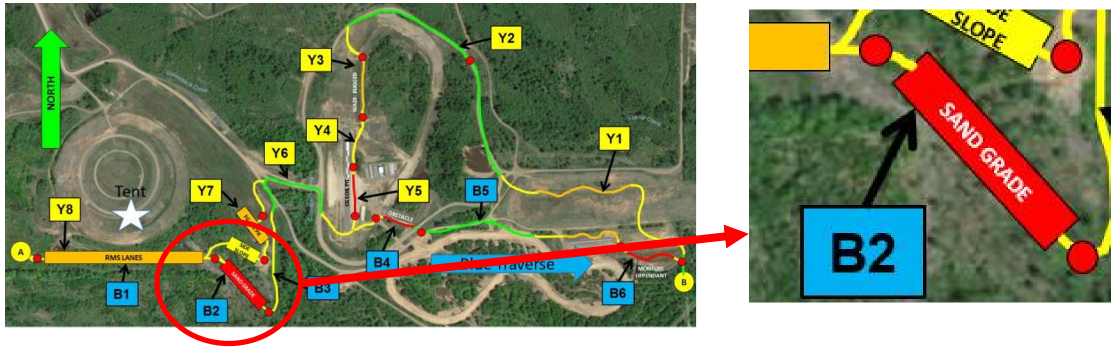
Mobility Traverse B1: RMS 1”

