

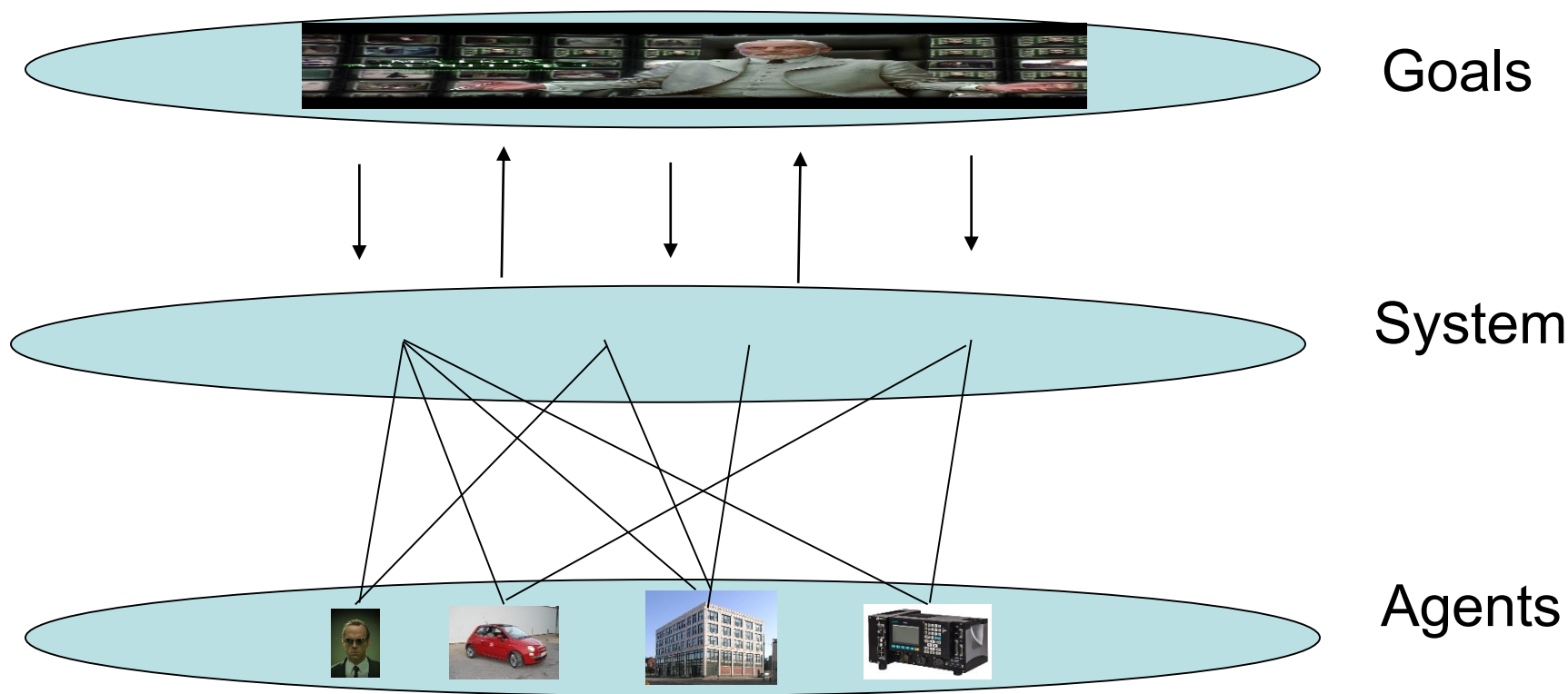


SAFETY AND MOBILITY APPLICATION WITH MULTI-AGENT SYSTEM AND DATA ANALYTICS

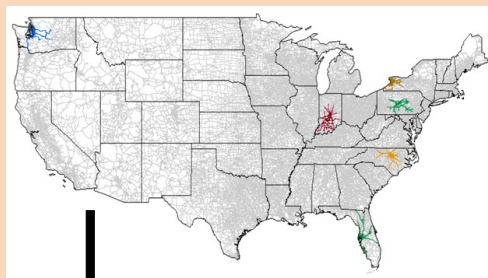
Monty Abbas, Virginia Tech
VT-SCORES
(Qichao Wang and Awad Abdelhalim)

