

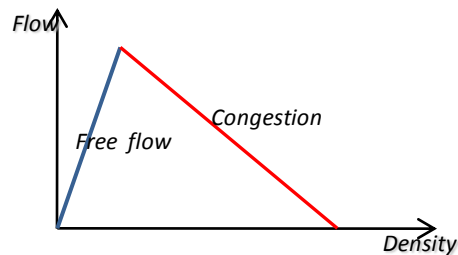
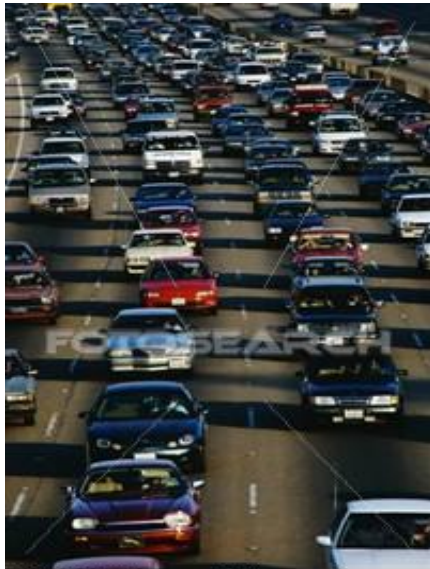
Impact of Traffic States on Freeway Collision Frequency: I-880 Site Investigation

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and Alexander Skabardonis**

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Freeway collision and traffic?

- How to relate traffic states and collision?



Previous Research

- Volume/VMT vs. Accident rate
 - SPF (Safety Performance Function)
 - V/C ratio, AADT
- Oh et al., 2001
 - Mean and variance of OCC
- Abdel-Aty and Abdalla, 2004
 - average speed and volume vs. freeway crash
- Golob and Recker, 2004

Study Site

- I-880 N
 - Fremont to Oakland
 - Number of detector stations: 65 stations.
 - 2005, 2006 and 2007

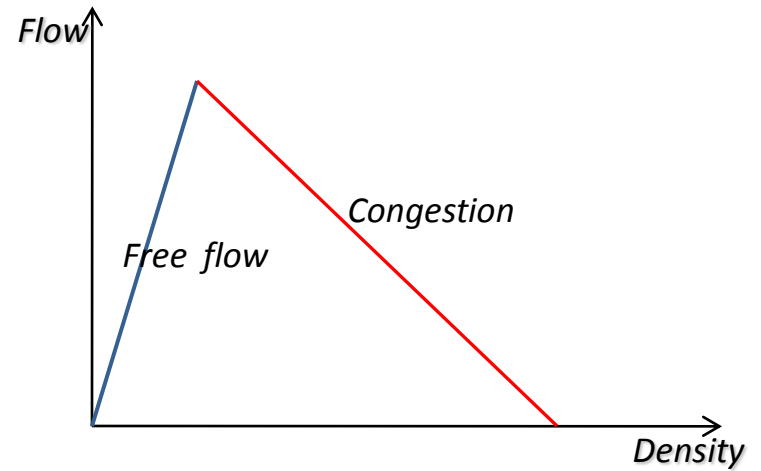
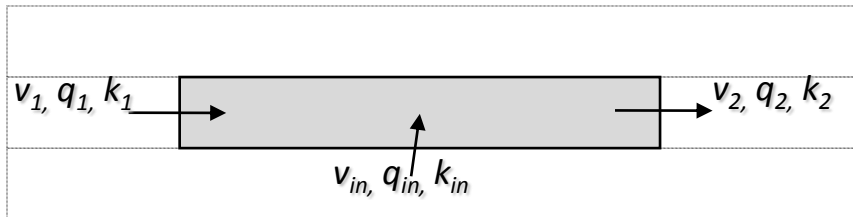


Research Approach

- Traffic state definition
 - **Section-based** traffic state definition
 - 4 traffic states (FF, BQ, BN, CT)
- Link Traffic data with collision data
 - Traffic data: PeMS (5min detector data)
 - Incident Data: TASAS data
 - accident type, location, time, ...
- Assess the collision probability
 - for each traffic state

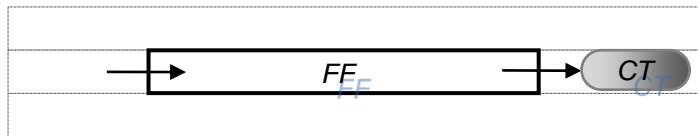
Traffic State definition(1)

