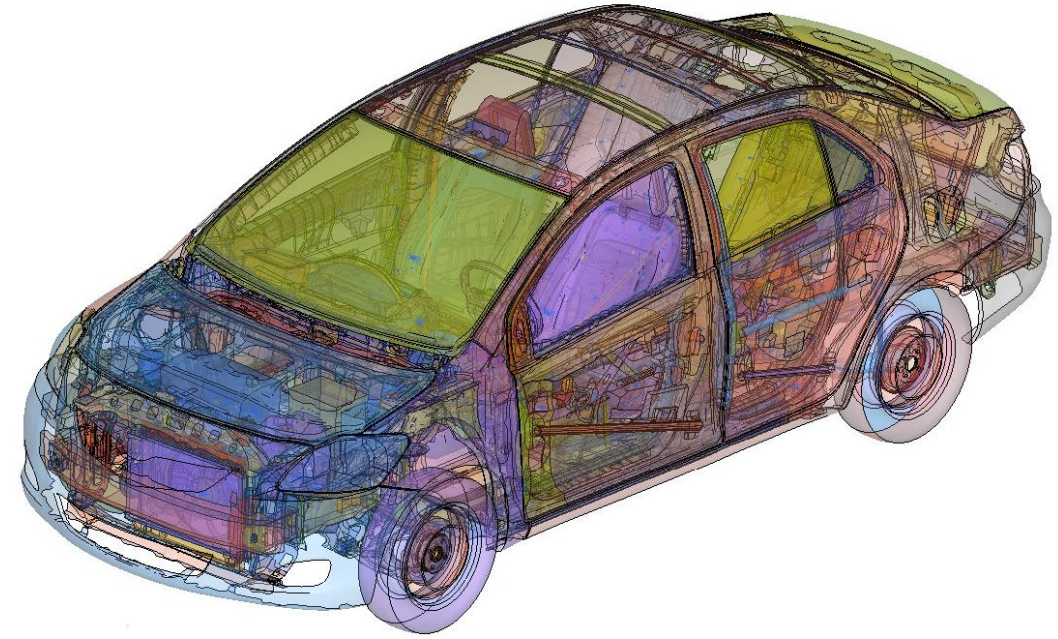
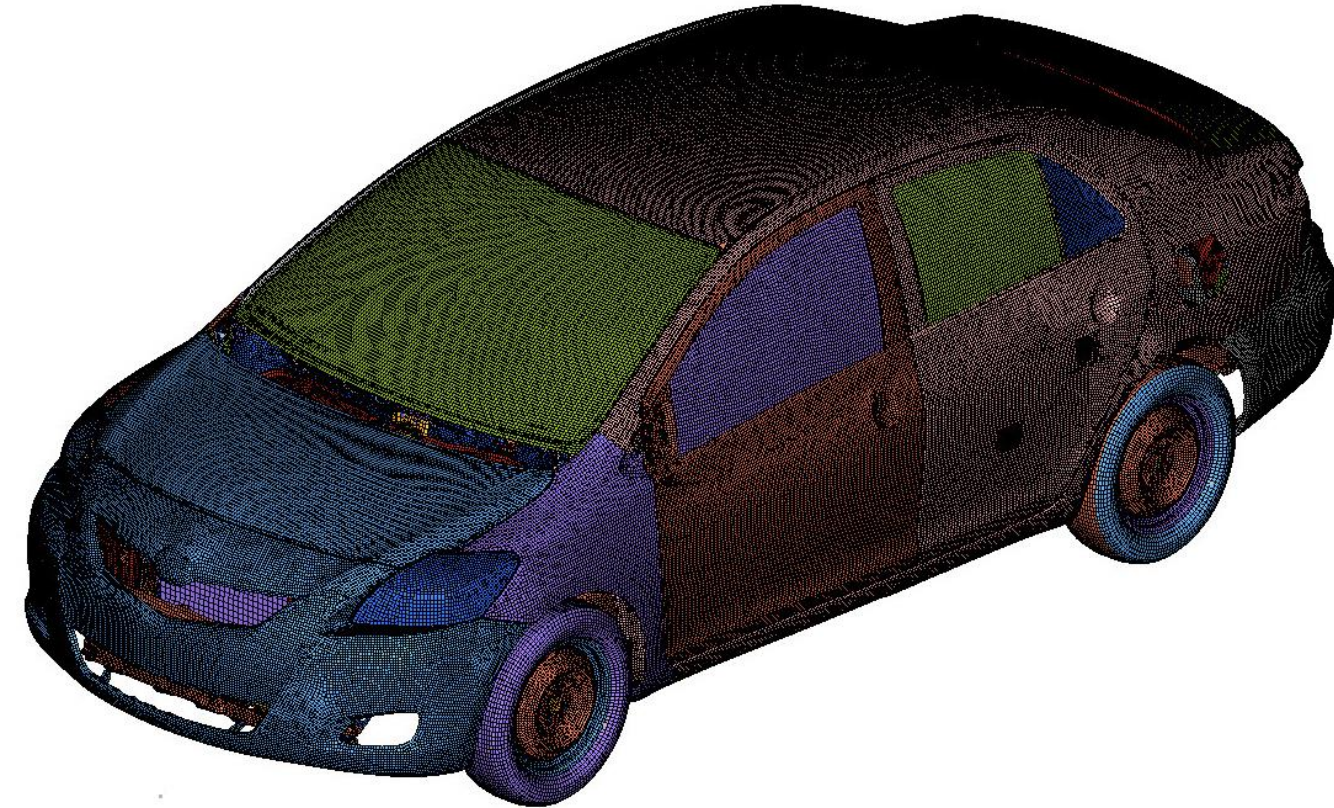


2010 Toyota Yaris Finite Element Model Validation Detail Mesh



doi: [10.13021/G8CC7G](https://doi.org/10.13021/G8CC7G)

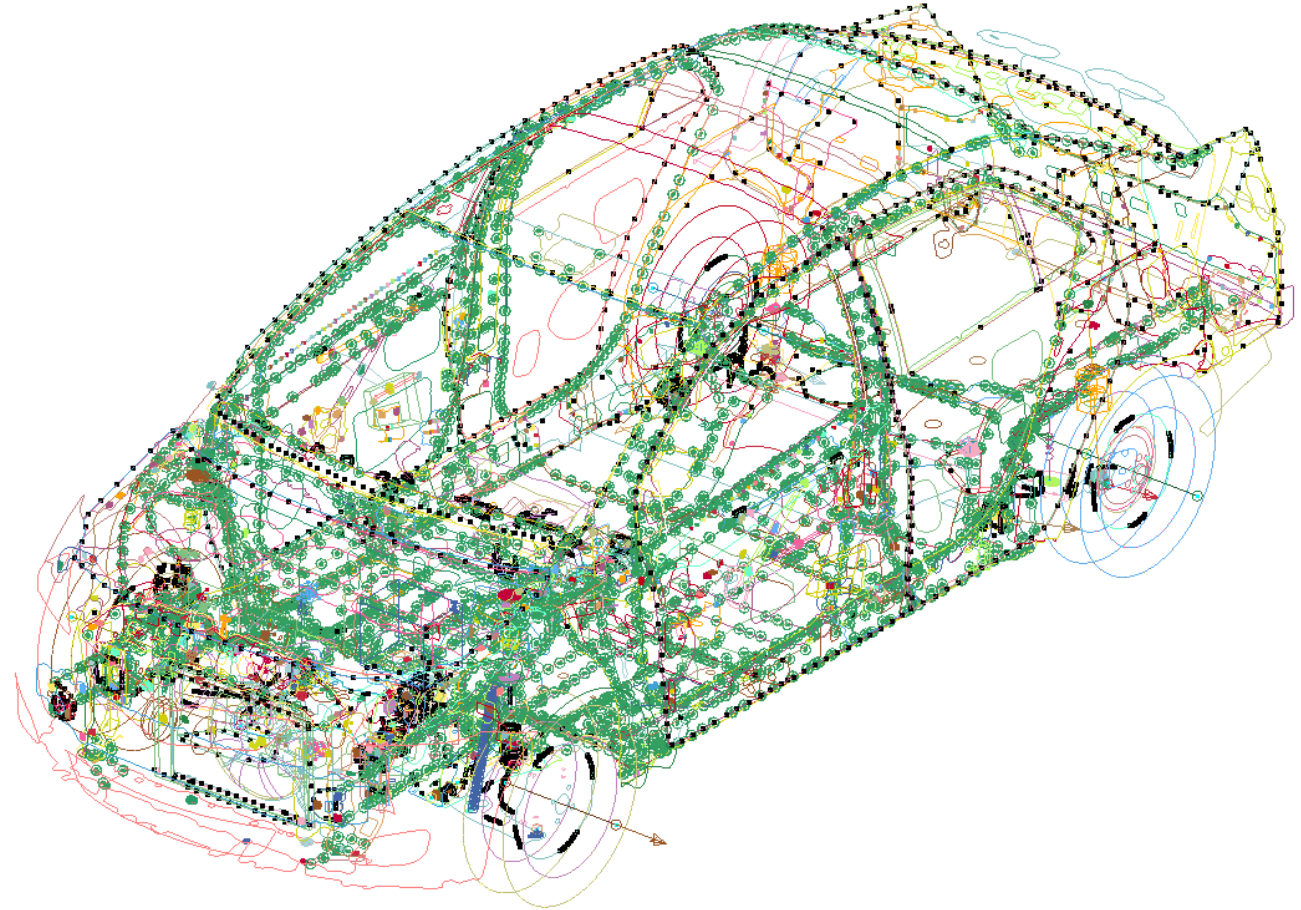
Model Information



Number of parts	940
Number of nodes	1488581
Number of solid elements	259792
Number of shell elements	1254993
Number of beam elements	4802
Number of constrained joints	19