Data Discovery for
November 16-17, 2017

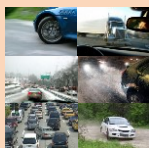
Background: Multi-agent System



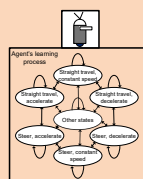
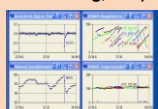
Vision



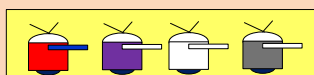
NDS Varying Traffic Behavior Maneuvers



Vehicle's Network Data (speed, acceleration, steering, etc.)



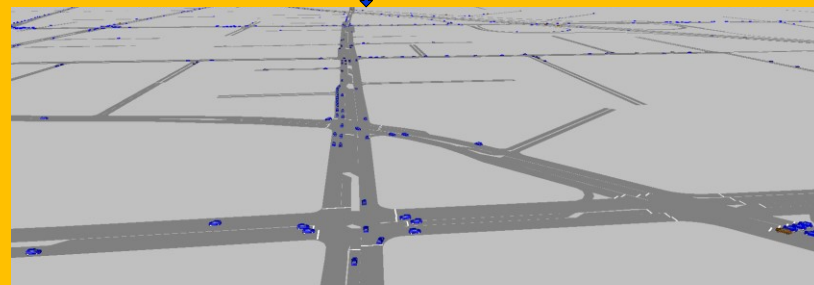
Agents Library: Type and Frequency



Calibration

Safety Simulation Kit

Simulation API



Safety Heat Map from Simulation



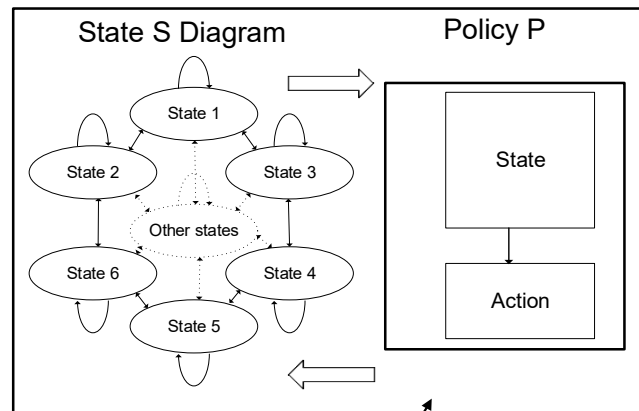
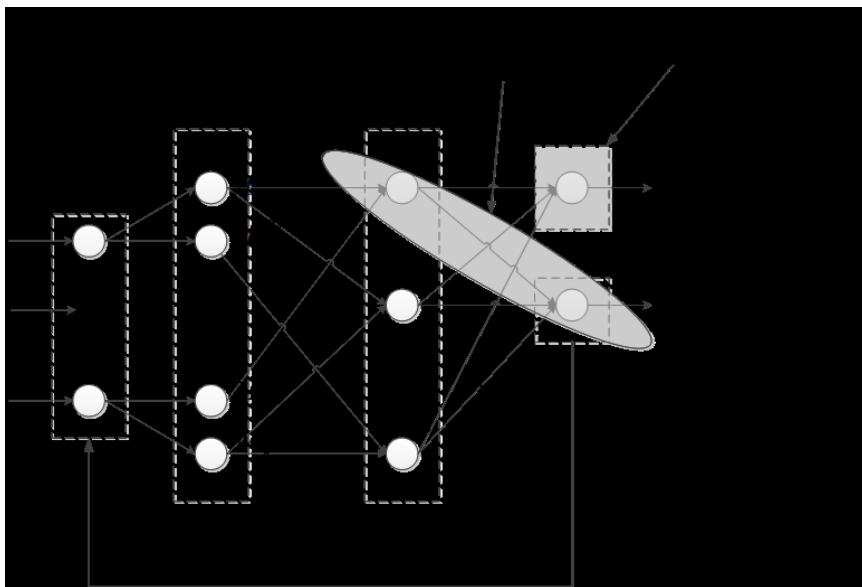
Safety Heat Map from SmarterRoads