- Section-based traffic states

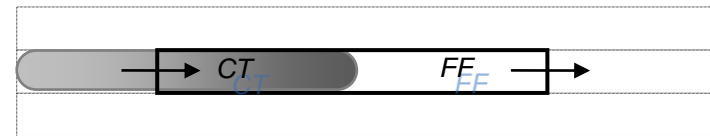


Traffic State definition(2)

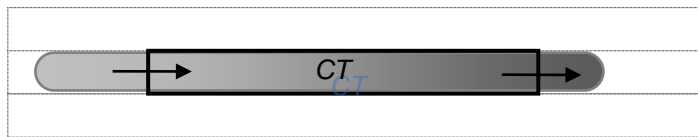
- 4 traffic states for a section
 - FF(Free flow)
 - BN(Bottleneck front)
 - BQ(Back of Queue)
 - CT(Congestion)



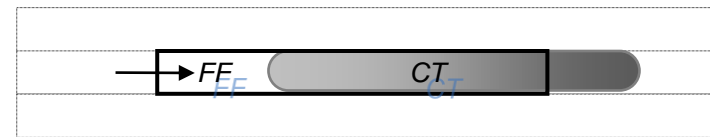
FF



BN



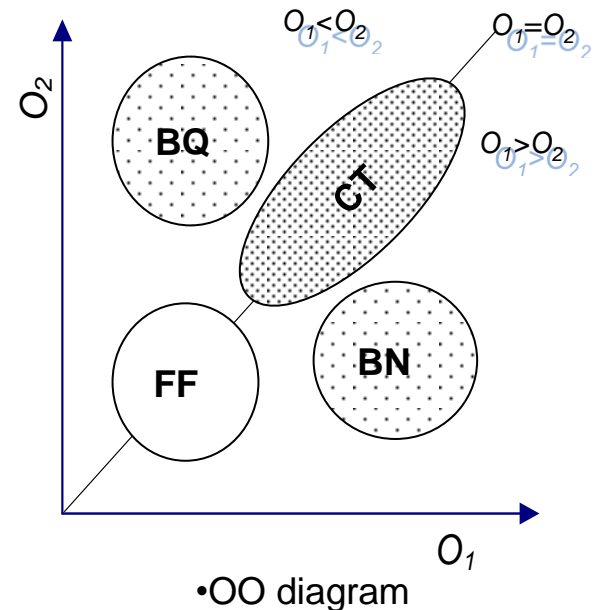
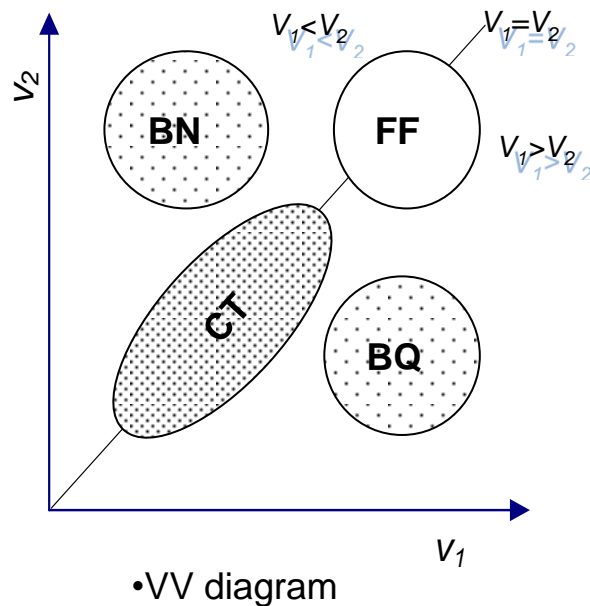
CT