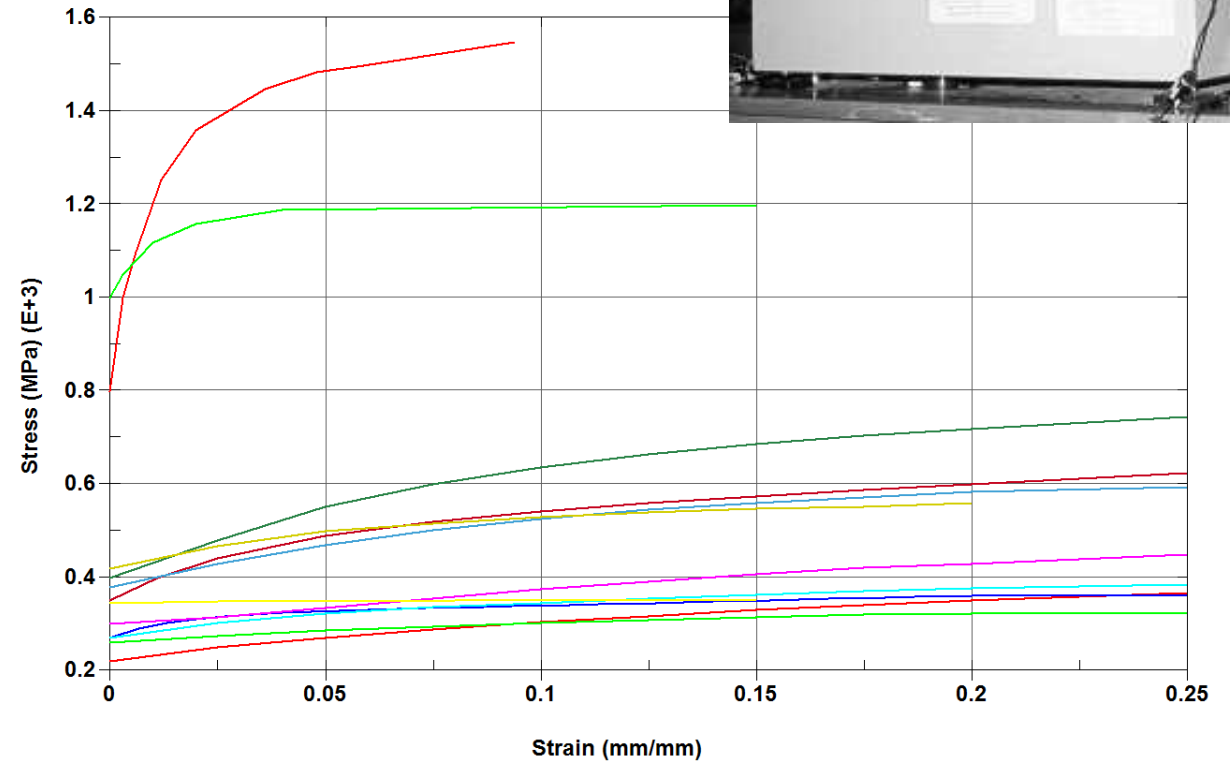
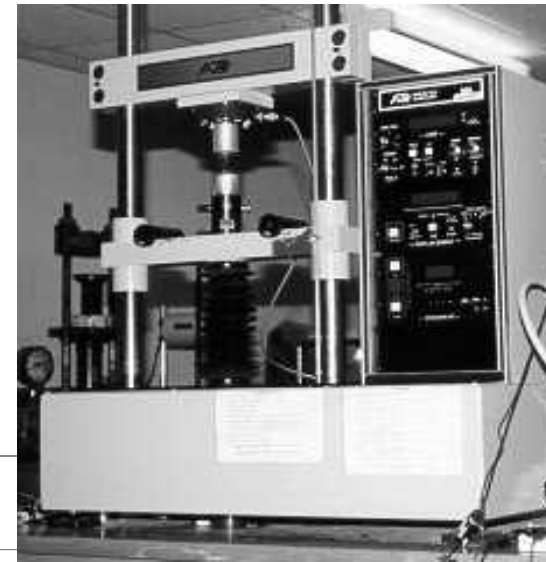
Connections

● BEAM CONNECTIONS	4802
● NODAL_RIGID_BODY	853
● EXTRA_NODES_SET	20
● JOINTS	44
● RIGID_BODIES	2
● SPOTWELD	3110



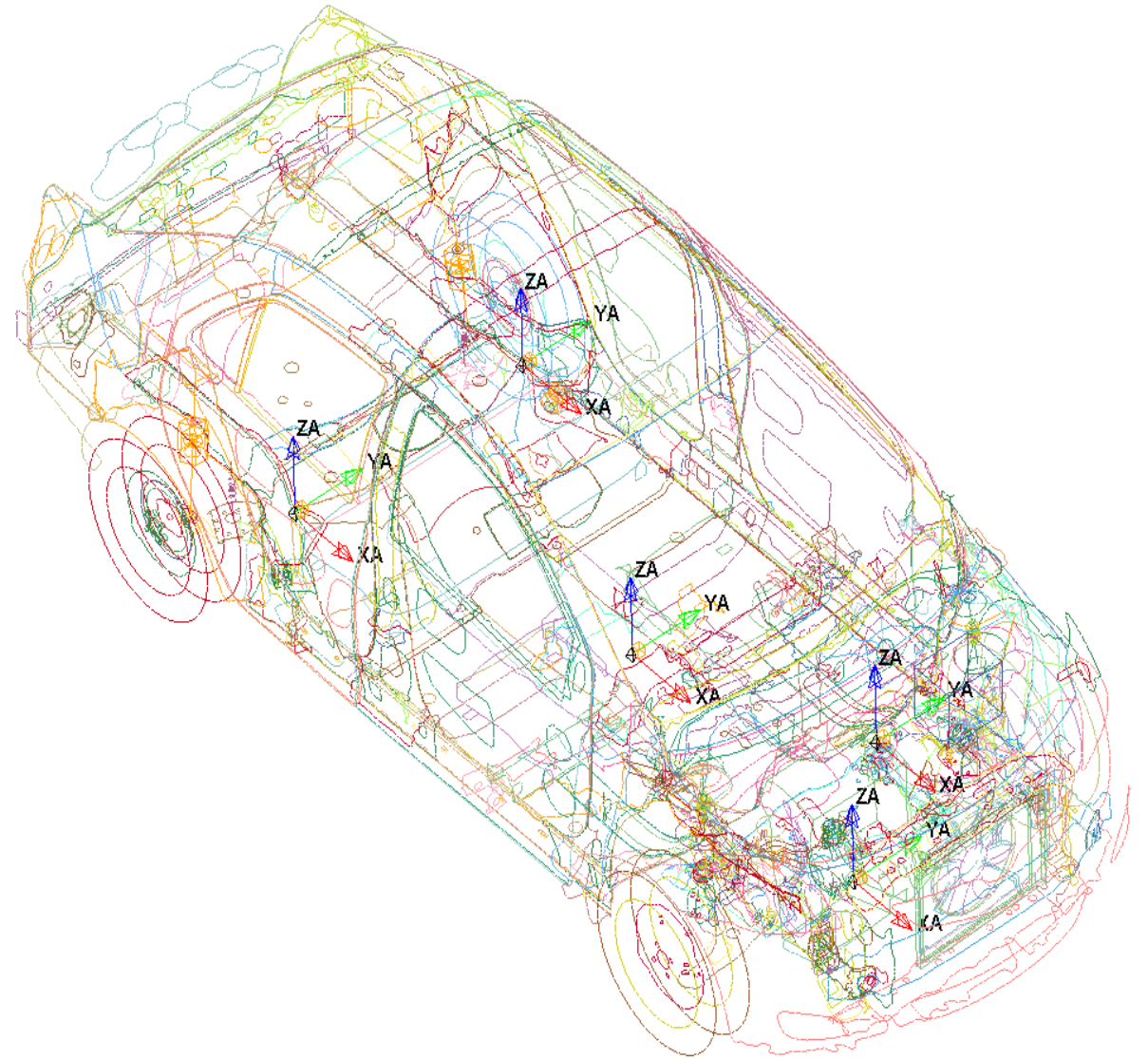
Material Testing

- Specimens were cut from actual components
- 160 tensile tests
- Data converted
- 12 different materials generated based on test data
- Parts grouped into