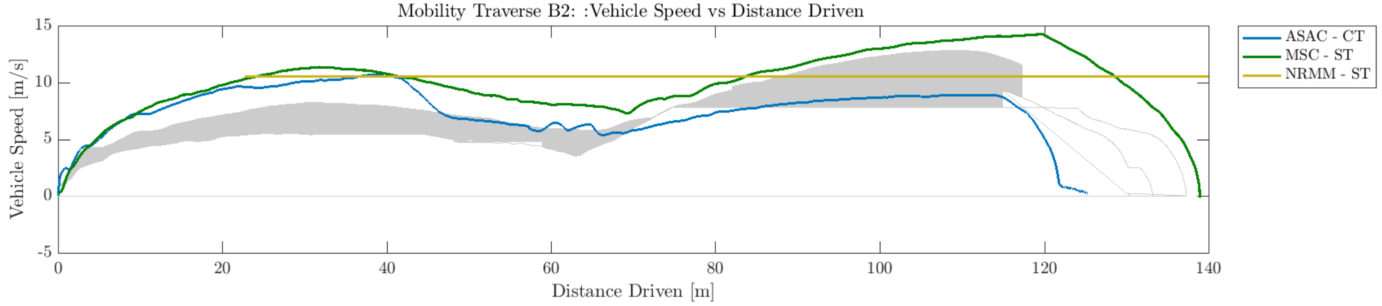


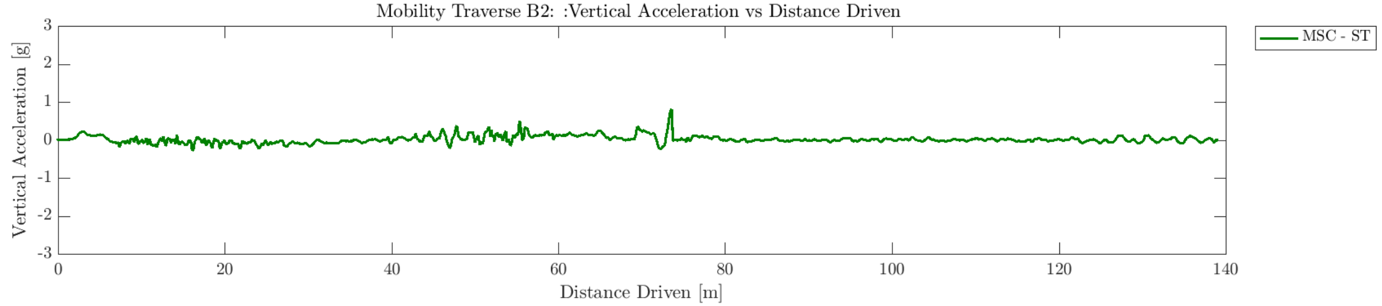


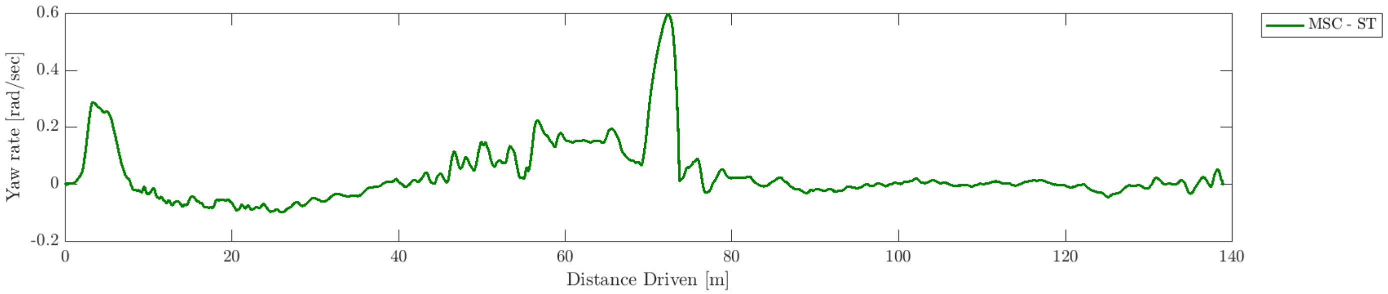


Mobility Traverse B2

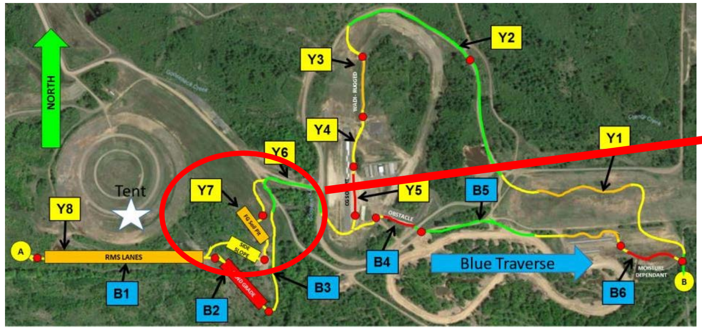


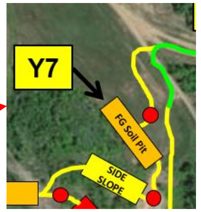


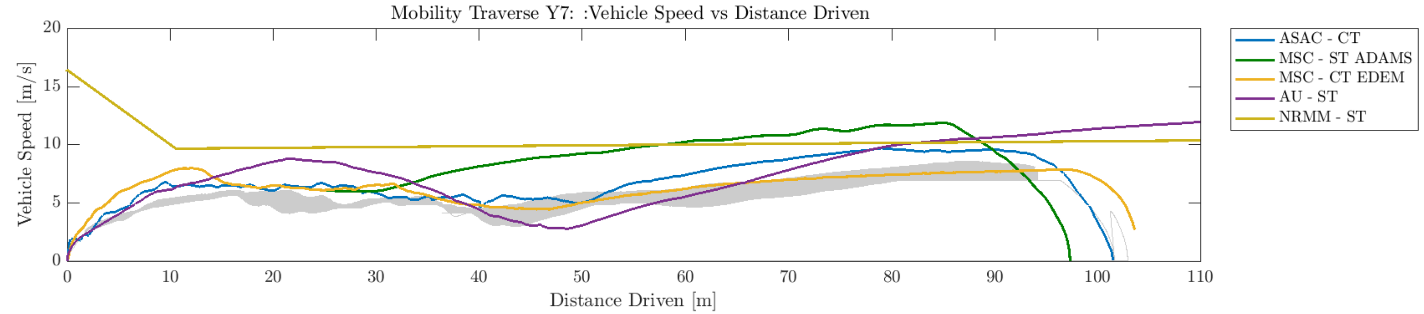


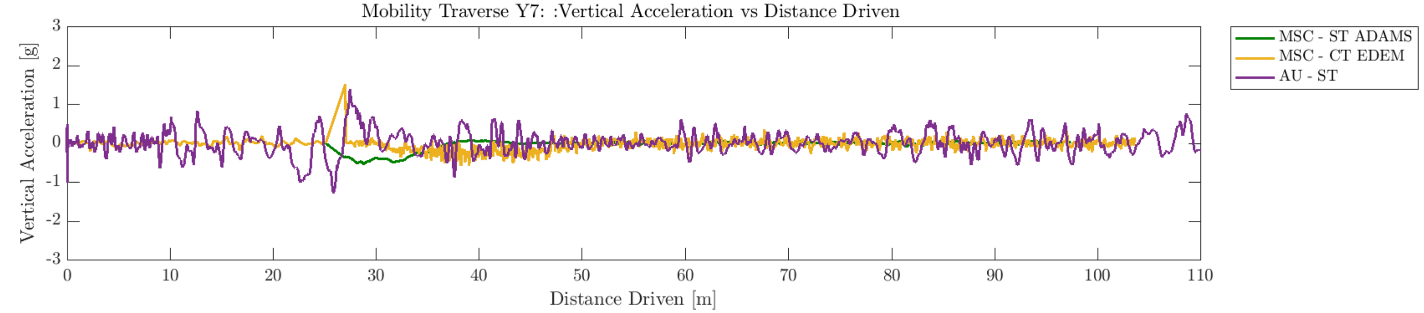


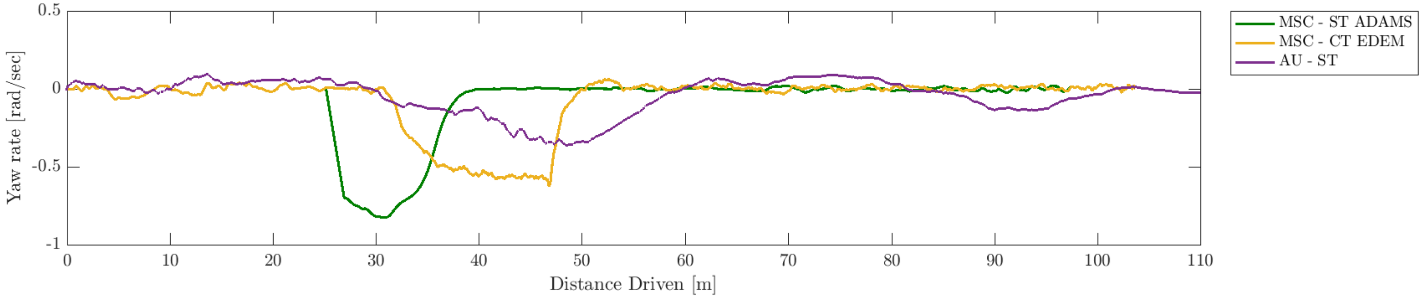
Mobility Traverse Y7



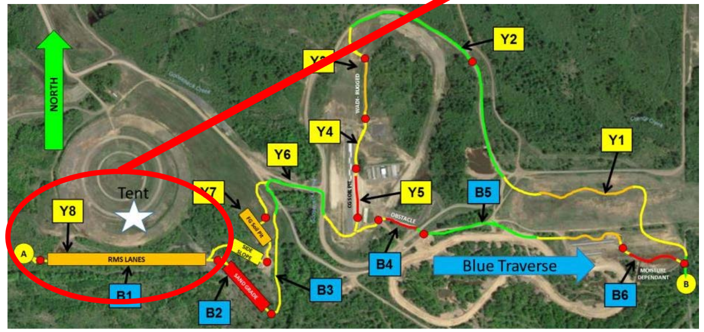


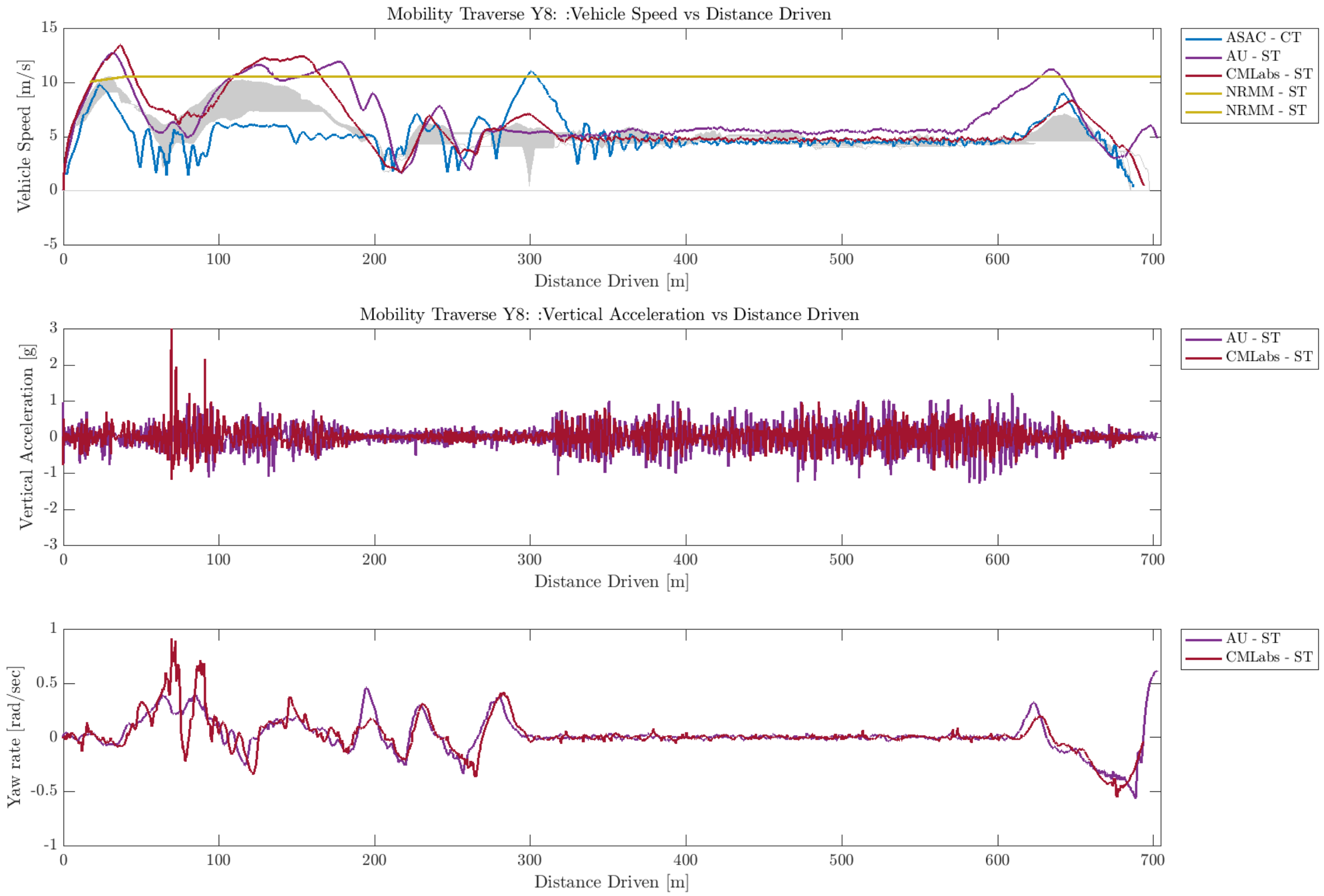






Mobility Traverse Y8





Traverse Comparisons: NRMM | NG-NRMM

Traverse		Max Speed		AVG Speed		Comments
		NRMM	NG-NRMM	NRMM	NG-NRMM	
B1	RMS 1.0 with Exit onto Gravel Pad	✗	✗	✓	✓	Test Driver Below 6W Speed
B2	Up Slope on Gravel Pad with Down Slope through 2NS Sand Grade	✓	✓	✗	✓	NRMM Low Avg Speed (Lacks Terrain Unit Transitions)
B3	Construction Site Road to Gravel Access Road & Loop 2, Rink Field Traverse with setup for OEF	✓	✓	✓	✓	
B4	OEF Trail	✗	✓	✗	✗	Asymmetric input, 6W Limits
B5	Gravel Road to Stability Side Trail, Sinusoidal Side Slope with Setup for Moisture Dependant Area	✓	✓	✗	✗	Driver Limits, 3D Maneuver