BQ

Section traffic state diagrams

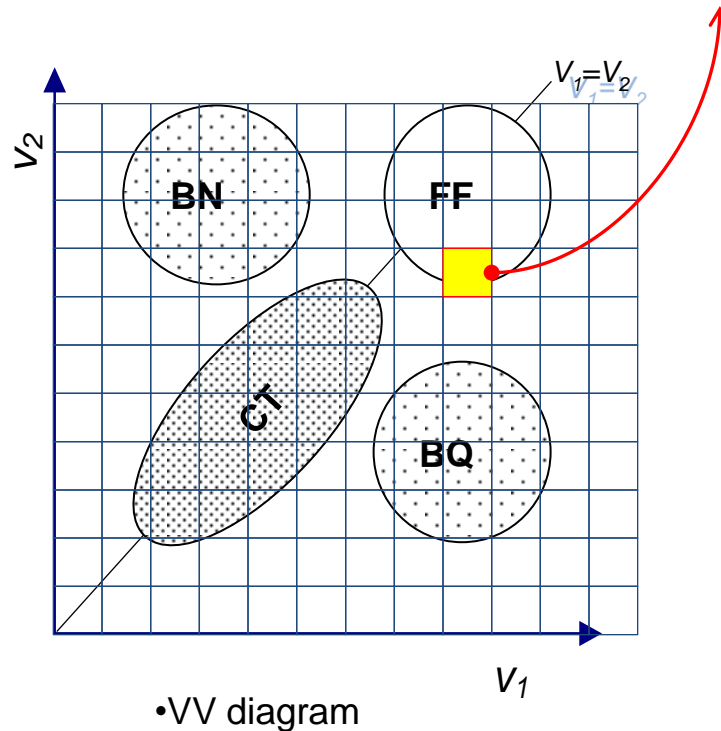
- Speed diagram (VV)
- Occupancy diagram (OO)



Collision Probability

- Collision Probability

$$P(\text{Collision} \mid \text{Traffic state}) = \frac{\text{Number of collisions}}{\text{MVMT}}$$



Collision Probability per MVM, 2005

CT		Vd														BN		
		0mph				50mph				80mph								
Vu	0mph	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	47.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	27.10	7.71	12.76	0.00	24.17	7.87	39.68	15.61	0.00	0.00	26.30	17.06	0.00	0.00	0.00	0.00	0.00
	0.00	113.74	6.86	8.68	5.62	8.32	5.78	8.97	10.45	0.00	13.69	0.00	0.00	22.16	0.00	0.00	0.00	0.00
	0.00	0.00	9.42	10.55	7.99	3.42	6.50	2.32	7.72	7.30	3.63	11.80	1.96	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	14.12	0.00	4.42	2.75	4.14	1.57	7.10	2.89	8.80	3.73	1.24	12.12	6.92	0.00	0.00	0.00
	0.00	0.00	11.82	2.84	6.03	6.04	4.17	4.18	4.76	3.66	7.76	4.88	5.88	5.57	5.09	0.00	0.00	0.00
	0.00	0.00	0.00	13.16	10.97	7.71	4.30	3.23	2.42	0.00	4.95	1.55	5.68	2.96	4.58	0.00	0.00	0.00
	0.00	0.00	0.00	10.47	7.92	5.26	4.61	6.18	6.52	3.96	4.73	3.66	3.31	3.28	8.35	0.00	0.00	0.00
	0.00	0.00	54.70	10.65	13.19	6.84	3.63	5.56	4.20	4.24	2.96	2.78	4.14	4.46	5.11	0.00	0.00	0.00
50mph	0.00	0.00	0.00	0.00	3.45	7.15	10.79	4.05	7.80	3.76	2.30	1.10	2.42	1.20	3.89	0.00	0.00	
	0.00	0.00	0.00	24.19	10.42	10.62	2.94	5.58	7.56	3.99	1.33	0.79	1.30	1.33	0.68	0.00	0.00	
	0.00	0.00	0.00	0.00	3.10	1.38	6.28	9.26	2.89	2.70	1.52	0.93	0.70	0.83	1.22	1.36	0.00	
	0.00	0.00	0.00	57.27	10.73	2.25	2.41	2.04	2.52	1.78	1.50	0.50	0.60	0.50	0.74	0.49	0.00	
	0.00	0.00	0.00	0.00	0.00	20.07	4.98	0.00	0.00	0.00	0.96	0.95	1.16	0.81	0.78	0.40	0.00	
80mph	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.99	0.00	0.00	0.00	3.07	0.81	0.53	1.21	0.31	0.00	