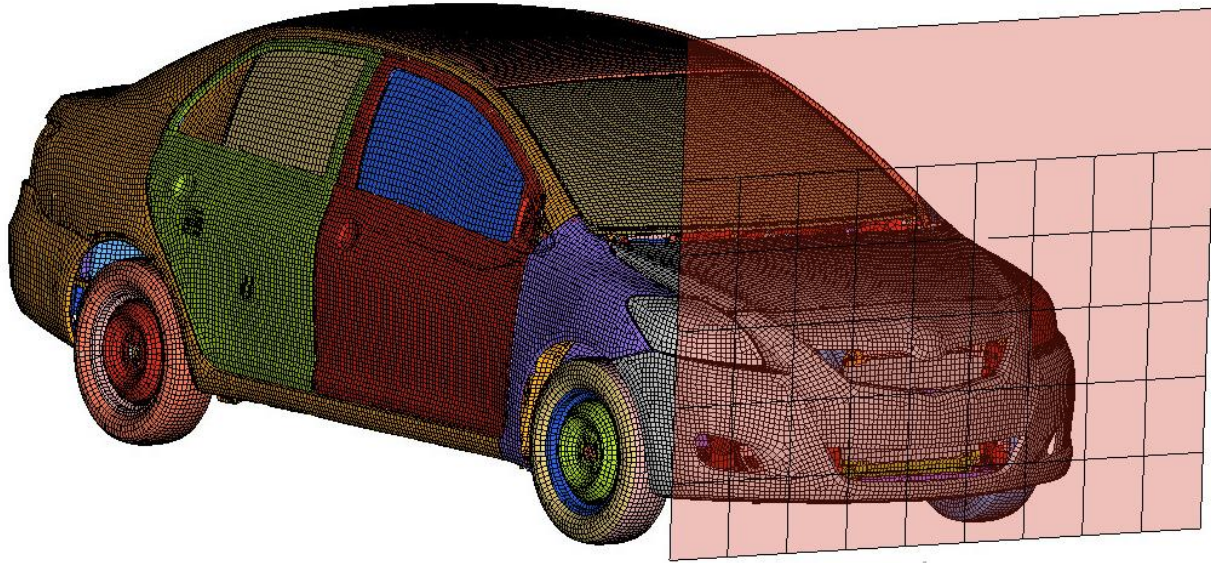


Accelerometers

- Left Rear Seat (Node 4000390)
- Right Rear Seat (Node 4000398)
- Engine Top (Node 4000414)
- Engine Bottom (Node 4000422)
- Vehicle C.G. (Node 4000406)



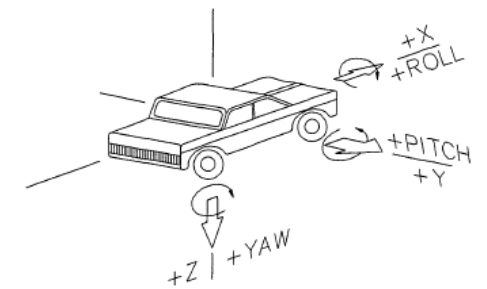
Simulation Benchmark



LS-DYNA	
Platform	Linux RHEL 5.4
Version	mpp s R6.1.2
Revision	85139
Precision	Single precision (I4R4)
Time to simulate 200 ms	5 hour 58 min.
Number of processors	16

Inertia Comparisons

	<i>Actual Vehicle</i>	<i>FE Model</i>
Weight, kg	1078	1102
Pitch inertia, kg-m ²	1498	1547
Yaw inertia, kg-m ²	1647	1721
Roll inertia, kg-m ²	388	397
Vehicle CG X, mm	1022	1022
Vehicle CG Y, mm	-8.3	-3.0
Vehicle CG Z, mm	558	556



Full-Scale Crash Tests

● Toyota Yaris (2006-2010)

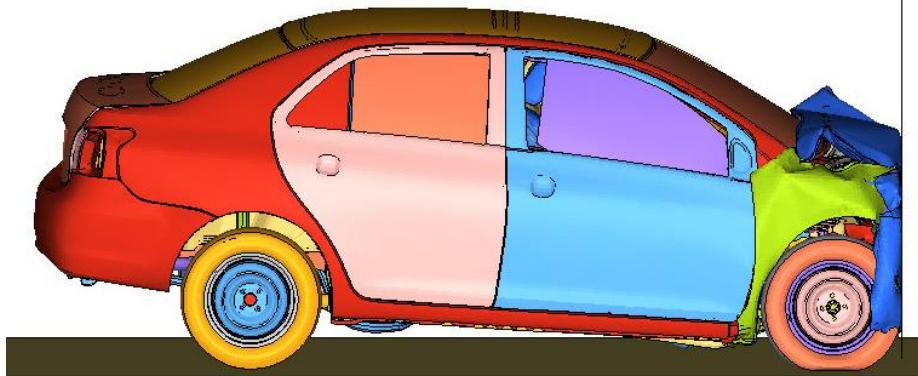
Test Type	Test Number
Frontal Full Wall	NHTSA 5677 (56.3 km/hr), 6221 (56.2 km/hr), 6059 (39.8 km/hr), 6060 (39.8 km/hr), 6069 (39.8 km/hr)
Frontal Offset	IIHS CEF0610 (64.7 km/hr)
Side Impact NHTSA	NHTSA 5679 (62.1 km/hr), 6220 (62.3 km/hr), 6558 (61.9 km/h), 6585 (61.8 km/hr)
Side Impact IIHS	IIHS CES50638 (50.2 km/hr), CES0639 (50.0 km/hr)
Rigid Pole Test	NHTSA 7145 (7 deg, 56 km/hr)
Vehicle to Vehicle	NHTSA 7371 (15 deg, 112.7 km/hr, 50 % overlap), 7293 (7 deg, 112.7 km/hr, No frame overlap),
Roof Strength	IIHS SWR0920
Speed Bump	FOIL10002 (8 tests: varied speed bump configurations)
Sloped Terrain	FOIL 10003 (6 tests: 6H:1V slopes, 25 deg - 8, 16, and 24 km/hr)

Yaris – Frontal Full Wall – 56 km/hr

- Two Full-scale Crash Tests @ 56 km/hr:
 - NHTSA 5677 (56.3 km/hr) – 2007 Sedan
 - NHTSA 6221 (56.2 km/hr) – 2008 Hatch Back



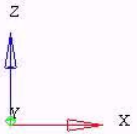
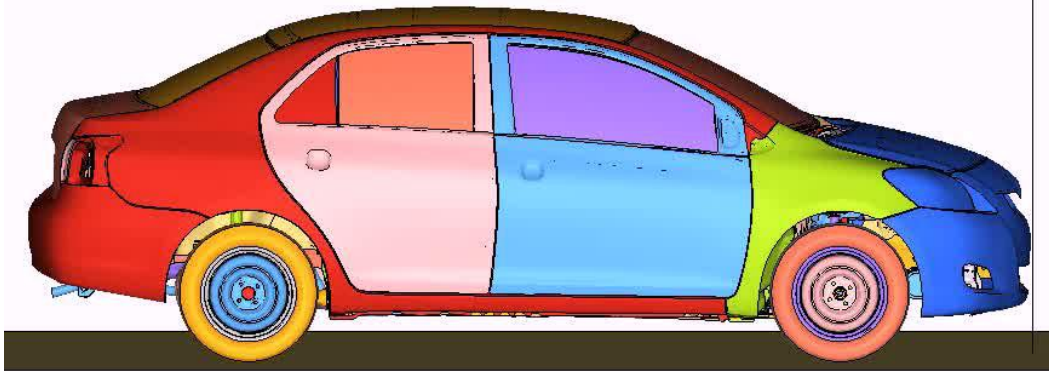
Yaris – Frontal Full Wall – 56 km/hr



	FE Model	Test 5677	Test 6221
Weight (kg)	1263	1271	1245
Engine Type	1.5L V4	1.5L V4	1.5L V4
Tire size	P185/60R15	P185/60R15	P185/60R15
Attitude (mm) (As delivered)	F – 668	F – 673	F – 675
	R – 673	R – 680	R – 673
Wheelbase (mm)	2538	2551	2463
CG (mm) Rear of front wheel C/L	1022	999	976
Body Style	4 Door Sedan	4 Door Sedan	3 Door Liftback

