Chapter 6

Output Variable List

1	Time	TIME	sec.
2	Distance	DISTANCE	ft.
3	Path Radius	RADIUS	ft.
4	Road Bank	BANK	deg.
5	Road Grade	GRADE	deg.
6	Speed Tangent to Path	SPEED	mph
7	Steering wheel angle	STEER	deg.
8	Reference Steer (Ave. front wheel steer)	REF STR	deg.
9	Drive Shaft Torque	PRP TORQ	ft.-lb.
10	Brake Torque	BRK TORQ	ft.-lb.
11	Accelerator Pedal Position	AC PD DE	in.
12	Brake Pedal Force	BR PD FO	lb.
13	Transmission Gear	IGEAR	-
14		ISPEED	-
15		ISKID	-
16		ISTEER	-
21	Lateral Acceleration in vehicle axes	LAT ACC	g's
22	Longitudinal Acceleration in vehicle axes	LONG ACC	g's
23	Vertical Acceleration in vehicle axes	VERT ACC	g's
24	CG Acceleration in ground plane tangent to path	XDDCG	g's
25	CG Acceleration in ground plane normal to path	YDDCG	g's
26	Yaw Acceleration in vehicle axes	YAW ACC	deg./sec.^{2}

27	Roll Acceleration in vehicle axes	ROLL ACC	deg./sec.^{2}
28	Pitch Acceleration in vehicle axes	PTCH ACC	deg./sec.^{2}
29	Longitudinal Velocity in vehicle axes	UCG	ft./sec.
30	Lateral Velocity in vehicle axes	VCG	ft./sec.
31	Vertical Velocity in vehicle axes	WCG	ft./sec.
32	Roll Rate in vehicle axes	P	deg./sec.
33	Pitch Rate in vehicle axes	Q	deg./sec.
34	Yaw Rate in vehicle axes	R	deg./sec.
35	CG X Position in Space	XCG	ft.
36	CG Y Position in Space	YCG	ft.
37	CG Z Position in Space	ZCG	ft.
38	Roll Angle	PHI	deg.
39	Yaw Angle	PSI	deg.
40	Pitch Angle	THT	deg.
41	Sideslip Angle	BETA	deg.
42	RF Wheel Spin Acceleration	DQW RF	rad./sec.^{2}
43	LF Wheel Spin Acceleration	DQW LF	rad./sec.^{2}
44	RR Wheel Spin Acceleration	DQW RR	rad./sec.^{2}
45	LR Wheel Spin Acceleration	DQW LR	rad./sec.^{2}
46	RF Wheel Spin Velocity	QW RF	rad./sec.
47	LF Wheel Spin Velocity	QW LF	rad./sec.
48	RR Wheel Spin Velocity	QW RR	rad./sec.
49	LR Wheel Spin Velocity	QW LR	rad./sec.
51	RF Unsprung Mass Acceleration	DDELD RF	in./sec.^{2}
52	LF Unsprung Mass Acceleration	DDELD LF	in./sec.^{2}
53	RR Unsprung Mass Acceleration	DDELD LR	in./sec.^{2}
54	LR Unsprung Mass Acceleration	DDELD RR	in./sec.^{2}
55	RF Unsprung Mass Velocity	DDEL RF	in./sec.
56	LF Unsprung Mass Velocity	DDEL LF	in./sec.
57	RR Unsprung Mass Velocity	DDEL RR	in./sec.