BQ

FF

Collision Probability per MVM, 2006

		Vd															
		0mph				50mph				80mph							
CT	0mph	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	65.00	50.34	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	20.02	8.52	6.51	0.00	48.38	17.74	80.14	0.00	23.21	27.46	27.29	16.67	0.00	0.00	0.00
		0.00	0.00	15.54	6.18	3.45	4.76	5.85	5.79	13.65	18.60	13.82	0.00	21.22	0.00	0.00	0.00
		0.00	0.00	0.00	1.91	4.97	3.34	6.89	5.28	10.27	15.15	5.32	9.70	11.06	16.31	0.00	0.00
		0.00	0.00	12.50	8.29	3.51	1.30	3.33	5.63	8.51	0.00	16.40	2.33	11.81	6.96	47.32	0.00
		0.00	0.00	0.00	5.77	8.51	3.57	2.42	3.80	4.39	6.93	5.37	9.45	8.67	4.36	21.89	0.00
		0.00	0.00	0.00	13.70	6.51	2.48	3.32	2.88	1.77	3.33	5.67	3.77	3.89	7.32	0.00	0.00
		0.00	0.00	58.92	16.98	6.79	2.25	3.35	4.32	1.67	2.39	2.19	5.49	8.17	4.60	3.88	0.00
		0.00	0.00	0.00	13.87	3.17	2.30	3.81	5.62	3.06	2.86	1.29	3.39	2.23	2.88	0.00	12.43
Vu	50mph	0.00	0.00	0.00	0.00	4.55	1.70	4.19	2.24	5.08	2.27	2.08	1.43	1.24	1.31	0.00	0.00
		0.00	0.00	0.00	0.00	4.39	1.78	4.37	3.83	4.11	1.90	1.37	0.91	0.83	0.74	1.83	0.00
		0.00	36.82	0.00	12.12	15.12	4.64	6.20	5.24	2.26	2.27	1.78	0.74	0.57	0.63	0.35	1.12
		0.00	14.00	24.15	0.00	0.00	5.37	7.54	3.76	2.52	3.12	1.70	1.34	0.77	0.67	0.48	0.55
		0.00	0.00	39.32	0.00	0.00	0.00	11.50	0.00	3.78	0.00	3.79	0.21	0.62	0.69	0.62	0.71
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.60	0.00	0.70	1.06	1.66	0.64
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