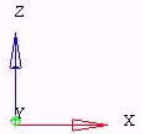
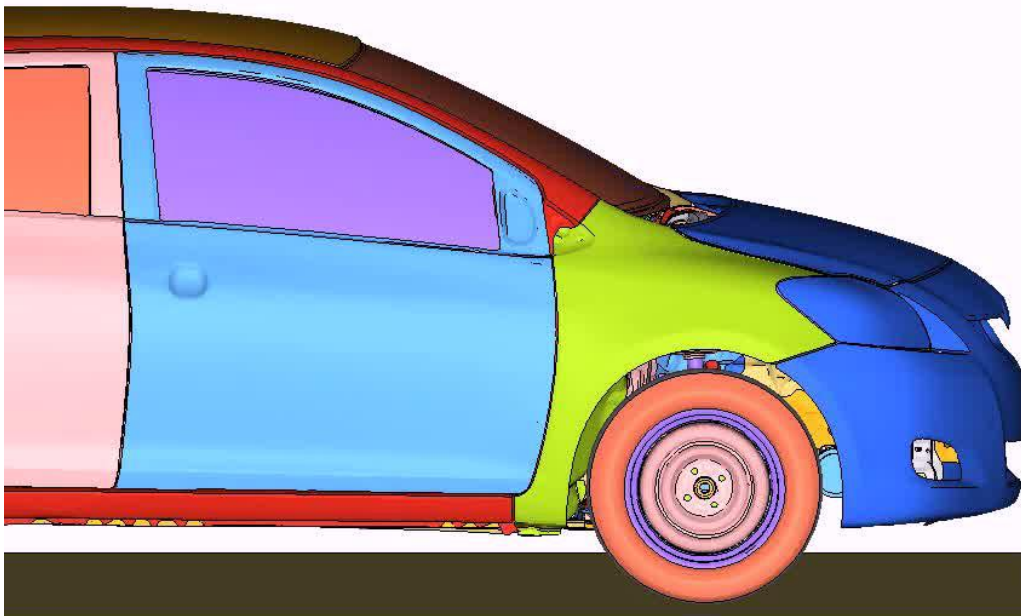
Yaris – Frontal Full Wall – 56 km/h - Video