B6	Moisture Dependant Area	NA	NA	NA	NA	Test Did Not Go Through Water

Traverse Comparisons: NRMM | NG-NRMM

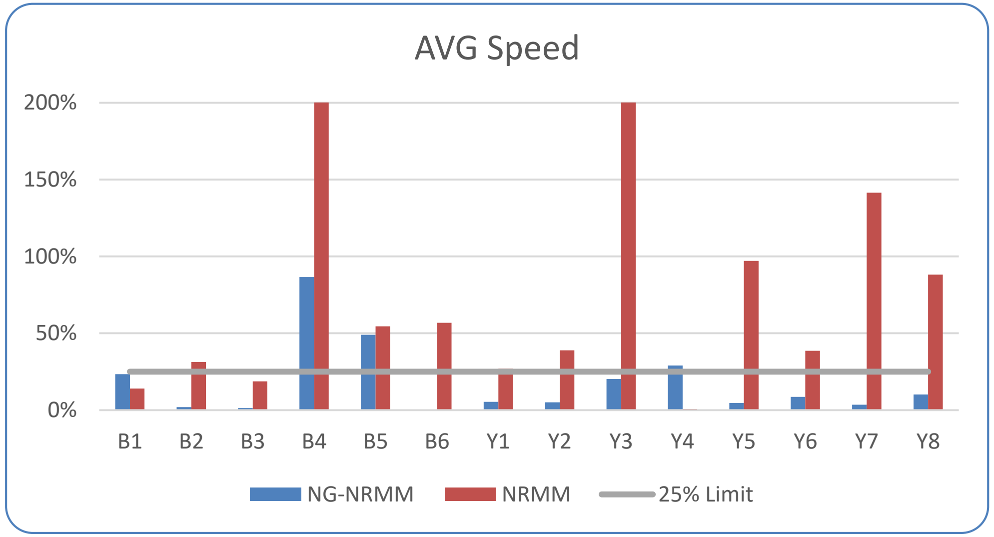
Traverse		Max Speed		Average Speed		Comments
		NRMM	NG-NRMM	NRMM	NG-NRMM	
Y1	Stability Field Traverse with Sinusoidal Side Slope, Loop 2 with Panic Stop	✓	✓	✓	✓	
Y2	Loop 2 with Rink Field Traverse & Setup for Wadi	✓	✓	✓	✓	
Y3	Wadi	✗	✓	✗	✓	Short + Transitions
Y4	Rink Field Traverse with Setup for Coarse Grain Pit	✗	✗	✓	✗	Driver Limits
Y5	Sinusoidal Coarse Grain Pit	✗	✓	✗	✓	Steering
Y6	Rink Field Traverse with Loop 2 & Access Road to VDA 2 Field Traverse & Setup for Fine Grain Soil	✓	✓	✓	✓	
Y7	Fine Grain Soil Pit - Up slope into pit then 90 degree turn in pit with accelerated exit	✗	✓	✗	✓	Steering 90 deg, Acceleration
Y8	Construction Site Road to Side Slope, Obstacle avoidance on Side Slope, then RMS 2.0	✗	✓	✗	✓	Steering, Roll

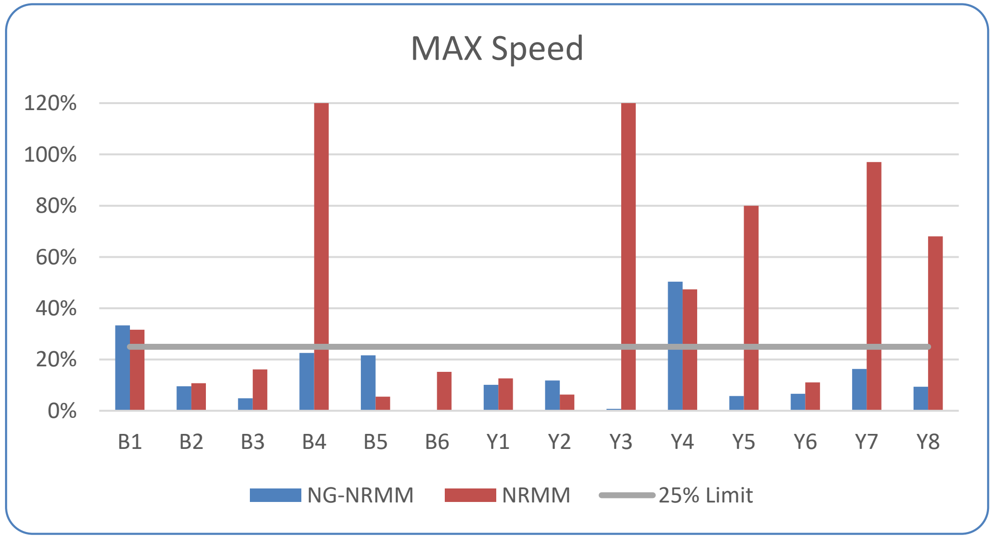
Traverse Summary

- **NG-NRMM in Comparison to Test and NRMM**

  - **Example Y7:**
    - *Up Slope into Pit then 90 deg Turn in Pit with Accelerated Exit*
    - NRMM does not slow down for the 90 deg turn and does not accelerate