Naturalistic driving behavior: event data

- Training input: traffic states and actions
- Training output: acceleration and steering
- Input variables discretized using fuzzy sets
- Continuous actions are generated from discrete actions
- Produces Individual agents combining acceleration and steering behavior

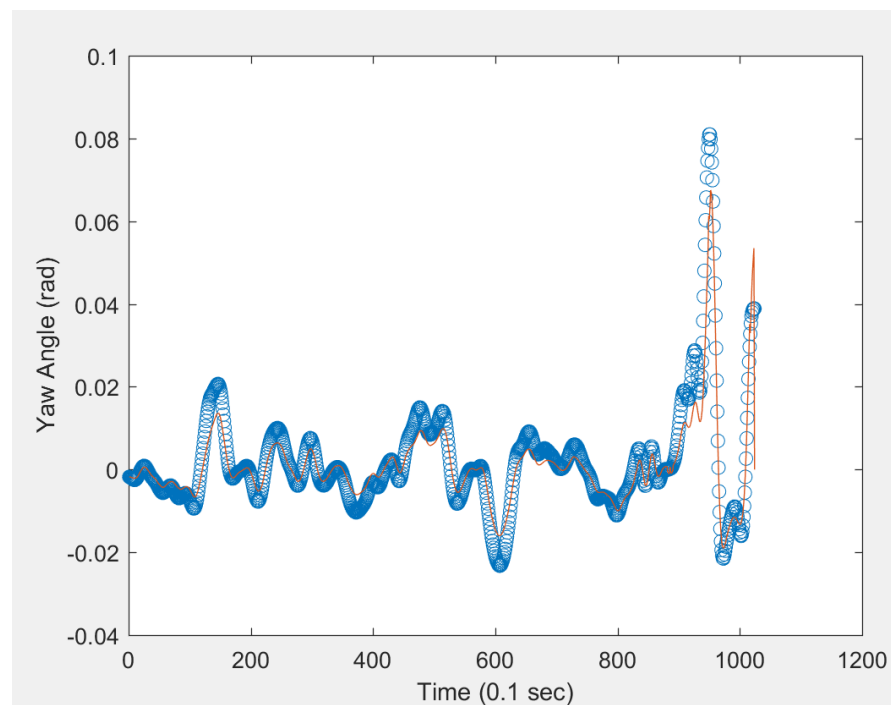
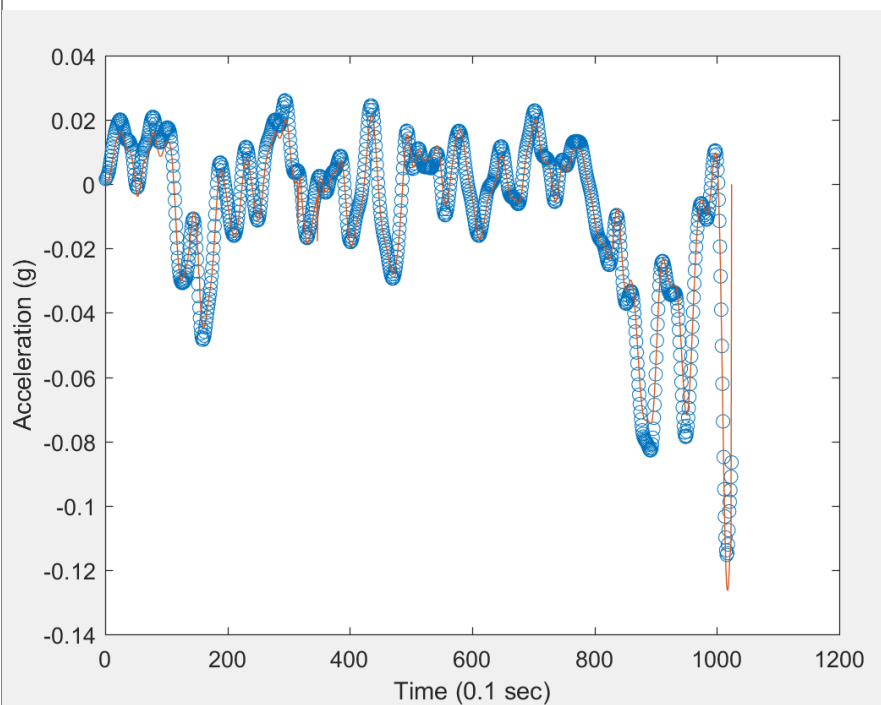
Learning Techniques