YARIS DETAIL MESH MODEL (CCSA 02)
Loadcase 1: Time = 0.000000
Frame 1

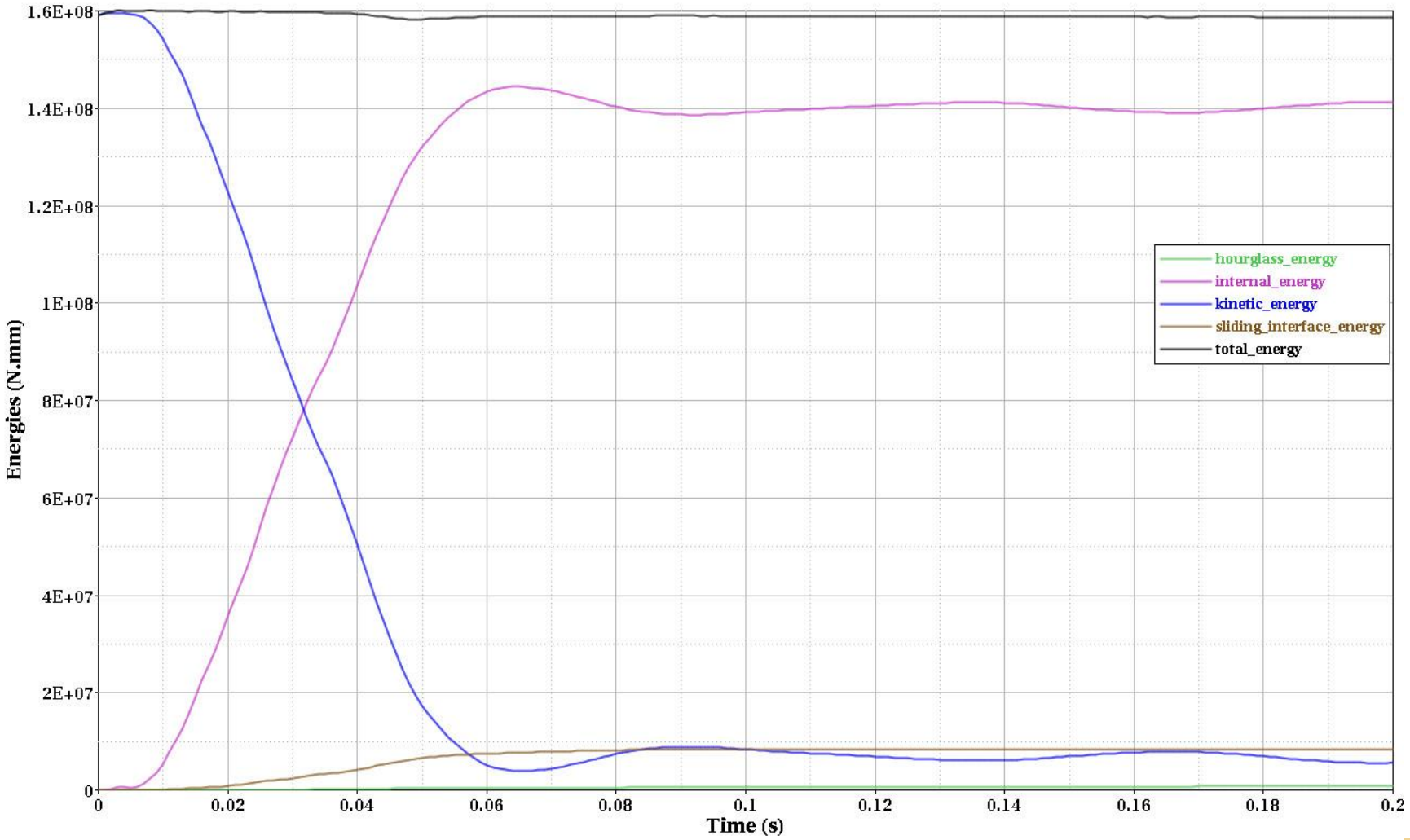


Yaris – Frontal Full Wall – 56 km/h - Video

YARIS DETAIL MESH MODEL (CCSA 02)
Loadcase 1: Time = 0.000000
Frame 1

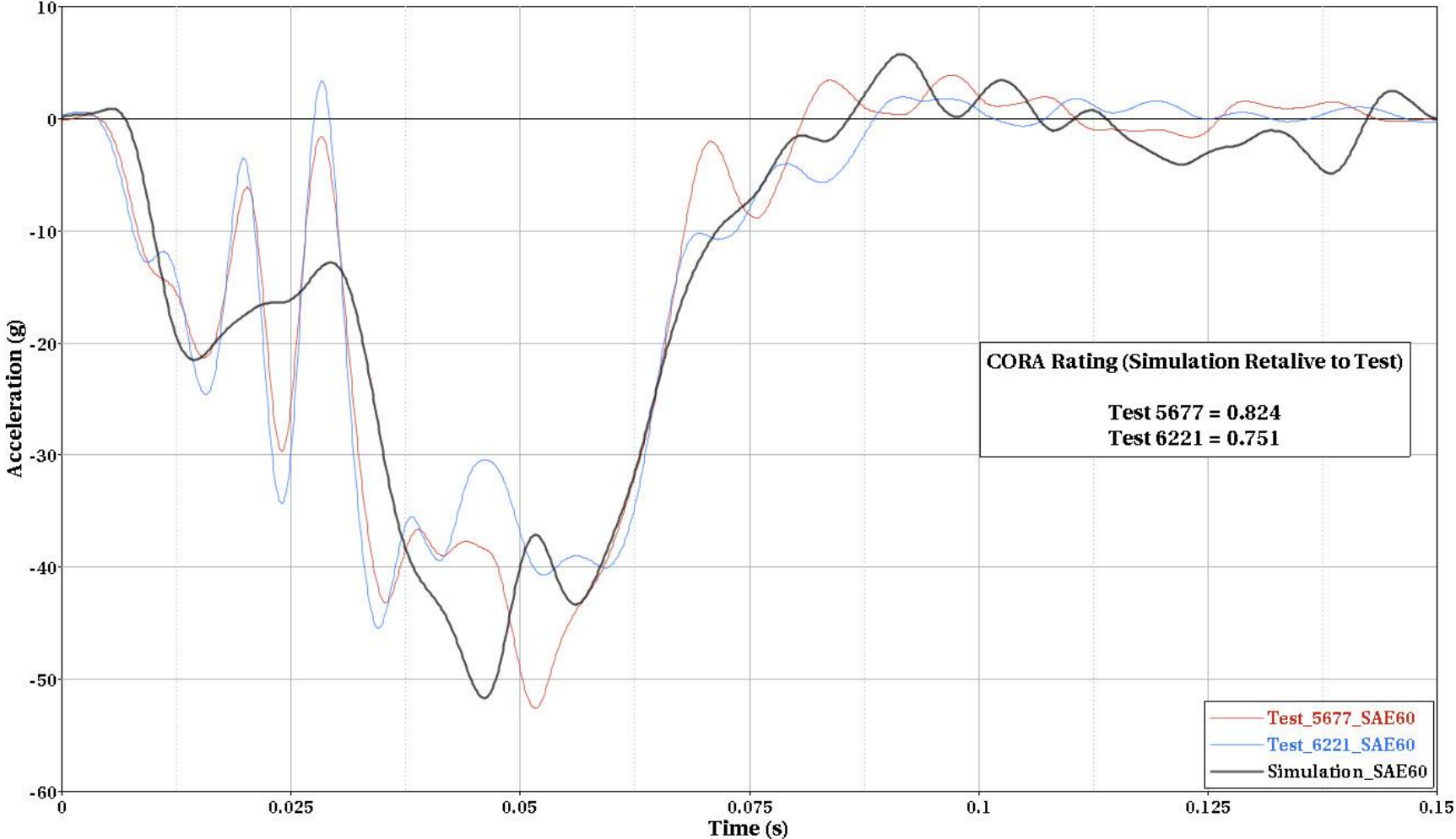


Yaris – Frontal Full Wall – 56 km/hr - Energy Summary

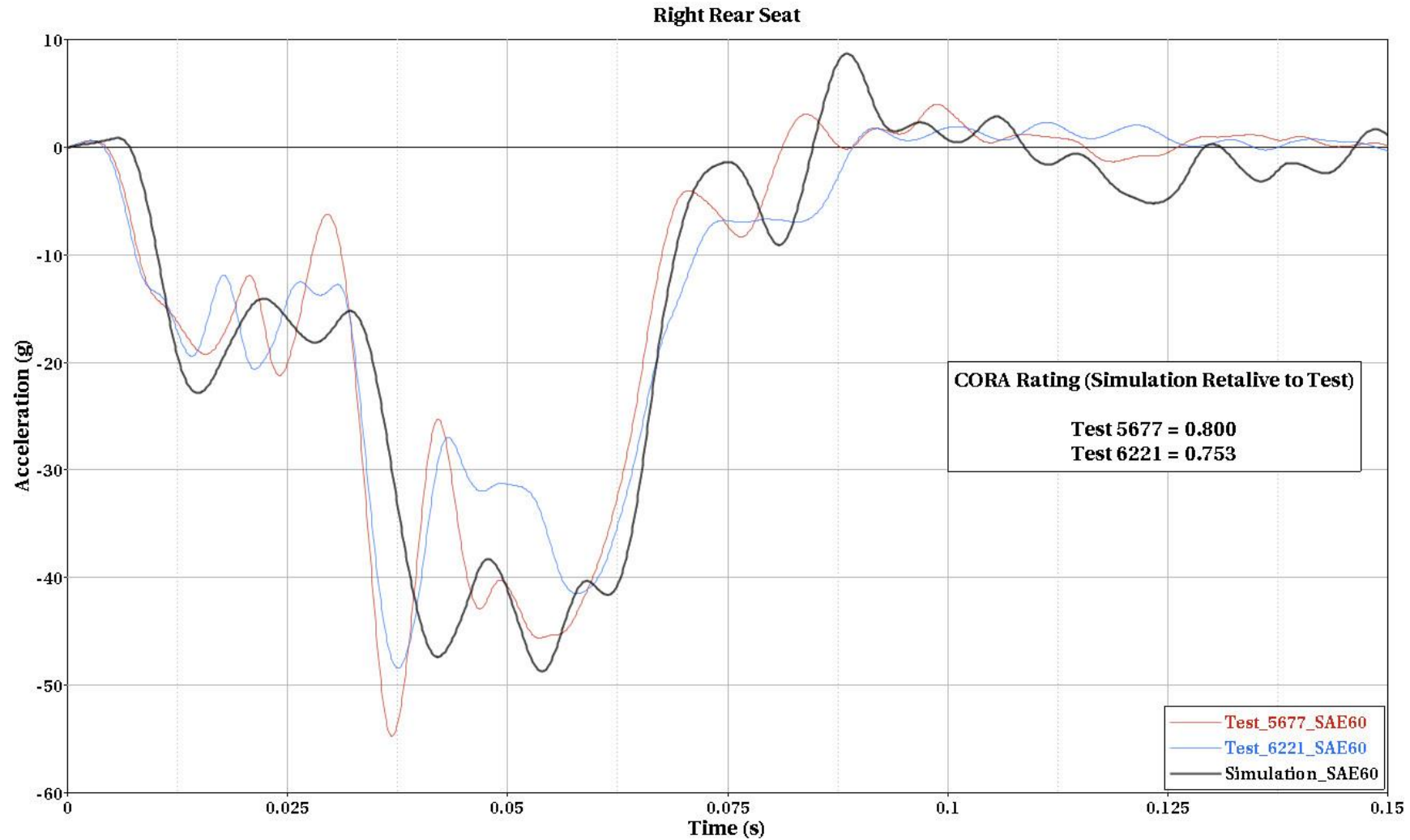