- **NG-NRMM in Better Agreement with Real Test Driver** ✓





Conclusions

- **Automotive Tests**
  - NRMM Lacks 3D dynamics and therefore only Performed Straight Line Tests.
  - NG-NRMM Based Models predict all Automotive Tests
- **Soft Soil Tests**
  - NRMM only predicts Fine Grain Soil Wet
  - NRMM showed Large Variation in Slope Prediction
  - NG-NRMM predicts all Soft Soil Events Except Coarse Grain Dry
  - CT and one ST Software Developer Demonstrated Multi-Pass Effects
- **Mobility Traverse**
  - NRMM Over-Predicts Average Speed Compared to Tests
  - NG-NRMM is within 25% of the Test Speed in more than 75% of the Traverses
  - NG-NRMM Driver Models do not have same perceived Speed Limits as Test Driver
- **NG-NRMM is Demonstrated to be in Better Agreement with Test** ✓

Questions

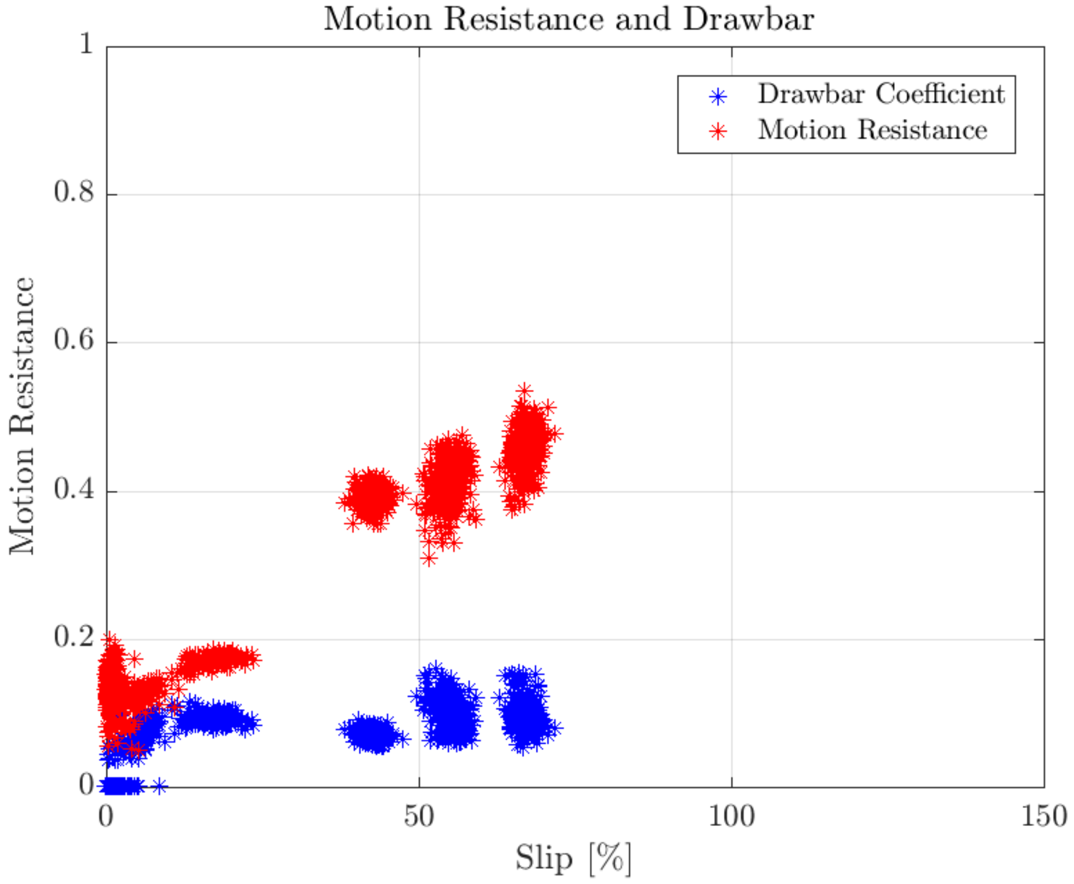
Backup Slides

For Reference

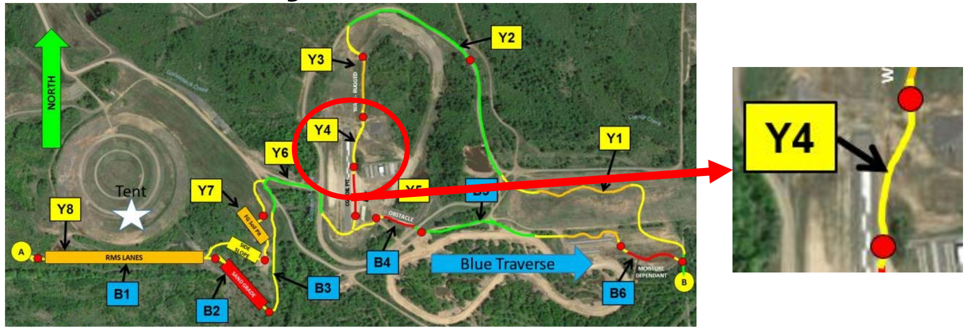
Speed (MAX and AVG) reported in mph			NG-NRMM*			Test			NRMM			MAX Speed		AVG Speed	
Section	Description	Traverse Length (m)	MAX	AVG	TIME (sec)	MAX	AVG	TIME (sec)	MAX	AVG	TIME (sec)	NG-NRMM	NRMM	NG-NRMM	NRMM
B1	RMS 1.0 with Exit onto Gravel Pad	385	24	18	48	18	15	60	24	17	52	33%	32%	23%	14%
B2	Up Slope on Gravel Pad with Down Slope through 2NS Sand Grade	131	24	13	22	27	13	23	24	17	17	-10%	-11%	2%	31%
B3	Construction Site Road to Gravel Access Road & Loop 2, Rink Field Traverse with setup for OEF	733	43	23	73	41	23	72	34	27	60	5%	-16%	-1%	19%
B4	OEF Trail	123	17	13	21	14	7	40	37	32	9	23%	162%	87%	353%
B5	Gravel Road to Stability Side Trail, Sinusoidal Side Slope with Setup for Moisture Dependant Area	580	44	27	48	36	18	89	34	28	47	22%	-5%	49%	54%
B6	Moisture Dependant Area	156	N/A	N/A	N/A	20	13	29	24	20	18	N/A	15%	N/A	57%
Y1	Stability Field Traverse with Sinusoidal Side Slope, Loop 2 with Panic Stop	882	47	23	86	42	24	82	37	31	64	10%	-13%	-5%	27%
Y2	Loop 2 with Rink Field Traverse & Setup for Wadi	356	44	26	31	39	24	33	37	34	24	12%	-6%	5%	39%
Y3	Wadi	205	16	7	70	16	8	53	38	30	15	-1%	137%	-20%	264%
Y4	Rink Field Traverse with Setup for Coarse Grain Pit	133	37	20	15	25	28	20	36	28	11	50%	47%	-29%	-1%
Y5	Sinusoidal Coarse Grain Pit	162	22	16	23	21	15	25	37	29	12	6%	80%	5%	97%
Y6	Rink Field Traverse with Loop 2 & Access Road to VDA 2 Field Traverse & Setup for Fine Grain Soil Pit	444	36	20	50	34	22	46	37	30	33	7%	11%	-9%	39%
Y7	Fine Grain Soil Pit - Up slope into pit then 90 degree turn in pit with accelerated exit	103	22	11	21	19	11	22	37	25	9	16%	97%	4%	141%
Y8	Construction Site Road to Side Slope, Obstacle avoidance on Side Slope, then RMS 2.0	713	25	10	161	23	11	141	38	21	77	9%	68%	-10%	88%

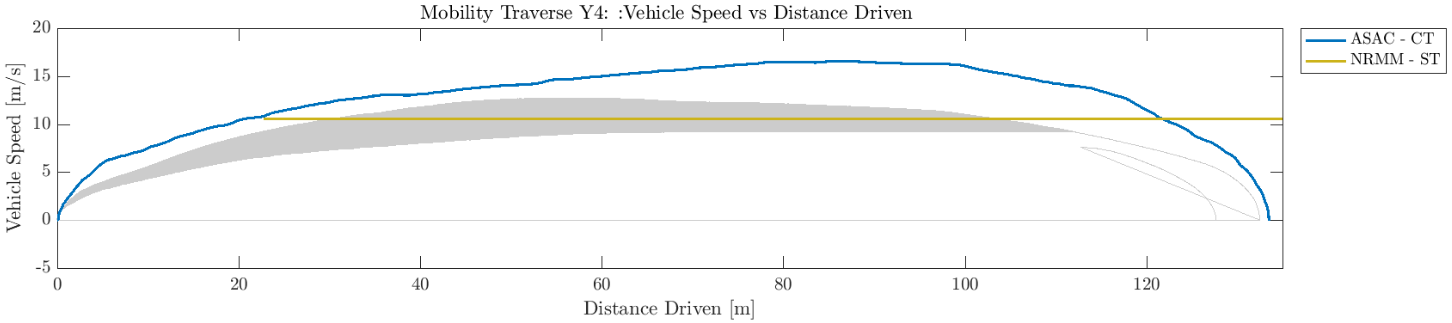
Drawbar Pull – Coarse Grain

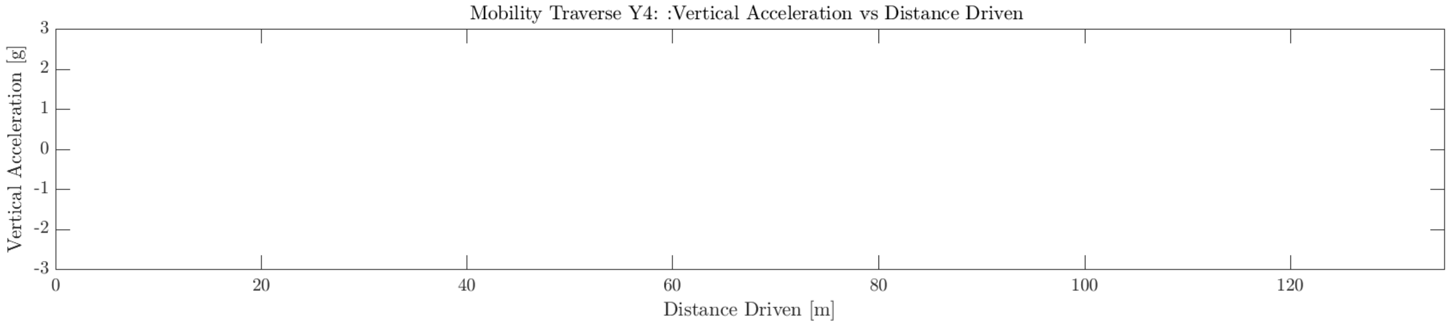
- **Drawbar Pull Results**
  - First Set of Drawbar Pull Tests was Performed by Slowing Vehicle Down
    - Low Slip – Zero Drawbar Pull Data Not Available
    - Not at Steady State Conditions
    - Inertia Correction was Performed
  - Second Set of Drawbar Pull Tests Done Under Steady State Conditions
    - Different Soil Moisture Content
    - Inertia Correction Yields Minor Effect
  - Software Developers Primarily Used First Set of Drawbar Pull Tests
  - Large Motion Resistance at Large Slip