BN

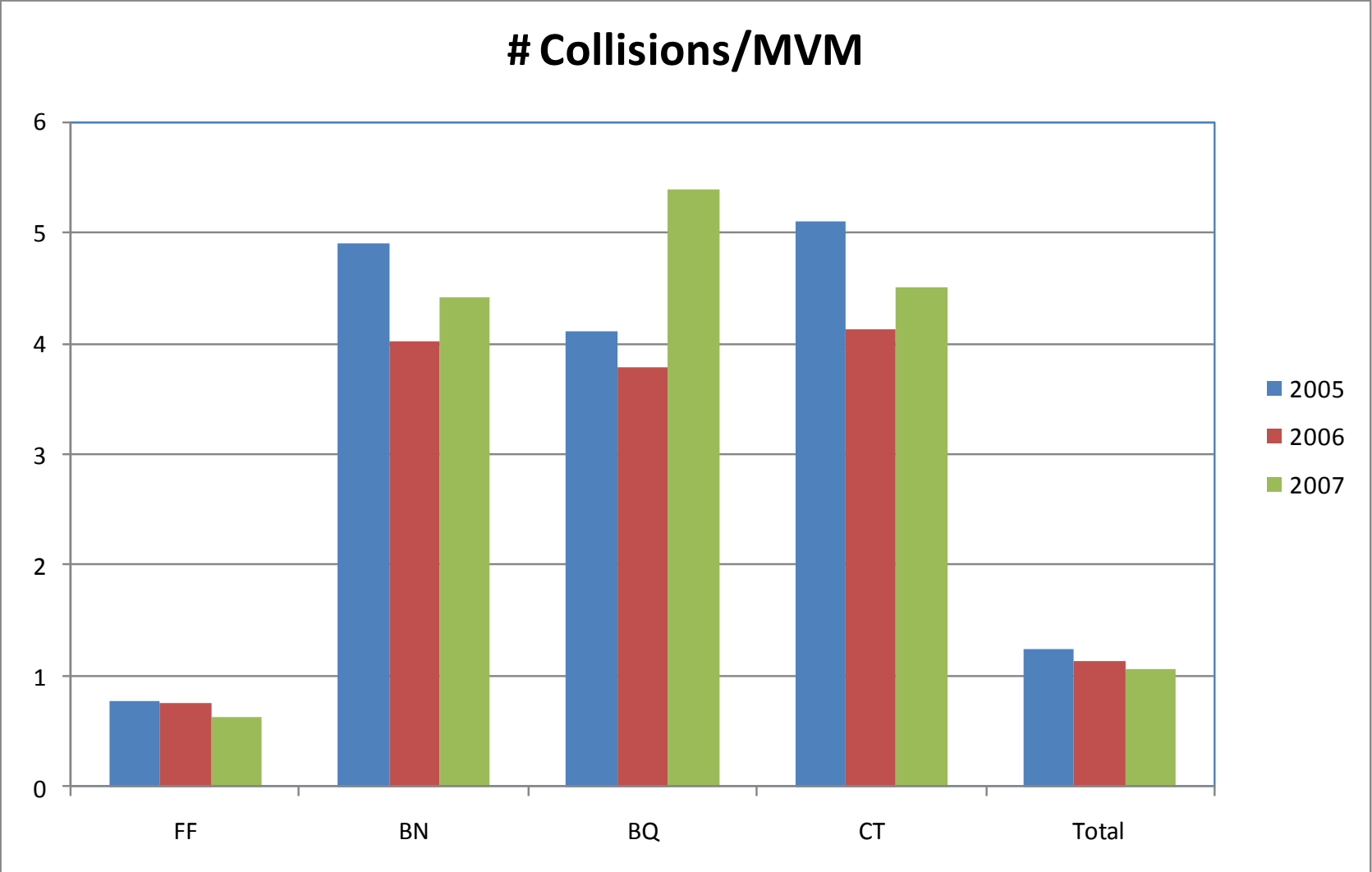
FF

BQ

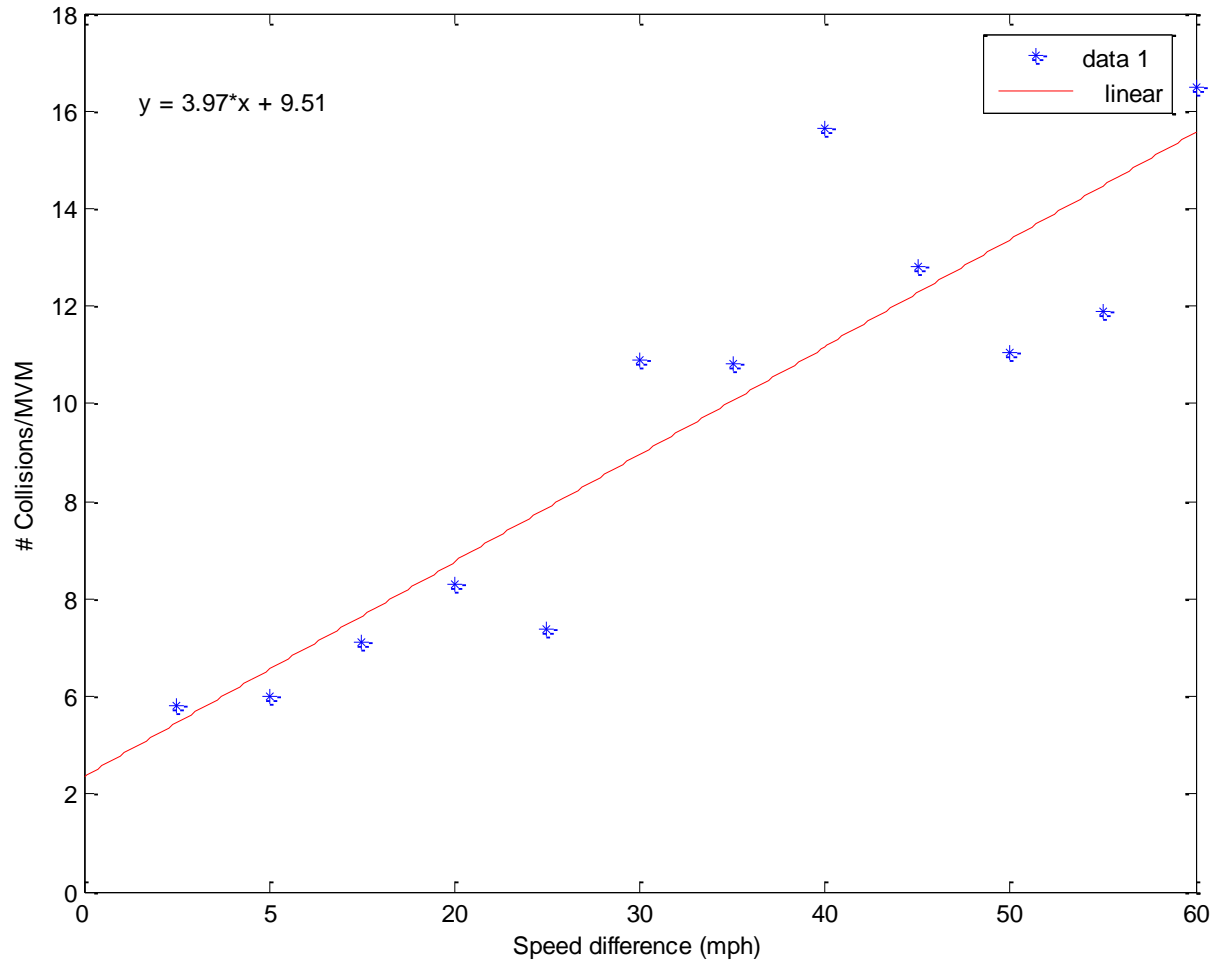
Collision Probability per MVM, 2007

CT		Vd														BN	
		0mph				50mph				80mph							
0mph	0mph	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	50mph	0.00	9.25	0.00	0.00	0.00	0.00	0.00	0.00	65.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vu	0mph	0.00	18.47	2.51	3.95	20.78	16.27	0.00	31.57	76.51	120.01	0.00	0.00	17.94	44.20	0.00	0.00
	50mph	0.00	31.76	13.88	4.85	5.42	2.21	7.21	23.28	32.87	24.41	37.25	19.01	6.18	0.00	67.75	0.00
80mph	0mph	0.00	42.07	0.00	10.03	1.33	6.56	6.69	5.15	12.29	43.27	7.24	9.11	23.12	3.98	11.51	0.00
	50mph	0.00	0.00	30.50	3.92	4.36	1.38	8.32	4.89	10.29	8.28	17.32	7.36	5.53	16.20	33.63	0.00
FF	0mph	0.00	0.00	0.00	14.75	2.54	4.28	2.29	4.77	6.53	4.85	5.27	2.99	3.85	11.34	18.52	0.00
	50mph	0.00	0.00	0.00	12.42	1.92	3.21	2.20	3.23	3.30	5.64	10.59	6.40	4.87	6.42	58.47	0.00
BQ	0mph	0.00	0.00	59.26	0.00	2.96	5.65	3.78	5.41	4.28	2.98	0.65	3.69	7.34	14.99	34.90	0.00