Yaris – Frontal Full Wall – 56 km/hr - Acceleration

Left Rear Seat

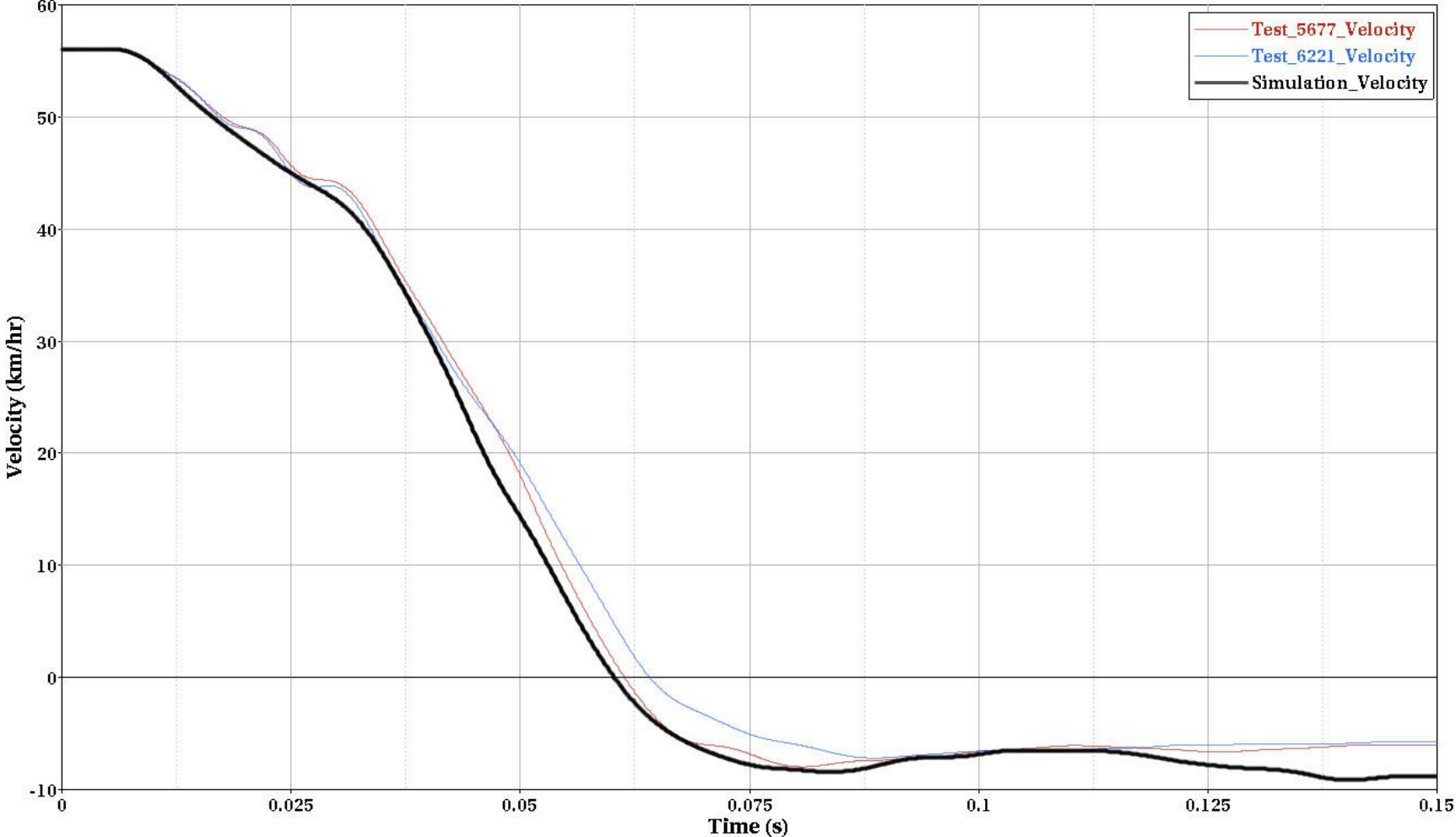


Yaris – Frontal Full Wall – 56 km/hr - Acceleration



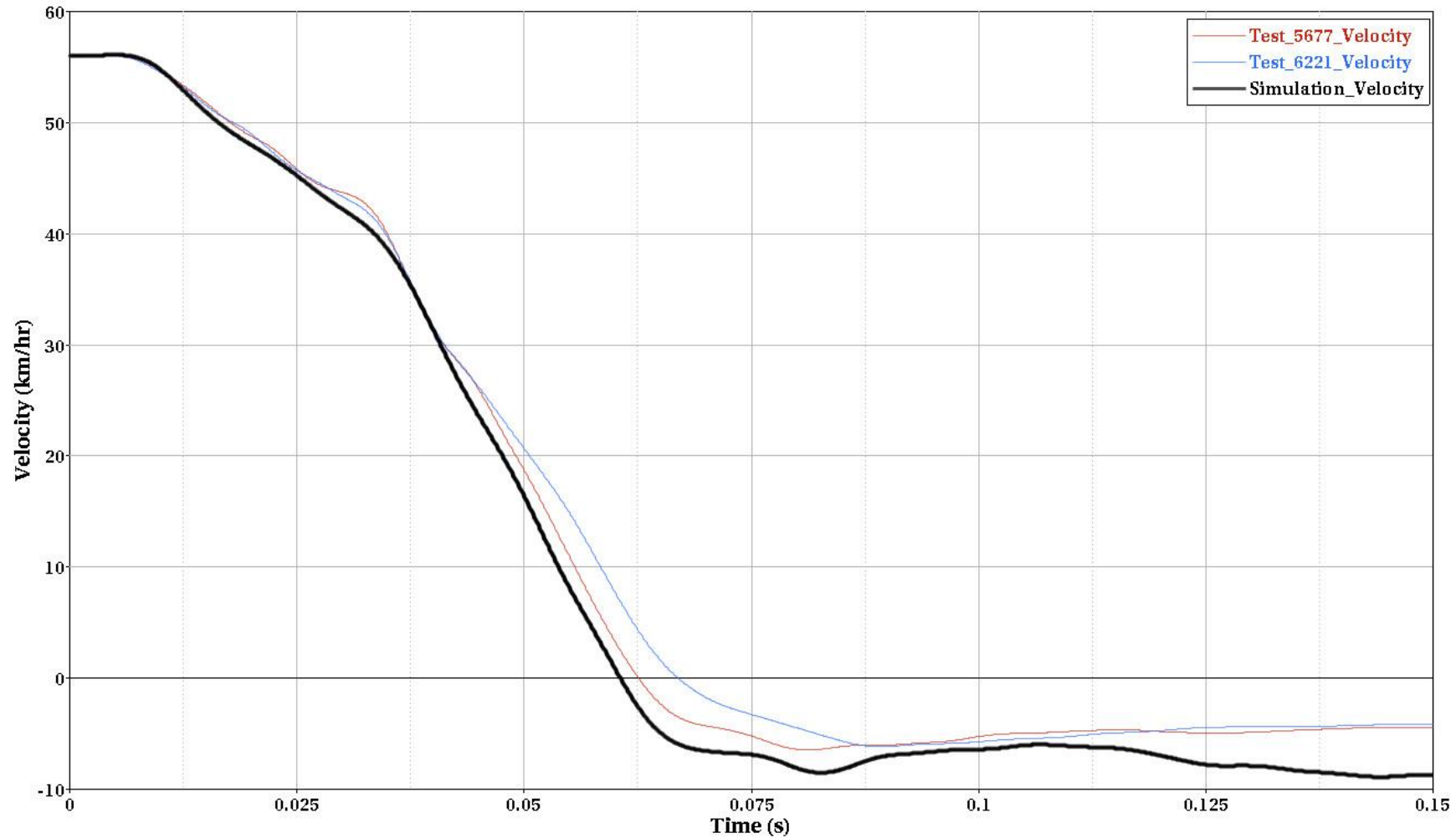
Yaris – Frontal Full Wall – 56 km/hr - Velocity

Left Rear Seat



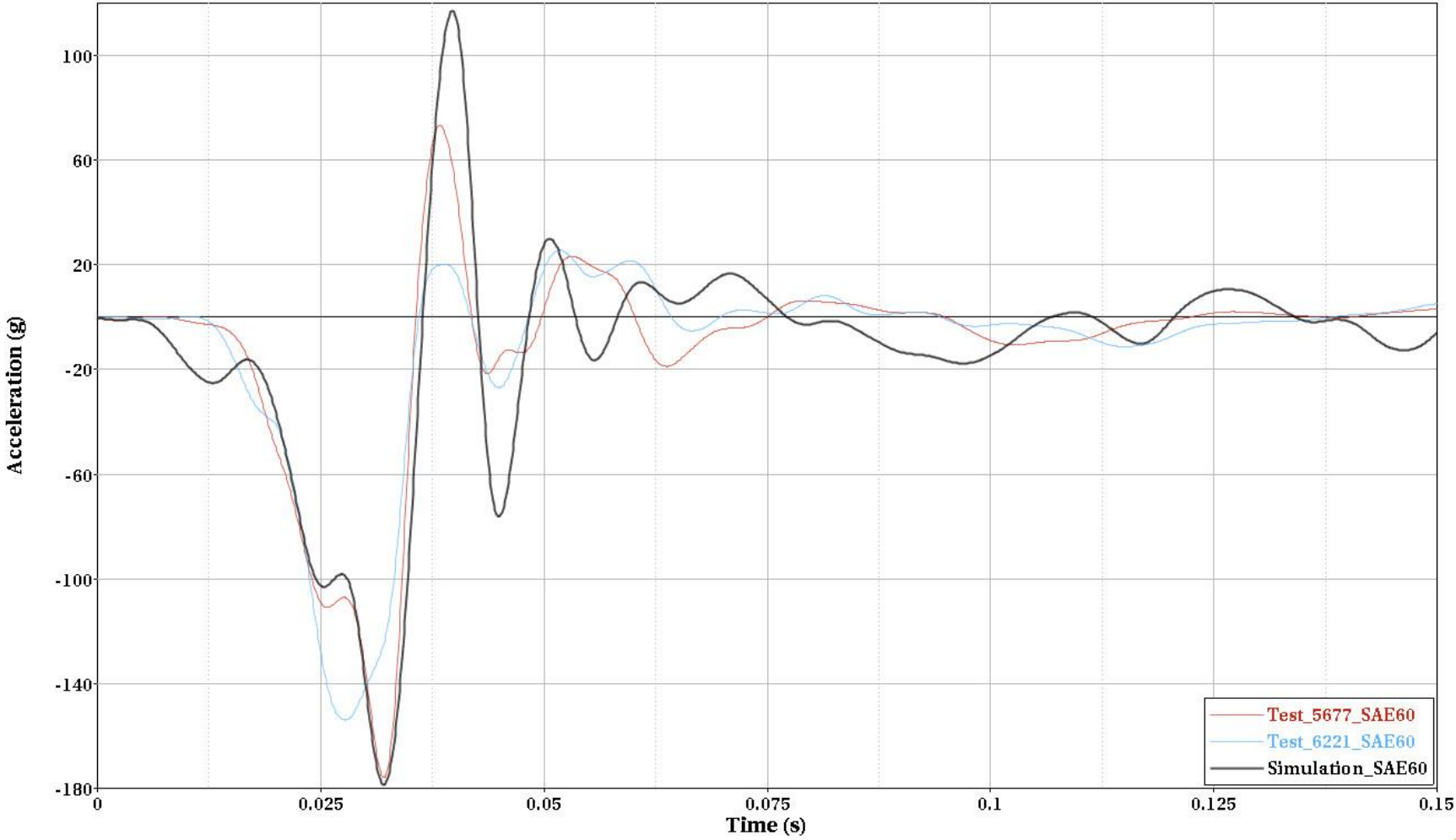
Yaris – Frontal Full Wall – 56 km/hr - Velocity