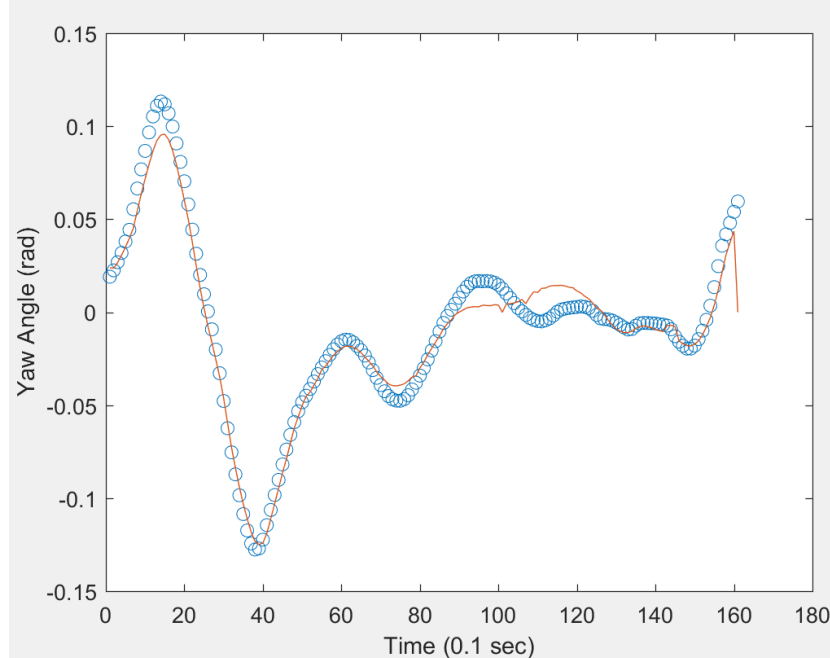
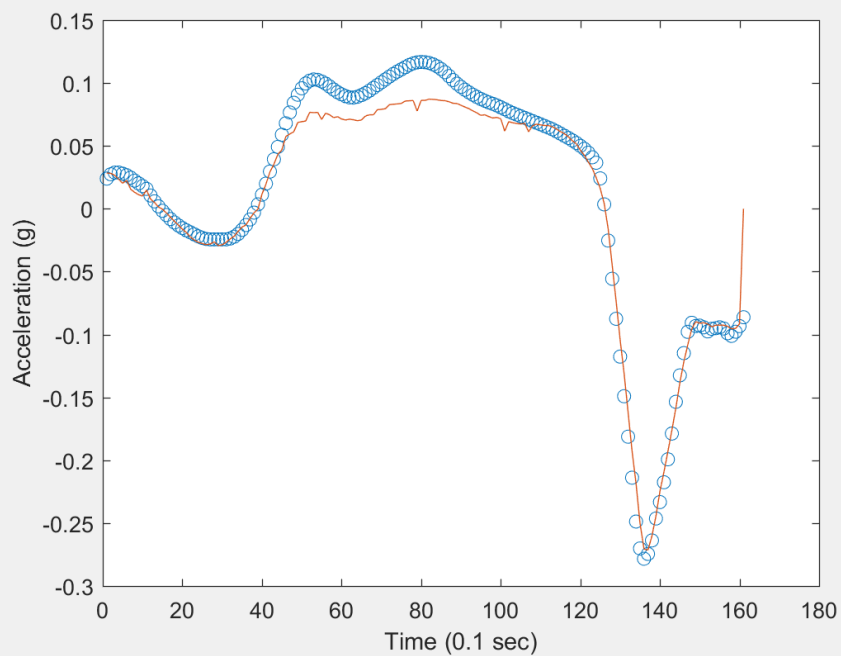
Value Iteration
 $i=0 \Rightarrow i=k$
 $P \Rightarrow P^*$

