Roundabout Vs Traffic Light Intersection Traffic Flow Optimization

Team: SUMO Traffic Simulation

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The Project

- Description:
  - In our project, we developed simulations that compare roundabout and a traffic light regulated intersection and their effectiveness at redirecting traffic at a four-way junction.

- Objectives:
  1. Determine a which method is more effective at redirecting traffic
  2. Determine optimizations for faults found in original data analysis

Background

- According to Federal Highway Administration: [1]
  - New road are being constructed
  - Existing roads being modified
  - Roundabout:
    - Yield sign vs Red-Green light
    - Vehicles are constantly in traffic circulation
- The Myth-Busters [4]
  - 4 way stop and a roundabout

Project Plan

- Gather pre-existing traffic data
- Two simulations in SUMO
  - Four-way traffic control
  - Round-a-bout
- Analyze Results
- Draw Conclusions

Expected Data

- Avg # of cars at given lane
- Avg wait time at a junction
- Max # of cars at given lane
- Avg trip duration for all vehicles

Technical Description

- Simulations construction tools
  - NetEdit – click and place simulation editing interface that allows users to manipulate .xml files
  - .xml files: Manipulate the SUMO environment through code
  - SUMO GUI : an environment to initiate the simulation
  - Java & Python
  - Excel : data tables and calulations

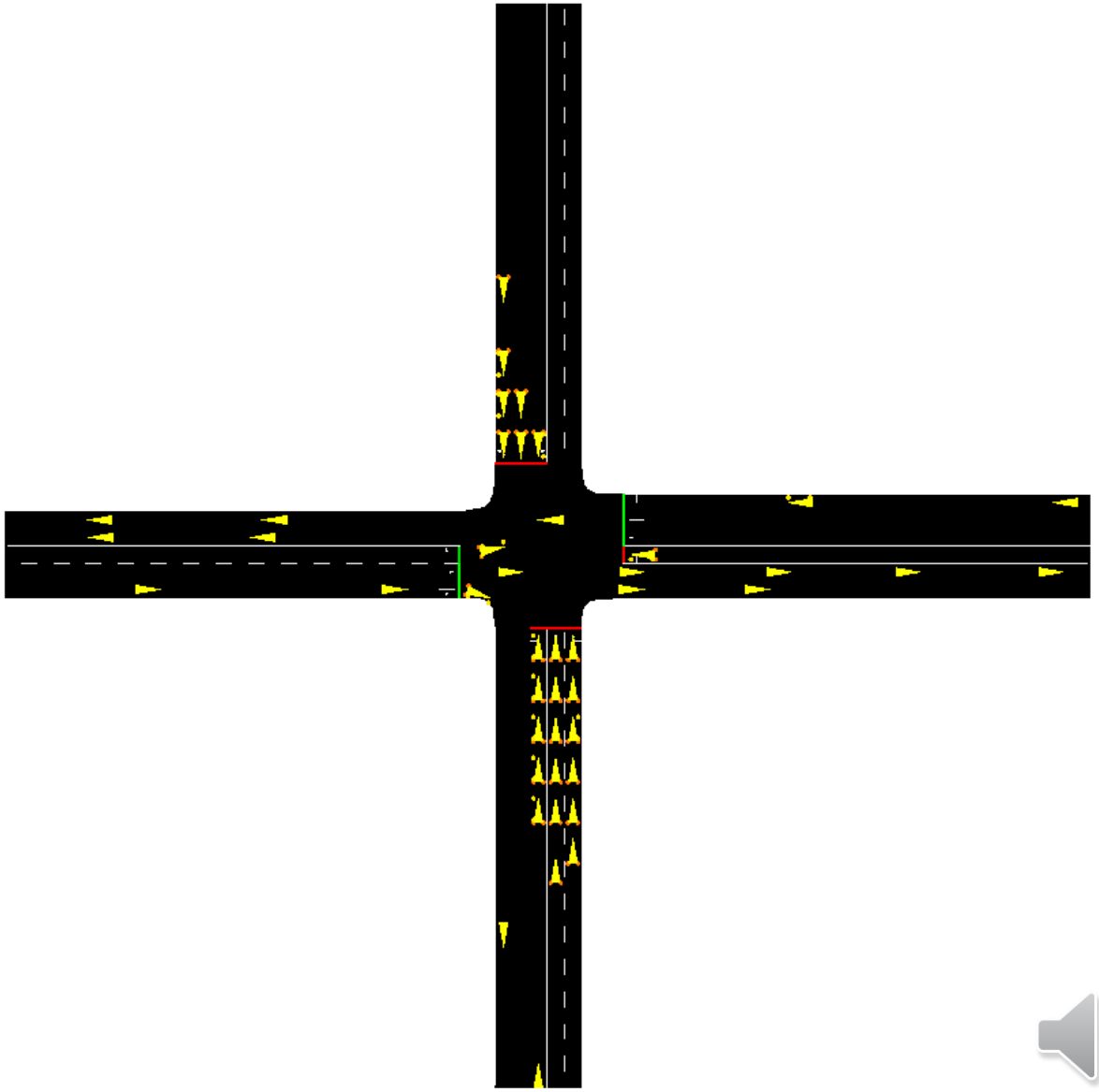
- We have 570 lines of code in this project
- Half a GB in data
- Features
- Output