Right Rear Seat

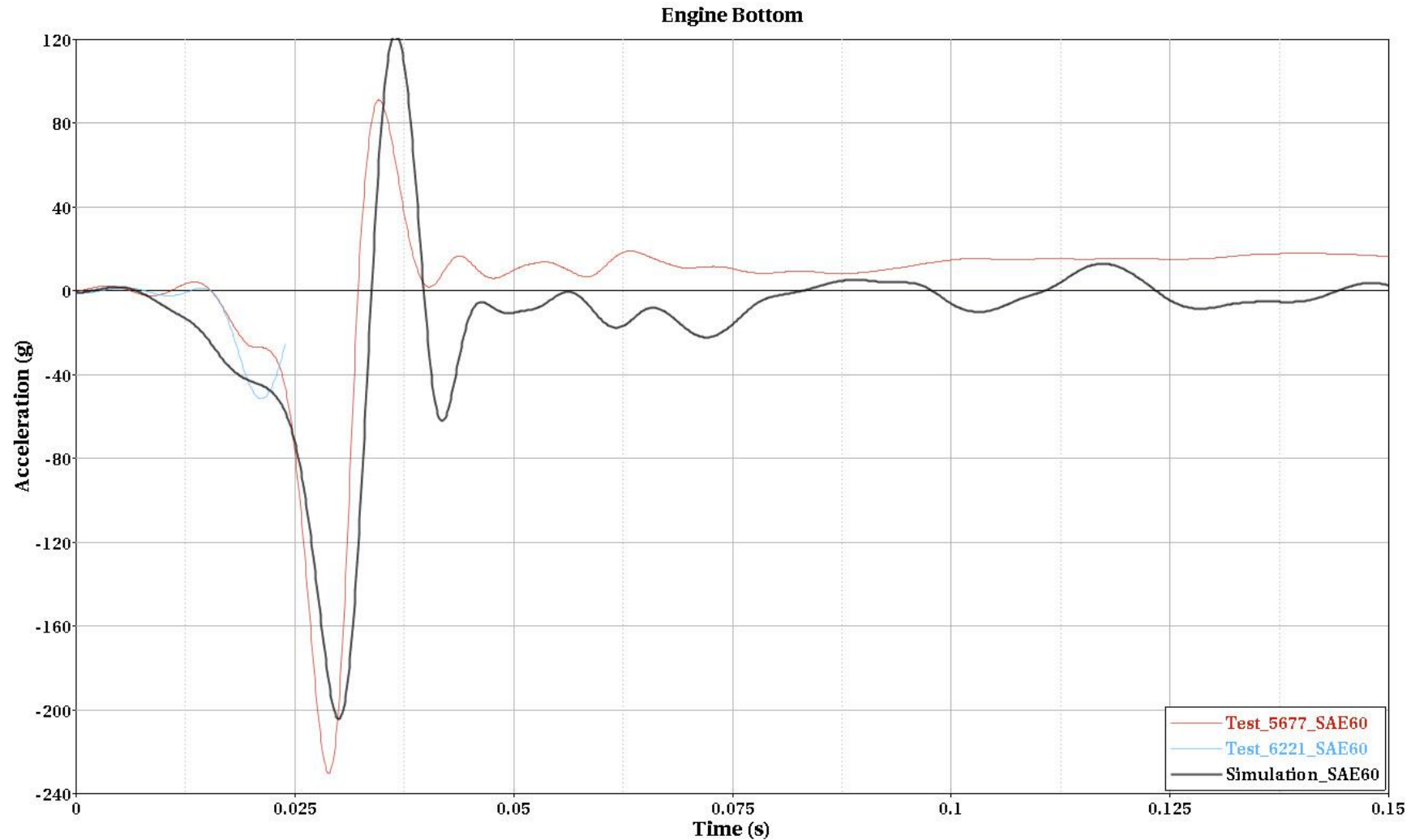


Yaris – Frontal Full Wall – 56 km/hr – Acceleration

Engine Top

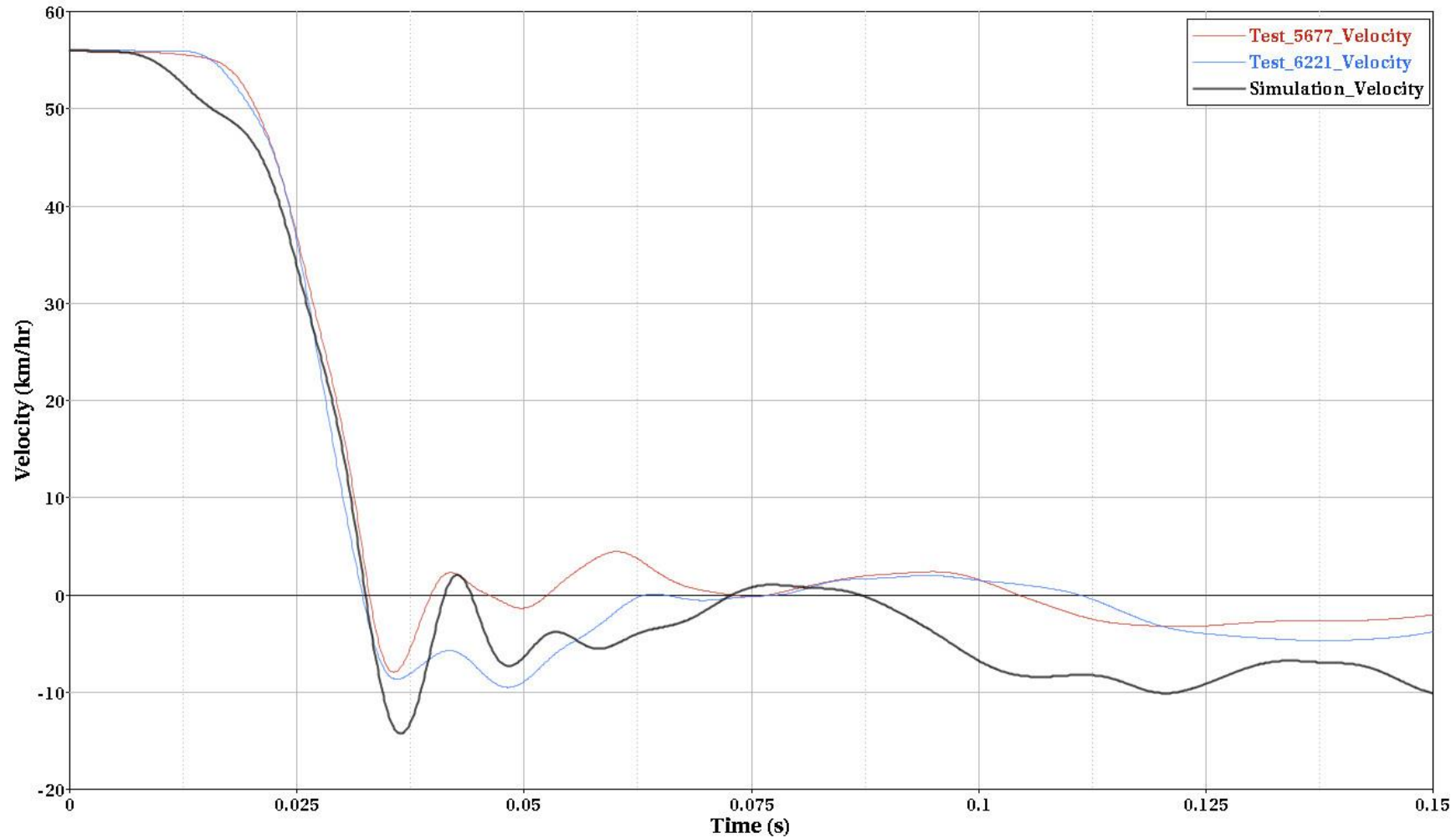


Yaris – Frontal Full Wall – 56 km/hr – Acceleration



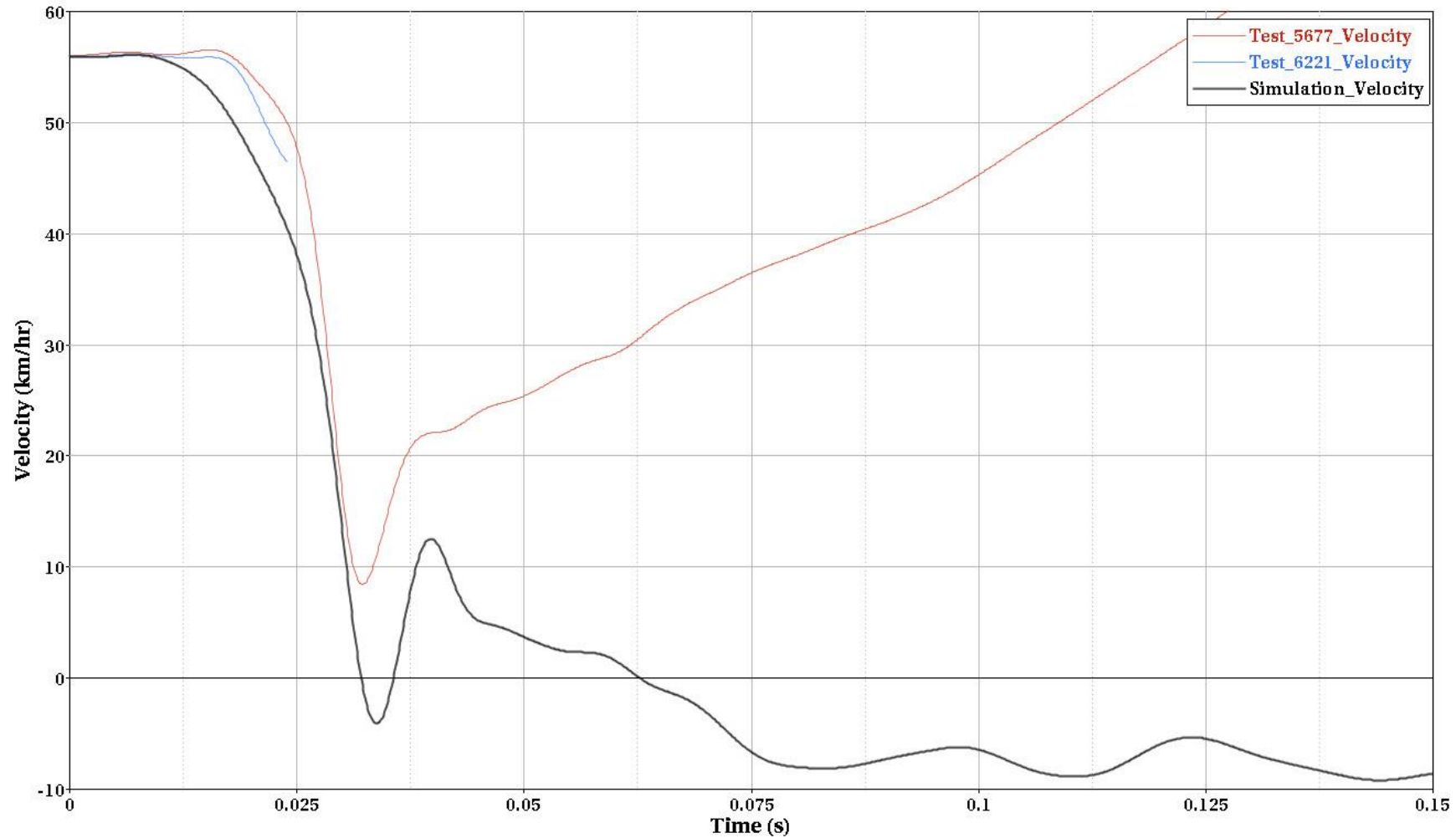
Yaris – Frontal Full Wall – 56 km/hr - Velocity