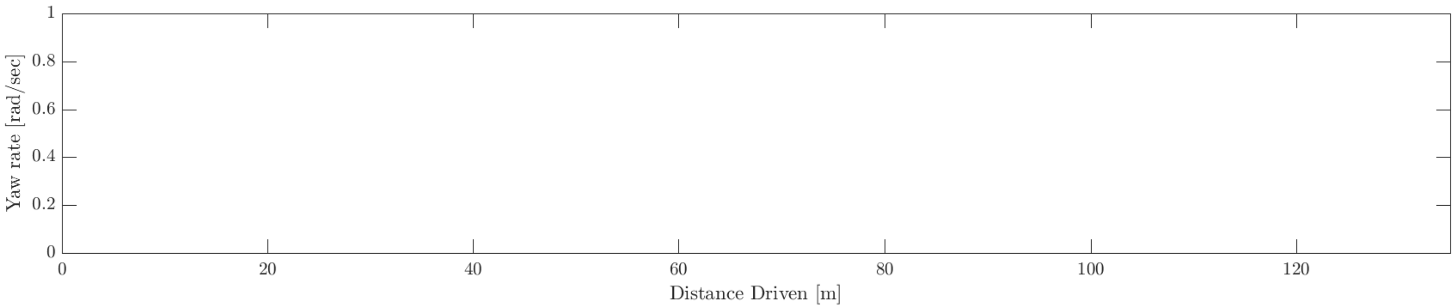


Mobility Traverse Y4

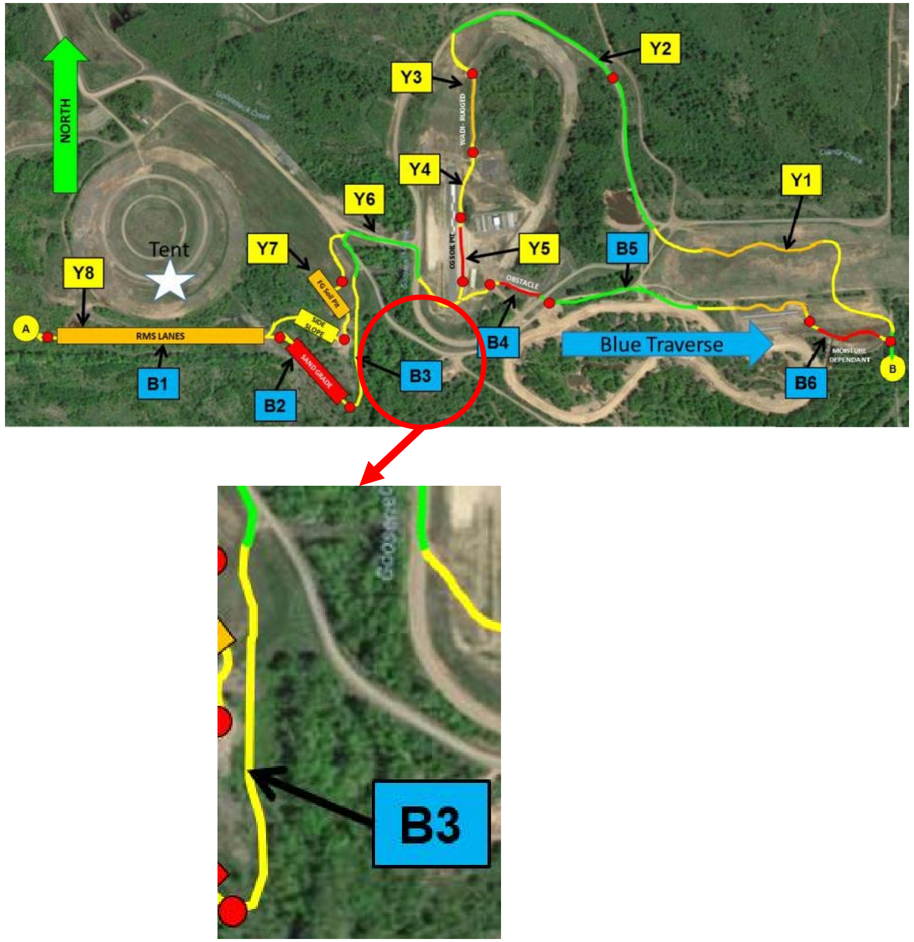


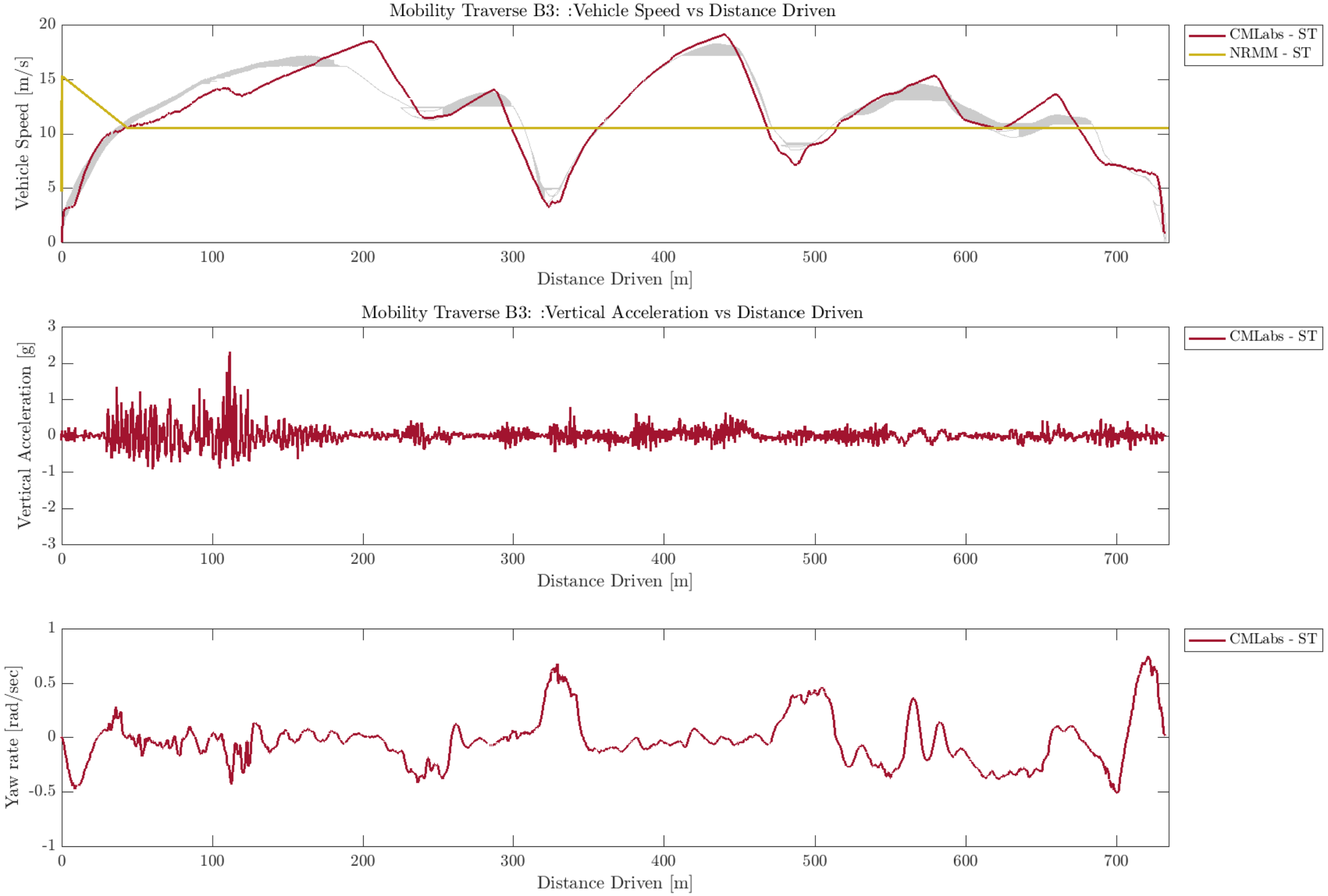




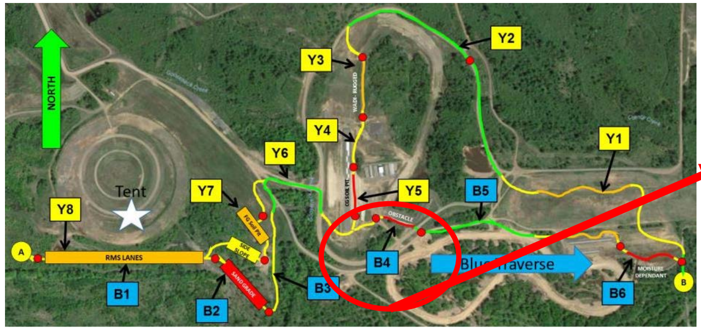


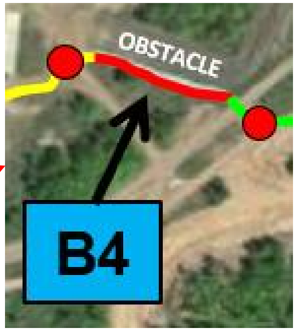
Mobility Traverse B3

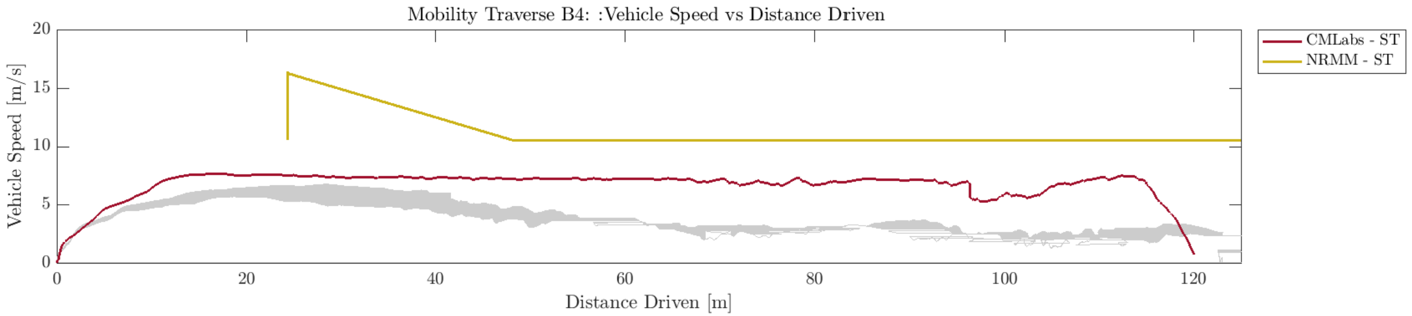


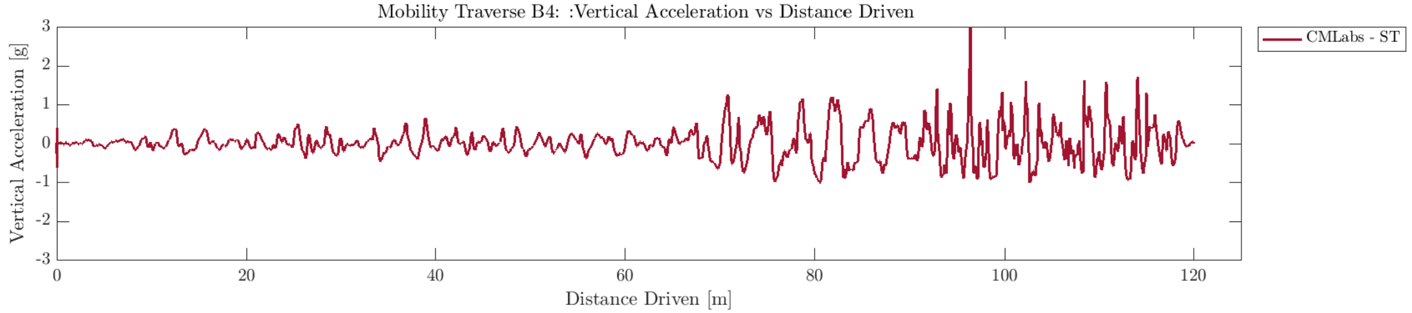


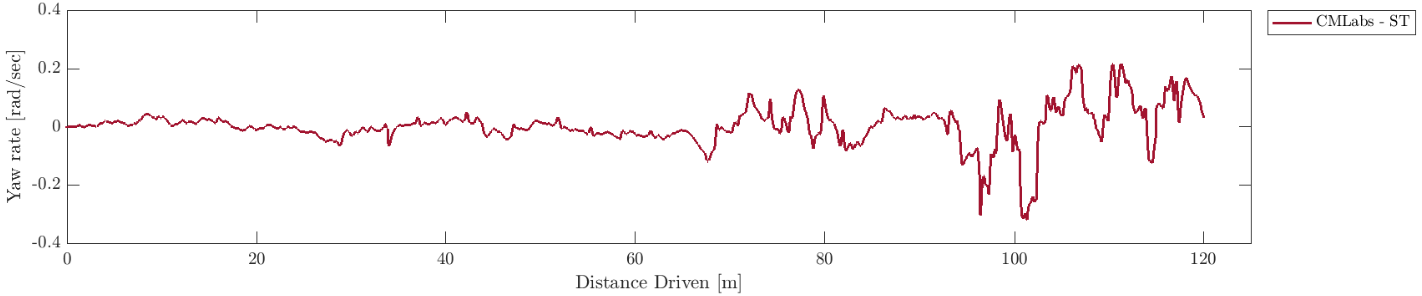
Mobility Traverse B4



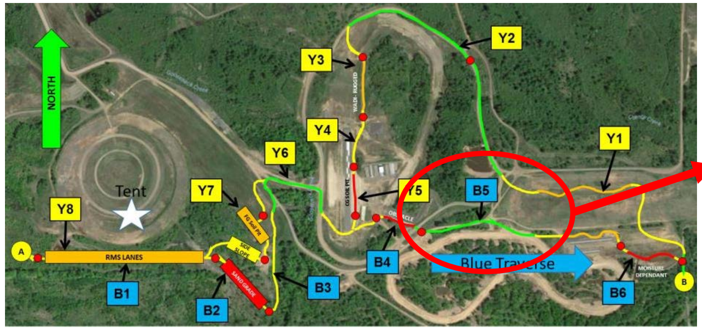