Data

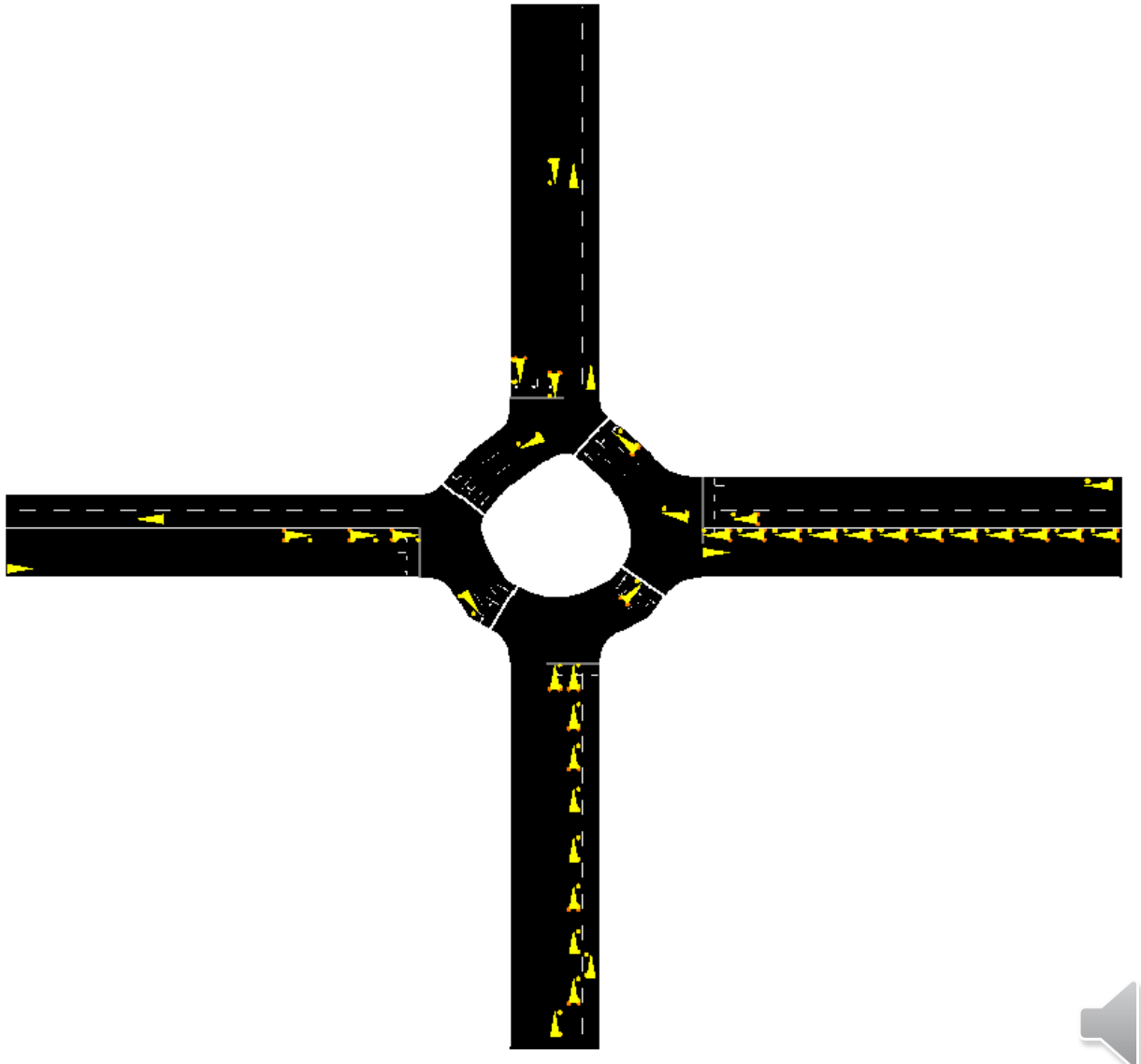
Turning Movement Data

Start Time	YANCEYVILLE RD Southbound						LEES CHAPEL RD Westbound						YANCEYVILLE ST Northbound						LEES CHAPEL RD Eastbound						Int. Total
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	
7:00 AM	25	72	4	0	2	101	8	80	4	0	2	92	6	36	14	0	2	58	30	66	16	0	2	112	361
7:15 AM	73	124	18	0	1	215	8	73	10	0	0	91	8	27	22	0	0	57	26	85	40	0	0	151	514
7:30 AM	61	138	16	0	3	215	13	128	22	0	0	163	10	56	29	0	1	95	37	88	40	0	1	165	638
7:45 AM	60	135	17	0	8	212	20	111	15	0	0	146	5	49	25	0	0	79	37	110	48	0	0	195	632
Hourly Total	219	469	55	0	14	743	49	392	51	0	2	492	29	168	90	0	3	287	130	349	144	0	3	623	2145
8:00 AM	56	103	21	0	2	180	28	107	11	0	0	146	6	45	30	0	0	81	28	75	72	0	0	175	582
8:15 AM	55	103	22	0	1	180	10	93	7	0	0	110	7	35	26	0	0	68	26	65	31	0	0	122	480
8:30 AM	36	62	7	0	1	105	9	104	15	0	0	128	4	22	20	0	0	46	29	46	15	0	0	90	369