58	LR Unsprung Mass Velocity	DDEL LR	in./sec.
59	RF Unsprung Mass Position	DEL RF	in.
60	LF Unsprung Mass Position	DEL LF	in.
61	RR Unsprung Mass Position	DEL RR	in.
62	LR Unsprung Mass Position	DEL LR	in.
63	RF Wheel Steer w/to Vehicle	PSIW RF	deg.
64	LF Wheel Steer w/to Vehicle	PSIW LF	deg.
65	RR Wheel Steer w/to Vehicle	PSIW RR	deg.
66	LR Wheel Steer w/to Vehicle	PSIW LR	deg.
67	RF Wheel Camber w/to Vehicle	PHIW RF	deg.
68	LF Wheel Camber w/to Vehicle	PHIW LF	deg.
69	RR Wheel Camber w/to Vehicle	PHIW RR	deg.
70	LR Wheel Camber w/to Vehicle	PHIW LR	deg.
71	RF Wheel Slip Angle	ALPHA RF	deg.
72	LF Wheel Slip Angle	ALPHA LF	deg.
73	RR Wheel Slip Angle	ALPHA RR	deg.
74	LR Wheel Slip Angle	ALPHA LR	deg.
75	RF Wheel Inclination Angle	PHIWG RF	deg.
76	LF Wheel Inclination Angle	PHIWG LF	deg.
77	RR Wheel Inclination Angle	PHIWG RR	deg.
78	LR Wheel Inclination Angle	PHIWG LR	deg.
79	RF Tire Rolling Radius	H RF	in.
80	LF Tire Rolling Radius	H LF	in.
81	RR Tire Rolling Radius	H RR	in.
82	LR Tire Rolling Radius	H LR	in.
83	RF Tire Slip Ratio	SR RF	%
84	LF Tire Slip Ratio	SR LF	%
85	RR Tire Slip Ratio	SR RR	%
86	LR Tire Slip Ratio	SR LR	%
87	Front Roll Center Lateral Position	YRCF	in.
88	Front Roll Center Vertical Position	ZRCF	in.
89	Rear Roll Center Lateral Position	YRCR	in.
90	Rear Roll Center Vertical Position	ZRCR	in.
91	RF Tire Normal Force	FN RF	lb.

92	LF Tire Normal Force	FN LF	lb.
93	RR Tire Normal Force	FN RR	lb.
94	LR Tire Normal Force	FN LR	lb.
95	RF Tire Side Force	FS RF	lb.
96	LF Tire Side Force	FS LF	lb.
97	RR Tire Side Force	FS RR	lb.
98	LR Tire Side Force	FS LR	lb.
99	RF Tire Tractive Force	FC RF	lb.
100	LF Tire Tractive Force	FC LF	lb.
101	RR Tire Tractive Force	FC RR	lb.
102	LR Tire Tractive Force	FC LR	lb.
103	RF Tire Aligning Torque	NA RF	ft.-lb.
104	LF Tire Aligning Torque	NA LF	ft.-lb.
105	RR Tire Aligning Torque	NA RR	ft.-lb.
106	LR Tire Aligning Torque	NA LR	ft.-lb.
107	RF Tire Overturning Moment	NO RF	ft.-lb.
108	LF Tire Overturning Moment	NO LF	ft.-lb.
109	RR Tire Overturning Moment	NO RR	ft.-lb.
110	LR Tire Overturning Moment	NO LR	ft.-lb.
111	RF Wheel Torque	WTORQ RF	ft.-lb.
112	LF Wheel Torque	WTORQ LF	ft.-lb.
113	RR Wheel Torque	WTORQ RR	ft.-lb.
114	LR Wheel Torque	WTORQ LR	ft.-lb.

Note: All suspension forces and components are effective at the wheel centers.

121	RF Suspension Total Force	SUS F RF	lb.
122	LF Suspension Total Force	SUS F LF	lb.
123	RR Suspension Total Force	SUS F RR	lb.
124	LR Suspension Total Force	SUS F LR	lb.
125	RF Suspension Spring Force	SPR F RF	lb.
126	LF Suspension Spring Force	SPR F LF	lb.
127	RR Suspension Spring Force	SPR F RR	lb.
128	LR Suspension Spring Force	SPR F LR	lb.
129	RF Roll Bar Force	BAR F RF	lb.
130	LF Roll Bar Force	BAR F LF	lb.

131	RR Roll Bar Force	BAR F RR	lb.
132	LR Roll Bar Force	BAR F LR	lb.
133	RF Anti-Pitch Force	AP FR RF	lb.
134	LF Anti-Pitch Force	AP FR LF	lb.
135	RR Anti-Pitch Force	AP FR RR	lb.
136	LR Anti-Pitch Force	AP FR LR	lb.
137	RF Anti-Squat Force	AS FR RF	lb.
138	LF Anti-Squat Force	AS FR LF	lb.
139	RR Anti-Squat Force	AS FR RR	lb.
140	LR Anti-Squat Force	AS FR LR	lb.
141	RF Anti-Roll Force	AR FR RF	lb.
142	LF Anti-Roll Force	AR FR LF	lb.
143	RR Anti-Roll Force	AR FR RR	lb.
144	LR Anti-Roll Force	AR FR LR	lb.
145	RF Shock Force	SA FR RF	lb.
146	LF Shock Force	SA FR LF	lb.
147	RR Shock Force	SA FR RR	lb.
148	LR Shock Force	SA FR LR	lb.
149	RF Suspension Friction Force	FRI F RF	lb.
150	LF Suspension Friction Force	FRI F LF	lb.
151	RR Suspension Friction Force	FRI F RR	lb.
152	LR Suspension Friction Force	FRI F LR	lb.
153	RR Coupled Anti-Pitch Force	APX F RR	lb.
154	LR Coupled Anti-Pitch Force	APX F LR	lb.
155	RR Coupled Anti-Squat Force	ASX F RR	lb.
156	LR Coupled Anti-Squat Force	ASX F LR	lb.
157	RR Anti-Prop Shaft Torque Force	APT F RR	lb.
158	LR Anti-Prop Shaft Torque Force	APT F LR	lb.
161	Longitudinal Aero + Rolling Drag Force	FXB	lb.
162	Lateral Aero Force	FYB	lb.
163	Vertical Aero Force	FZB	lb.
164	Aero Rolling Moment	NXB	ft.-lb.
165	Aero Pitching Moment	NYB	ft.-lb.
166	Aero Yawing Moment	NZB	ft.-lb.