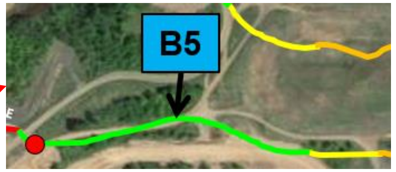


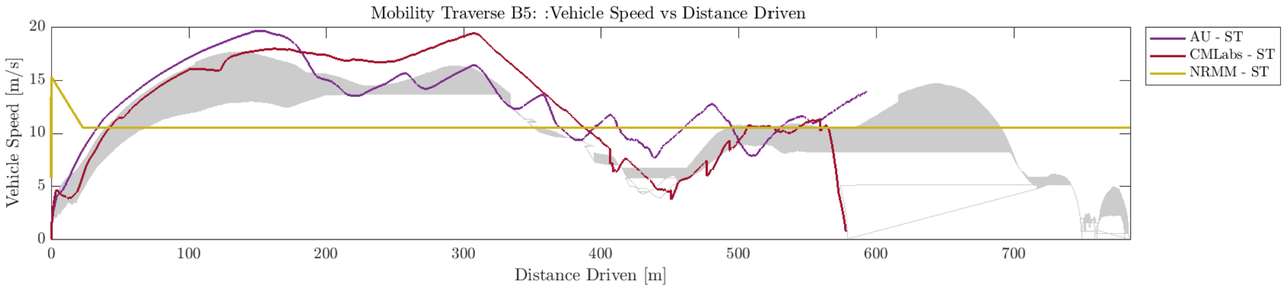


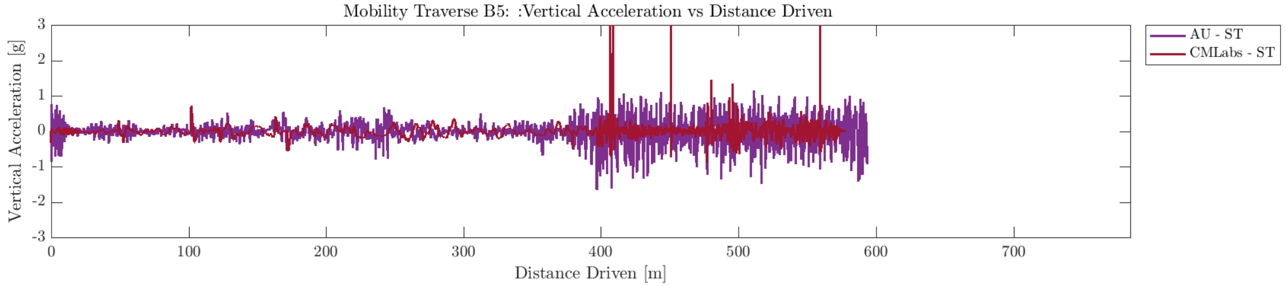


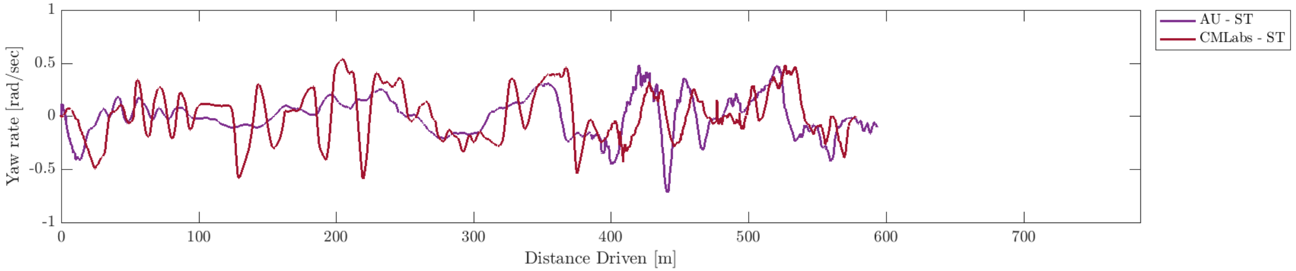
Mobility Traverse B5











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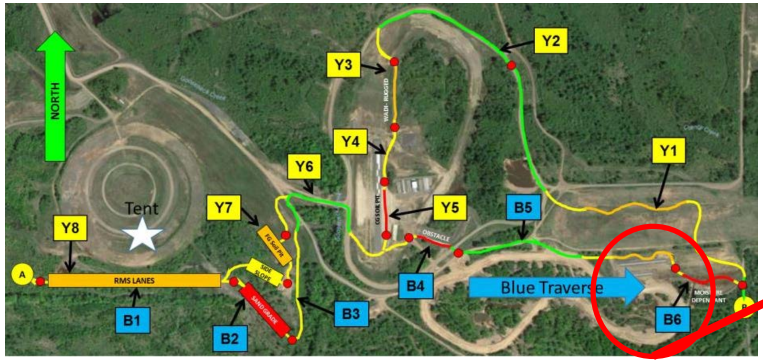
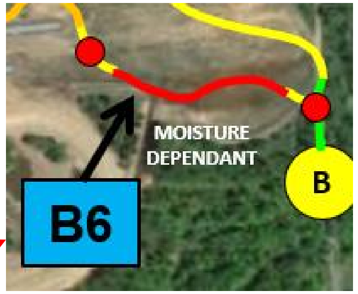
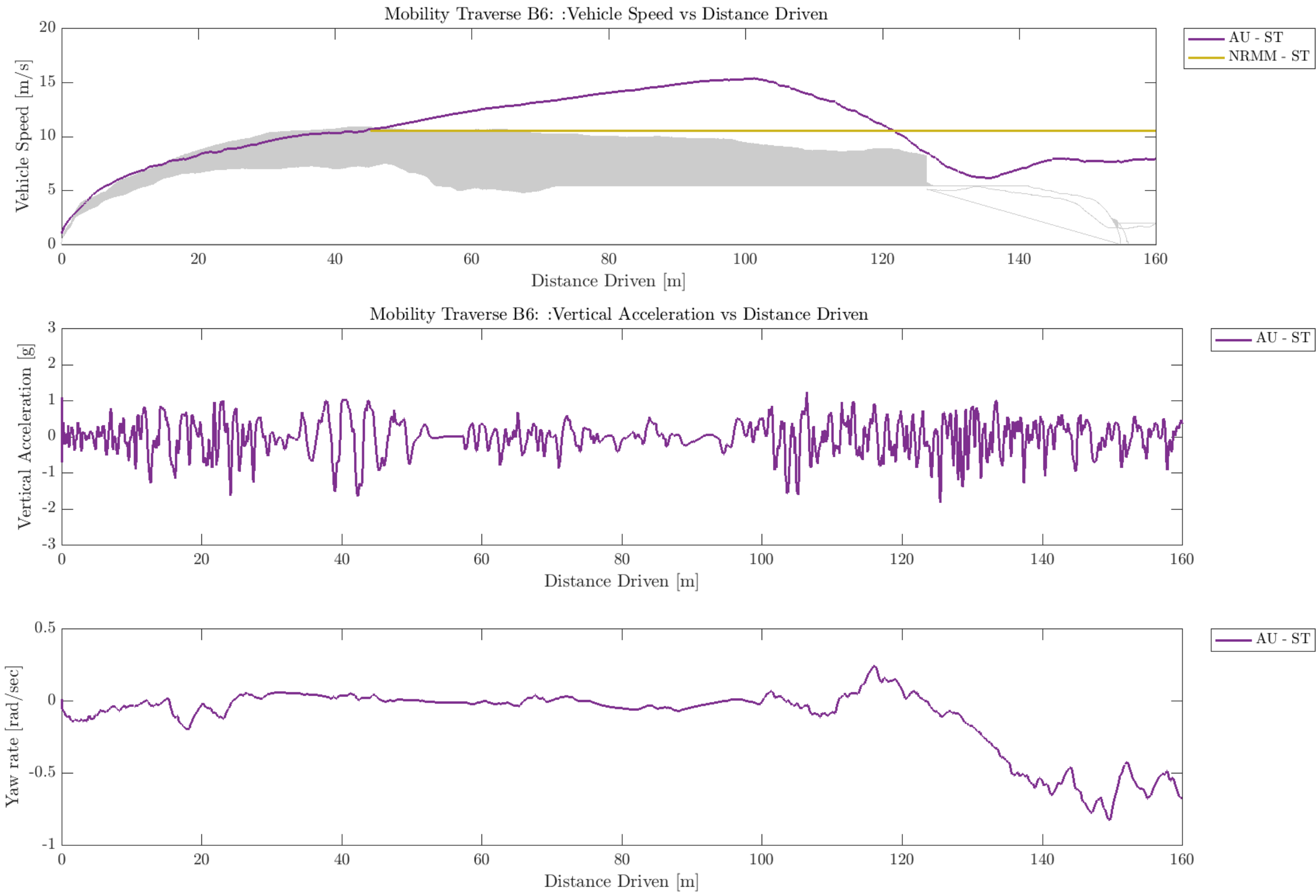
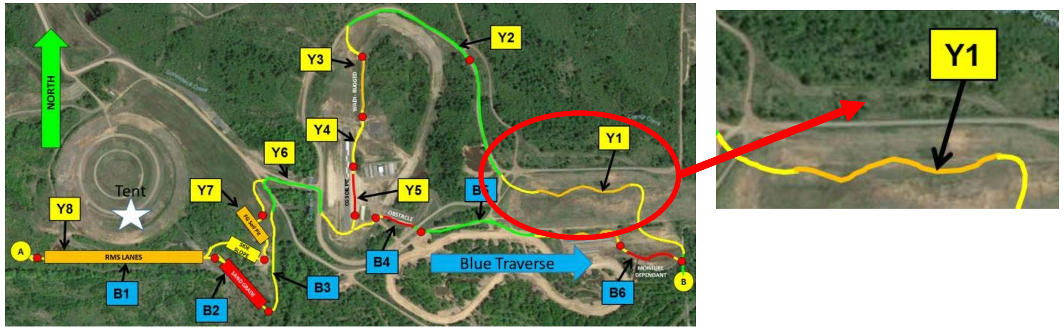
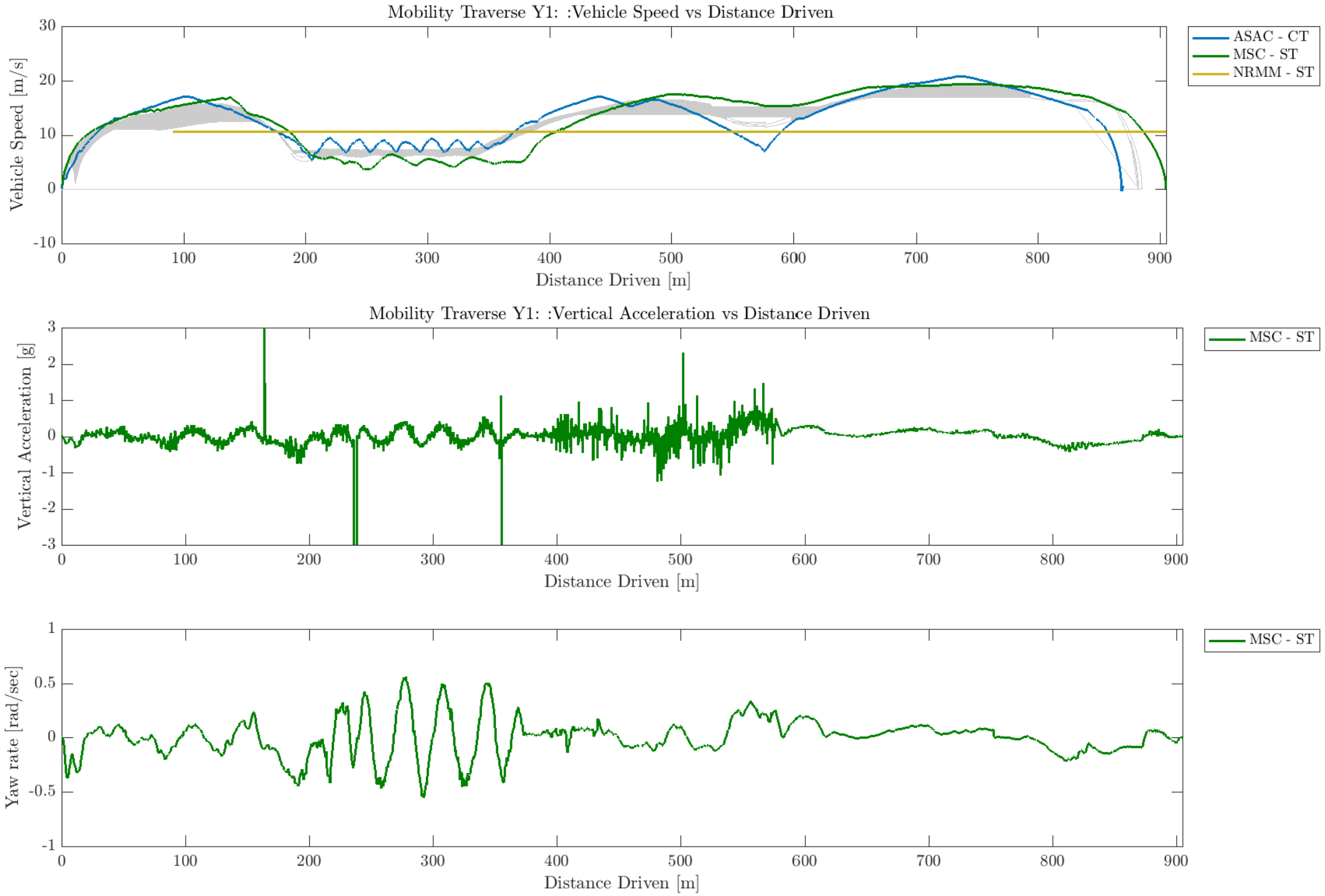