	50mph	0.00	0.00	0.00	12.55	6.00	3.29	3.97	4.16	1.27	2.83	2.30	2.75	4.42	3.09	17.35	0.00
FF	0mph	0.00	0.00	0.00	0.00	13.42	9.61	5.77	5.48	4.91	2.08	2.47	1.49	1.75	4.54	0.00	0.00
	50mph	0.00	0.00	0.00	19.98	21.74	2.09	7.50	3.33	5.05	0.97	2.15	0.63	1.07	0.80	2.15	0.00
FF	0mph	0.00	25.16	0.00	0.00	0.00	2.36	7.84	5.22	3.06	2.22	1.92	0.55	0.42	0.42	0.72	0.83
	50mph	0.00	0.00	0.00	0.00	0.00	7.35	0.00	5.84	1.68	1.29	1.92	0.59	0.65	0.42	0.48	1.22
FF	0mph	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.24	1.56	2.92	1.07	0.73	0.49	0.54
	50mph	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.74	0.00	0.00	0.28	0.40	0.94

Collision Probability



Collisions vs. speed difference



Conclusions

- Freeway collision probabilities are reproducible with traffic state.
- Collision probabilities in BQ, BN and CT are much higher than FF.
- Collision Probability increases with speed difference
- Potential use of the proposed method
 - Freeway safety performance measure monitoring
 - Combined with traffic simulation to assess number of collision