171	Steering Wheel Acceleration	DDTHETS	deg./sec.^{2}
172	Steering Rack Acceleration	SSXPIN	in./sec.^{2}
173	Steering Wheel Velocity	DTHETS	deg./sec.
174	Steering Rack Velocity	DXPIN	in./sec.
175	Steering Wheel Position	THETS	deg.
176	Steering Rack Position	XPIN	in.

Note: Signs for rack motion are relative to the y direction of the sprung mass. For a rack location behind the wheel centerline, negative motion results in a positive steer angle (right hand turn). Steering wheel motion is positive for a right hand turn.

177	Power steering torsion bar deflection	THET VLV	deg.
178	Steering pinion rotation	THET PIN	deg.
179	Net force acting on steering rack	TOT RK FRC	lb.
180	Rack force due to pinion gear	GEAR FRC	lb.
181	Net power steering piston force	PIST FRF	lb.
182	Net tie rod forces acting on rack	TIE RD F	lb.
183	Net steering system damping force acting on rack	DAMP FRC	lb.
184	Net steering system friction force acting on rack	FRIC FRC	lb.
185	Steering Pump Pressure	Pp	psig
186	Pressure at valve inlet	Pv	psig
187	Pressure at right hand turn side of piston	P1	psig
188	Pressure at left hand turn side of piston	P2	psig
189	Pressure at valve outlet	Pret	psig
190	P1 – P2	DELPL	psig
191	Right hand turn valve bridge flow	q1	in.^{3}/sec.
192	Left hand turn valve bridge flow	q2	in.^{3}/sec.
193	Right hand turn valve opening	A1	in.^{2}
194	Left hand turn valve opening	A2	in.^{2}
195	Torsion bar torque	TRQ VLV	in.-lb.
196-201	Steering system hydraulic pressures at various locations see hydraulic schematic in Appendix A		

202	Torque applied at steering wheel	Tapp	in.-lb.
203	RF moment about steering axis due to tire contact patch moments	MzSTRtcm(1)	lb.-ft.
204	LF moment about steering axis due to tire contact patch moments	MzSTRtcm(2)	lb.-ft.
205	RF moment about steering axis due to tire forces	MzSTRtcf(1)	lb.-ft.
206	LF moment about steering axis due to tire forces	MzSTRtcf(2)	lb.-ft.
207	RF moment about steering axis due to centrifugal caster	MzSTRcc(1)	lb.-ft.
208	LF moment about steering axis due to centrifugal caster	MzSTRcc(2)	lb.-ft.
209	RF moment about steering axis due to driving, braking & gyroscopic torques	MzSTRwc(1)	lb.-ft.
210	RF moment about steering axis due to driving, braking & gyroscopic torques	MzSTRwc(2)	lb.-ft.
211	RF gyroscopic torque about wheel z-axis due to camber change	Gyroz(1)	lb.-ft.
212	LF gyroscopic torque about wheel z-axis due to camber change	Gyroz(2)	lb.-ft.
213	RF wheel inertial reaction force applied to the rack	IRF(1)	lb.
214	LF wheel inertial reaction force applied to the rack	IRF(2)	lb.
215	RF force at outer end of the tie rod*	FE(1)	lb.
216	LF force at outer end of the tie rod*	FE(2)	lb.
	* This force is not necessarily in the direction of the tie rod, although the alignment is typically close.		
217	Total steering rack load from RF wheel	Fracky(1)	lb.
218	Total steering rack load from LF wheel	Fracky(2)	lb.