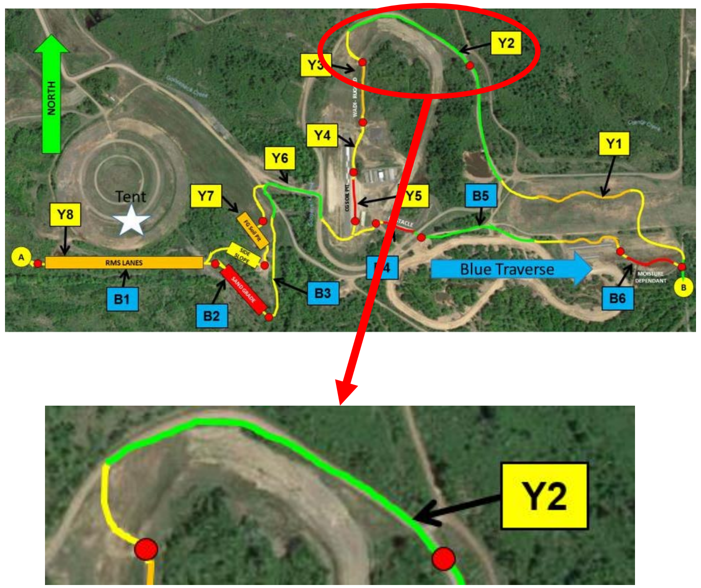


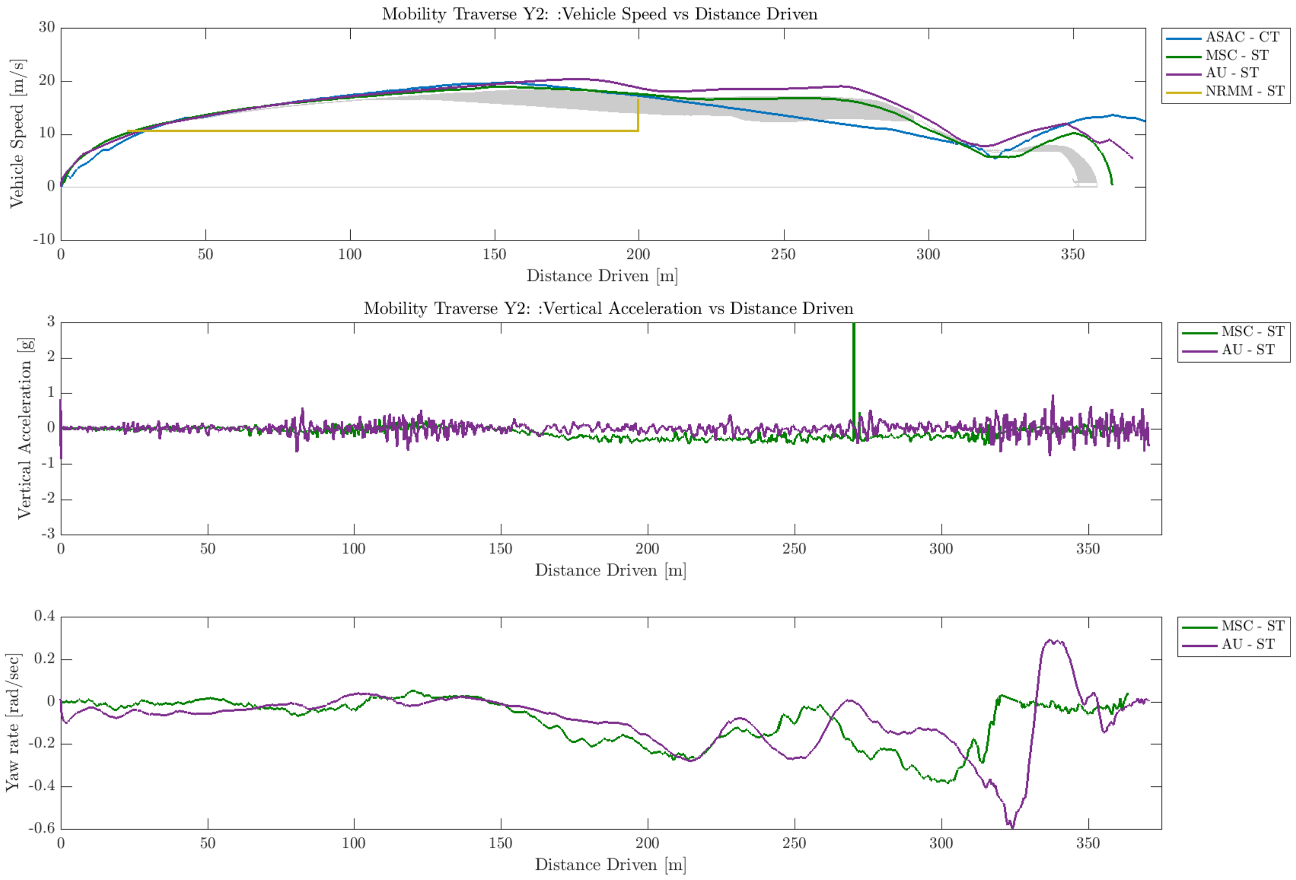
Mobility Traverse Y1



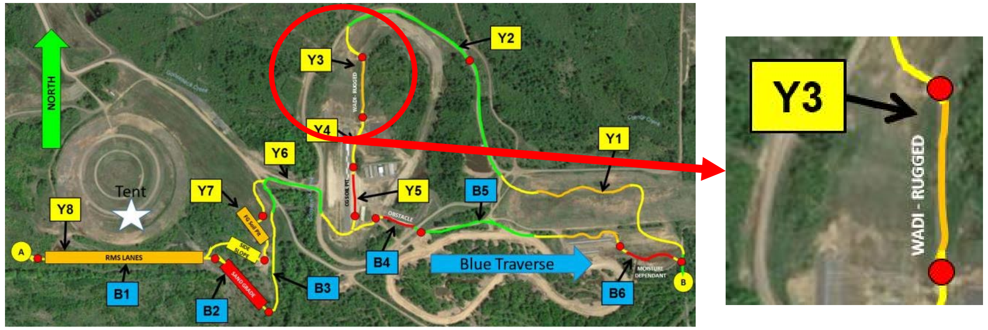


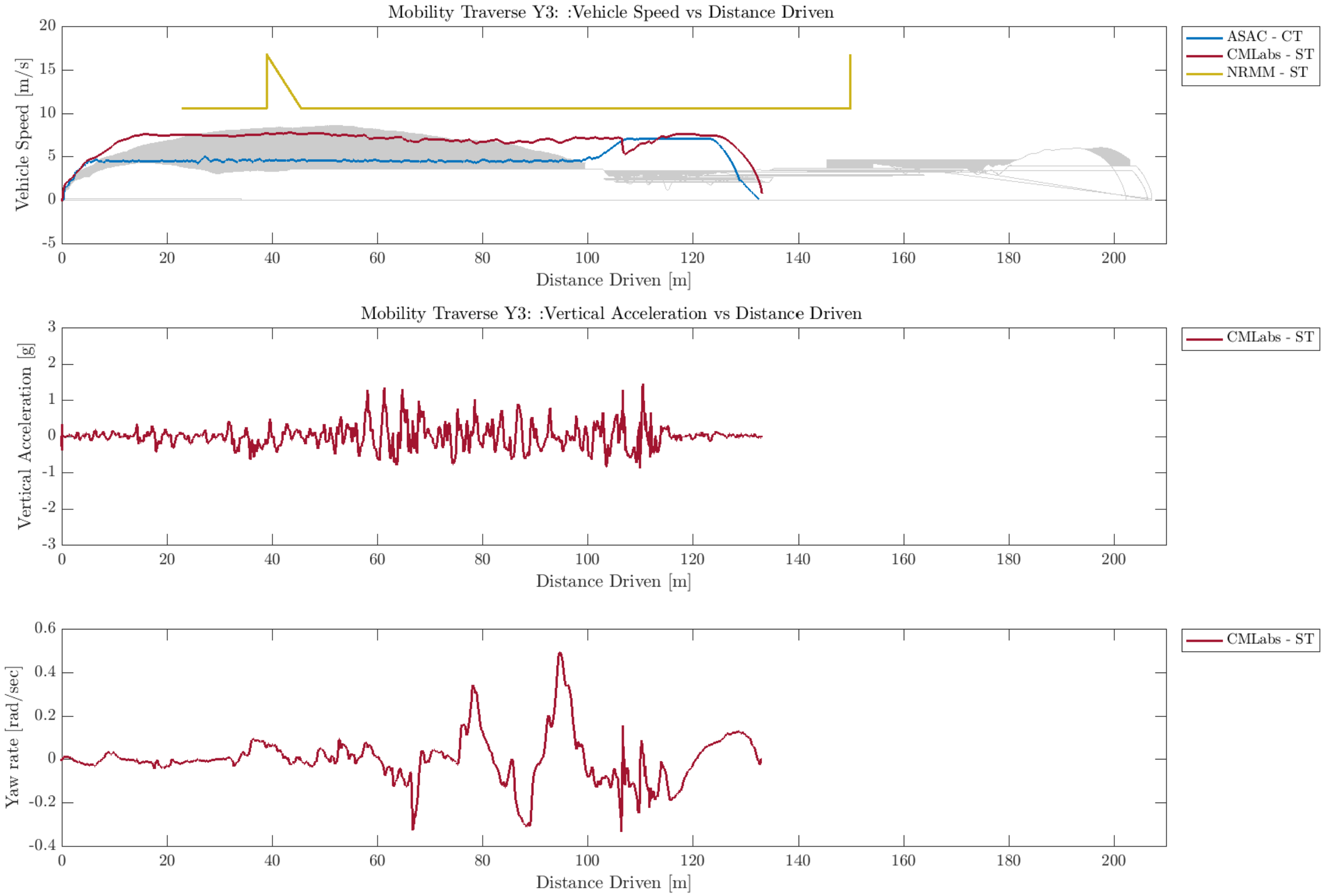
Mobility Traverse Y2



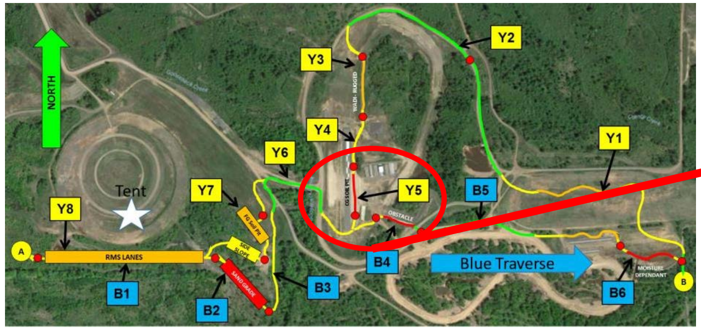


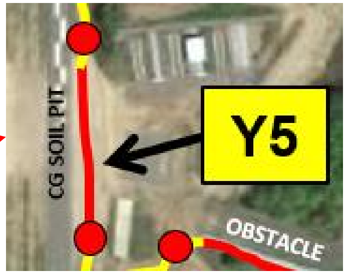
Mobility Traverse Y3

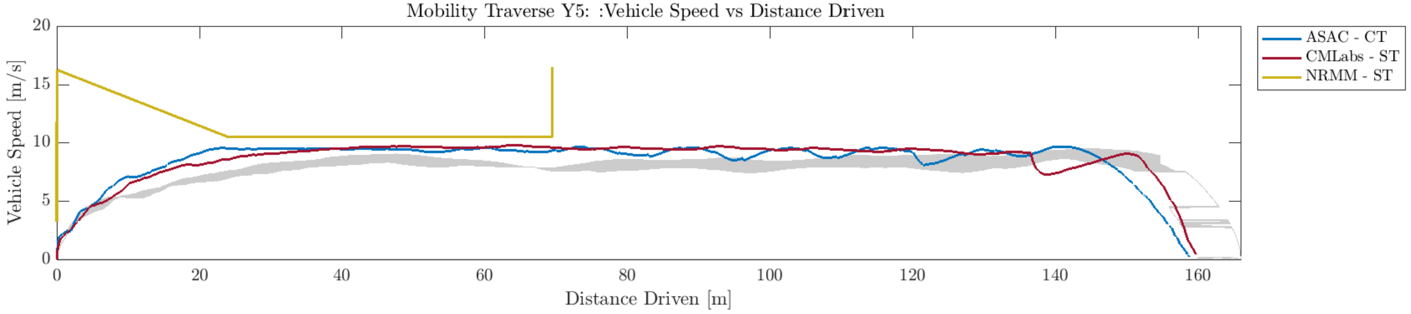


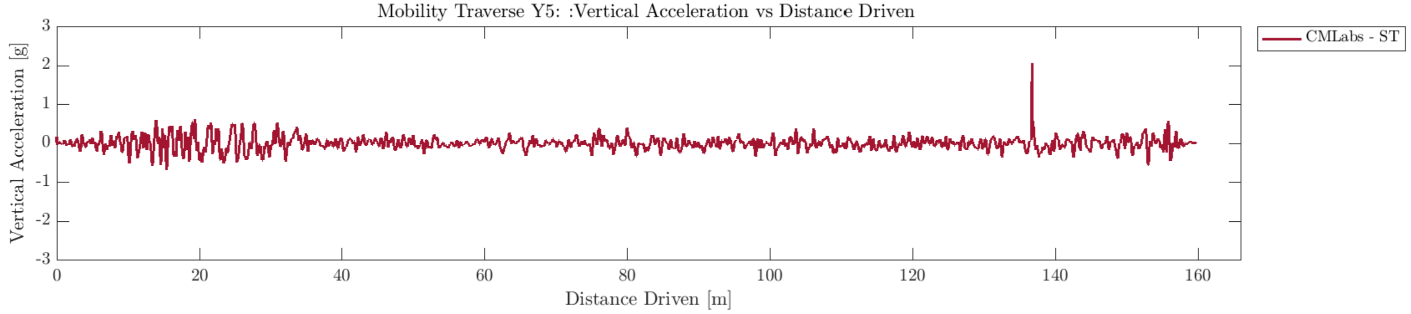


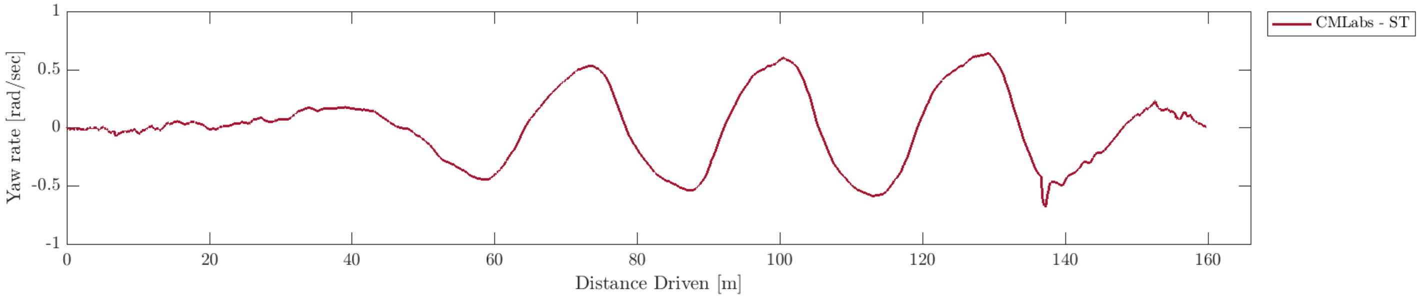
Mobility Traverse Y5



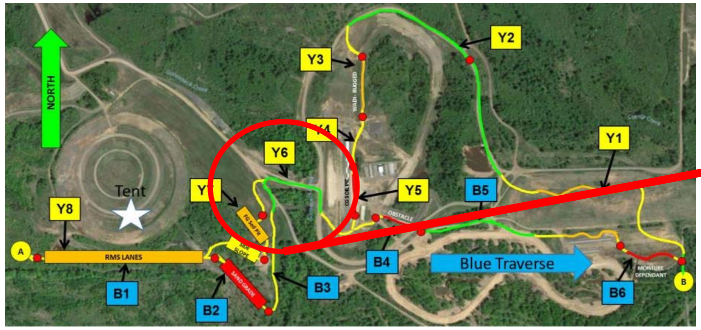


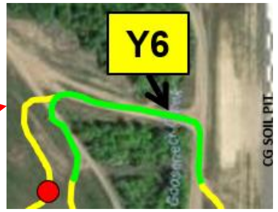


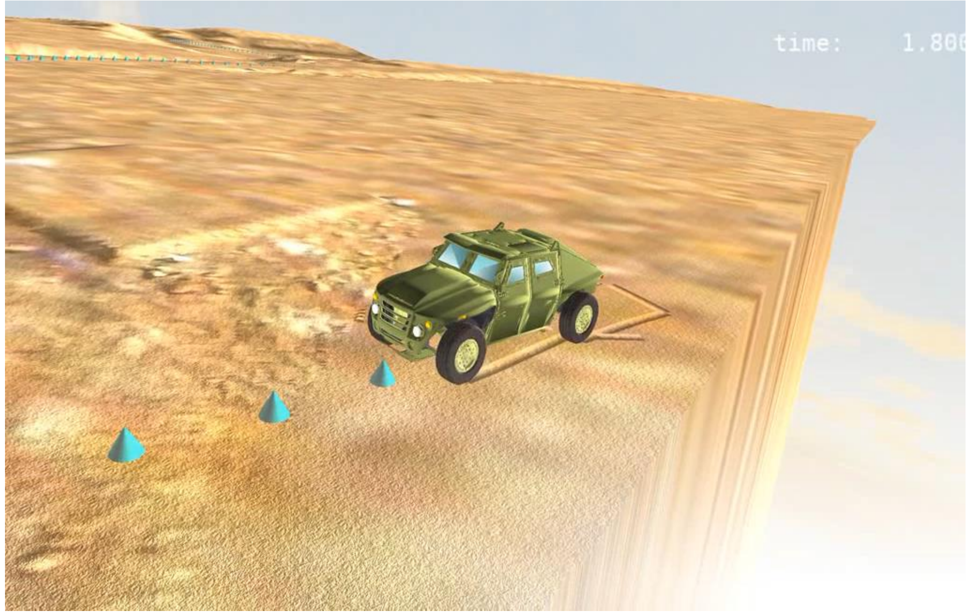