- Using actor-critic Reinforcement Learning

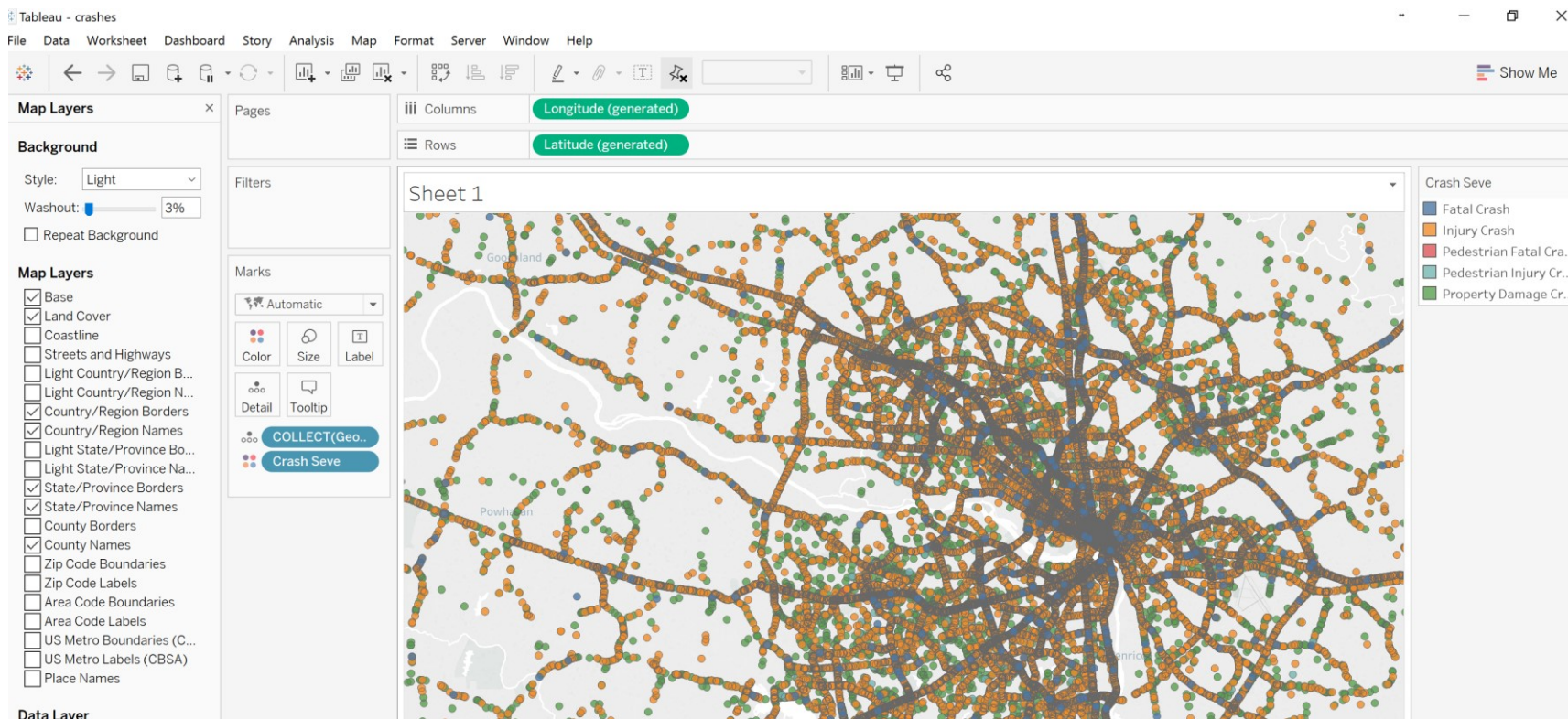
Agent 1: Eta*



Agent 2: Virginia*



Utilizing SmarterRoads Crash data



The Matrix has you

Data Analytics Pages

Virginia_Crashes

Columns: Crash Hour

Rows: Crash Seve

Dimensions:

- Collision
- Crash Date
- Crash Hour
- Crash Seve
- Crash Weat
- Crash Year
- Light Cond
- Location O
- Physical I
- Physical J

Filters

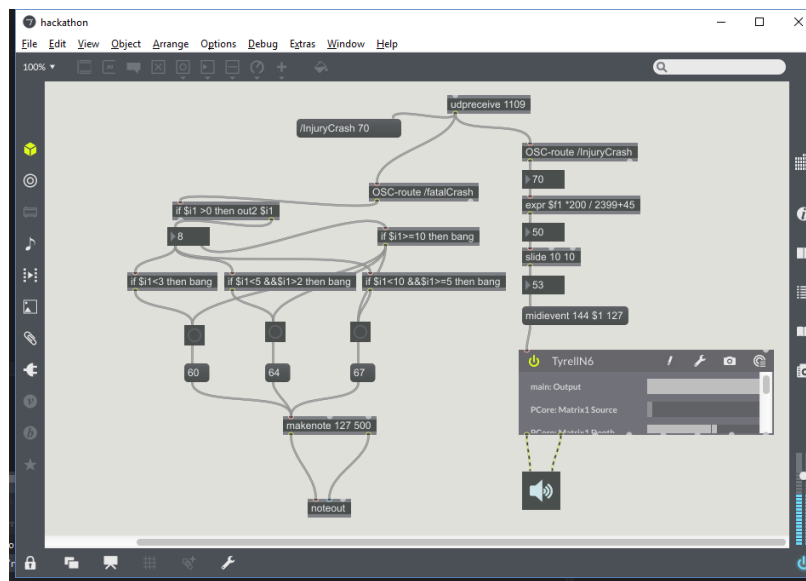
Marks: Automatic

Color Size Text

Detail Tooltip

Sheet 1

Crash Seve	00:00	00:01	00:02	00:03	00:04	00:05	00:06	00:07	00:08	00:09	00:10	00:11	00:12	00:13	00:14	00:15	00:16
Fatal Crash	10	4	2	1	1	2	2	3	1	10	2	1	1	1	10	1	
Injury Crash	671	135	64	51	51	175	43	63	54	53	199	48	50	50	43	215	48
Pedestrian ..	3		3			1				1					1		
Pedestrian ..	25	1	3	2		6	2	2	1	1	8	1	3	1		9	
Property D..	1,292	308	145	105	115	366	92	120	99	94	370	88	111	97	85	448	90



Summary

- Possibilities and Impact
 - Develop a library of agents (including disadvantages population)
 - Calibrate agent distribution in simulation to replicate safety performance at a site
 - Evaluate potential improvement strategies for public safety and mobility

Summary

- Innovation
 - Combined car-following and lane changing for normal and safety-critical driving
 - Better, more accurate modeling that can accommodate disruptive technology (e.g., CAV)
 - Can replicate existing safety performance (crashes) and mobility (congestion) in a region



“...I don't know the future. I didn't come here to tell you how this is going to end; I came here to tell you how it is going to begin!”

Thank you!