Engine Top

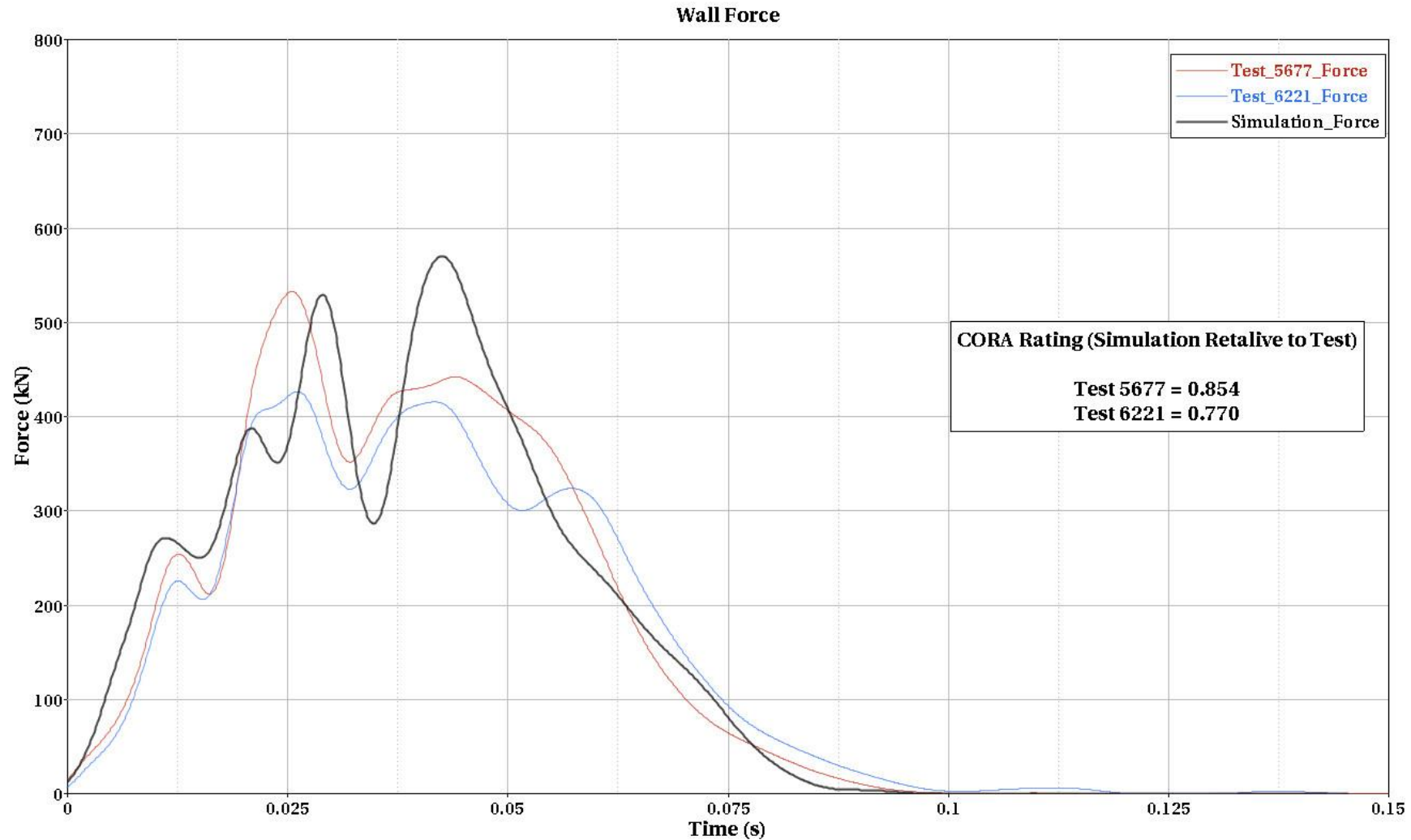


Yaris – Frontal Full Wall – 56 km/hr - Velocity

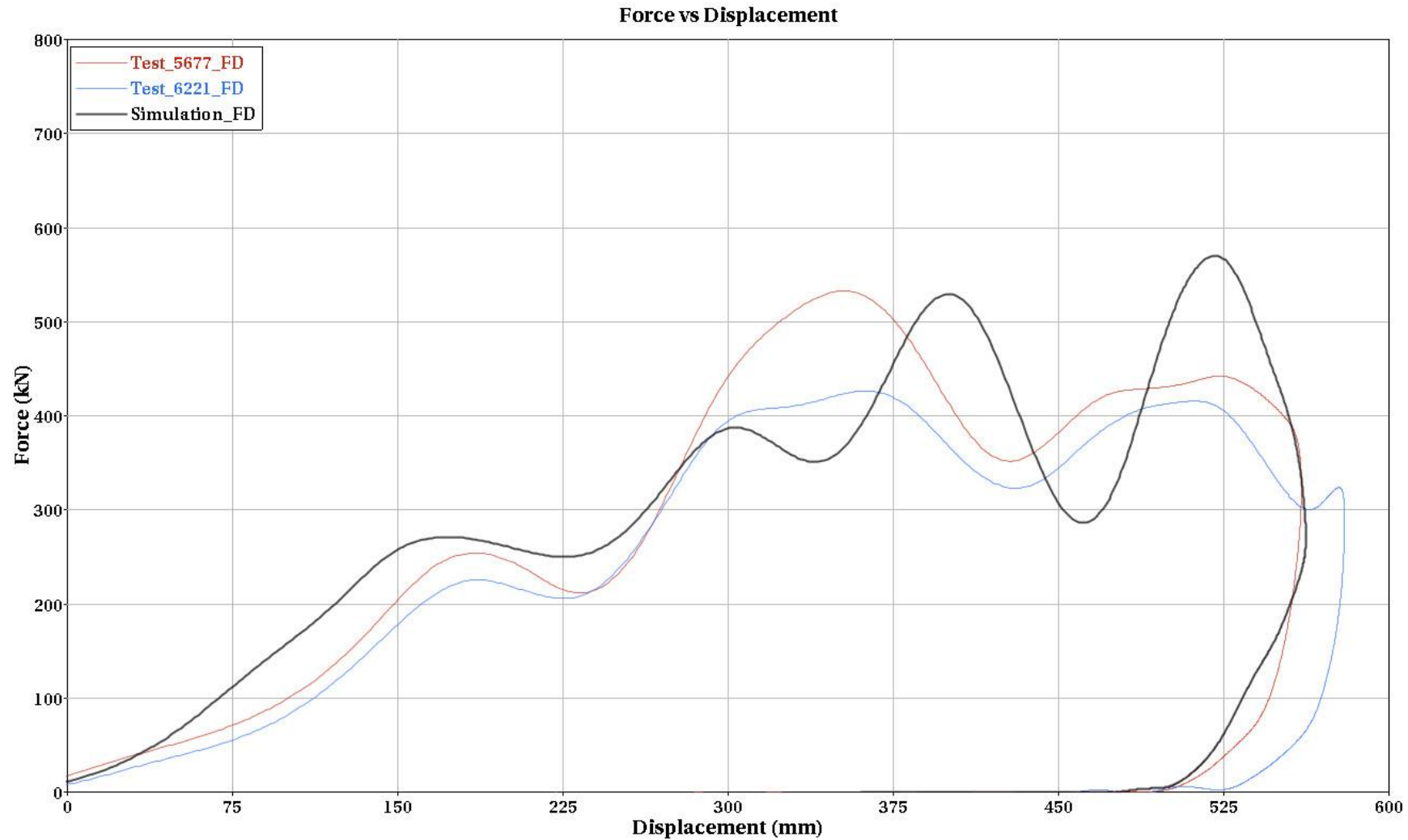
Engine Bottom



Yaris – Frontal Full Wall – 56 km/hr – Wall Force



Yaris – Frontal Full Wall – 56 km/hr – Wall Force



Summary

- **Model verified in 56 km/hr and 40 km/hr full frontal impacts (NHTSA tests 5677, 6221, and 6069)**
- **Model verified in 64 km/hr frontal offset impact (IIHS test CEF0610)**
- **Model verified in NHTSA and IIHS side impacts (NHTSA tests 5679, 6220, 6558, 6585 and IIHS tests CES50638 CES0639)**
- **Model Validated in NJ shape concrete barrier impact (MwRSF Test 2214NJ-1, Kia Rio vehicle)**