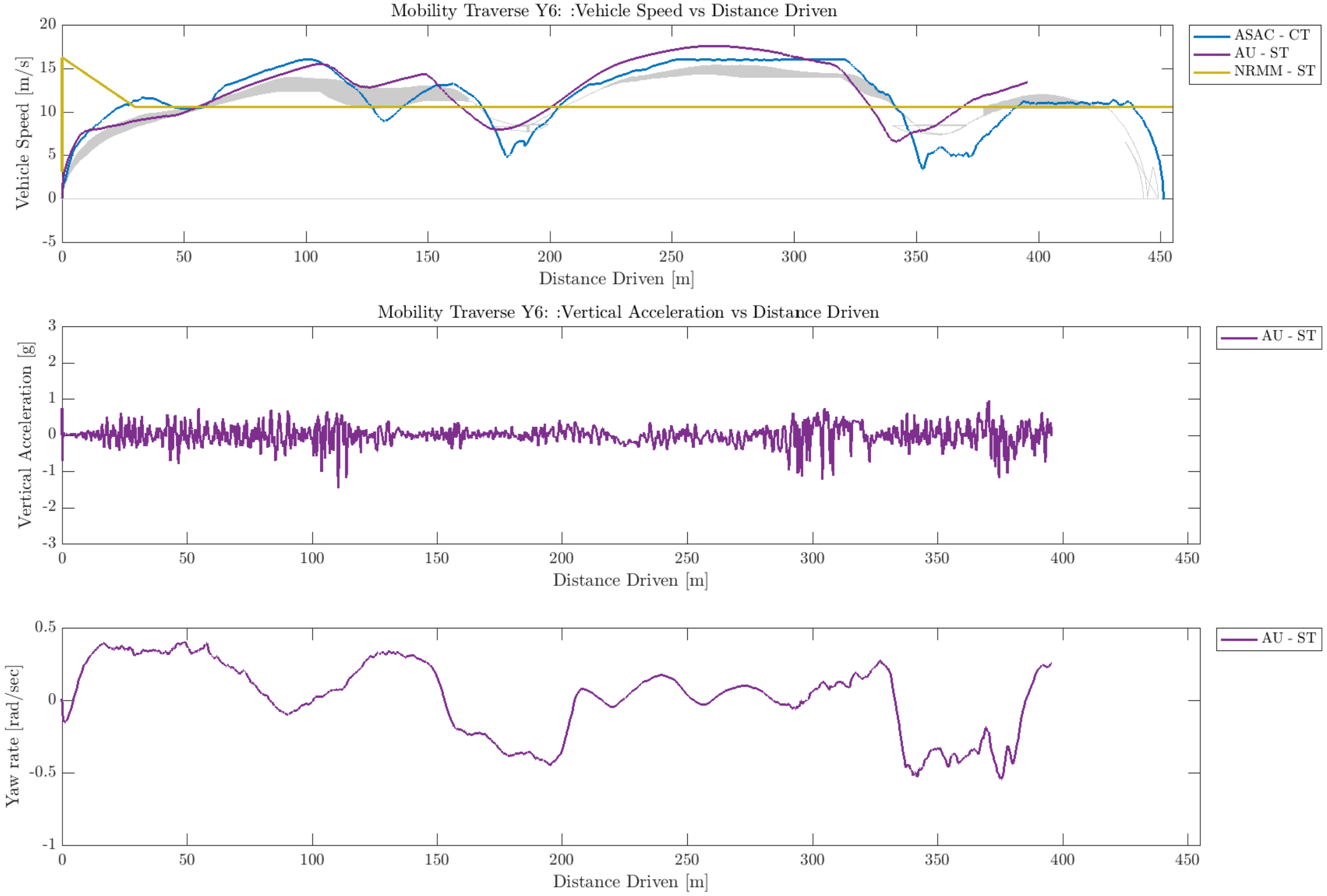


Mobility Traverse Y6









Traverse Summary

- **NG-NRMM 3D Physics based Simulations are Capable of Performing Mobility Traverse Simulation**
  - Will Drive Vehicle to Limit Speed (Faster than Test)
    - Terrain, Vehicle and Driver Limits the Mobility Traverse Performance
  - Driver Model
    - Advanced Driver Modeling was not the Focus of the CDT
    - Some Driver Models Look at Limiting Factors:
      - Speed for 6 Watt Absorbed Power
      - Upcoming Curvature
      - Design of Experiment Predicted Speed Values for the KRC Terrain