8:45 AM	22	62	7	0	0	91	6	87	10	0	0	103	6	28	23	0	0	57	28	65	18	0	0	111	362
Hourly Total	169	330	57	0	4	556	53	391	43	0	0	487	23	130	99	0	0	252	111	251	136	0	0	498	1793
9:00 AM	35	52	3	0	0	90	4	79	5	0	0	88	8	17	17	0	1	42	22	48	11	0	0	81	301
9:15 AM	27	41	6	0	0	74	4	56	4	0	1	64	12	15	17	0	5	44	21	54	11	0	3	86	268
9:30 AM	26	42	4	0	0	72	2	62	11	0	0	75	8	8	25	0	1	41	27	46	15	0	0	88	276
9:45 AM	20	27	7	0	3	54	1	55	4	0	0	60	9	16	16	0	0	41	29	60	10	0	0	99	254
Hourly Total	108	162	20	0	3	290	11	252	24	0	1	287	37	56	75	0	7	168	99	208	47	0	3	354	1099
10:00 AM	22	28	6	0	0	56	2	60	7	0	1	69	5	14	13	0	0	32	21	56	11	0	0	88	245
10:15 AM	13	23	2	0	0	38	4	65	8	0	0	77	9	21	26	0	1	56	34	49	12	0	0	95	266
10:30 AM	17	38	3	0	0	58	3	41	9	0	0	53	4	19	22	0	0	45	21	41	11	0	0	73	229
10:45 AM	21	23	2	0	0	46	8	52	12	0	0	72	8	18	21	0	1	47	24	64	13	0	2	101	266
Hourly Total	73	112	13	0	0	198	17	218	36	0	1	271	26	72	82	0	2	180	100	210	47	0	2	357	1006

Status: 4-way Traffic light



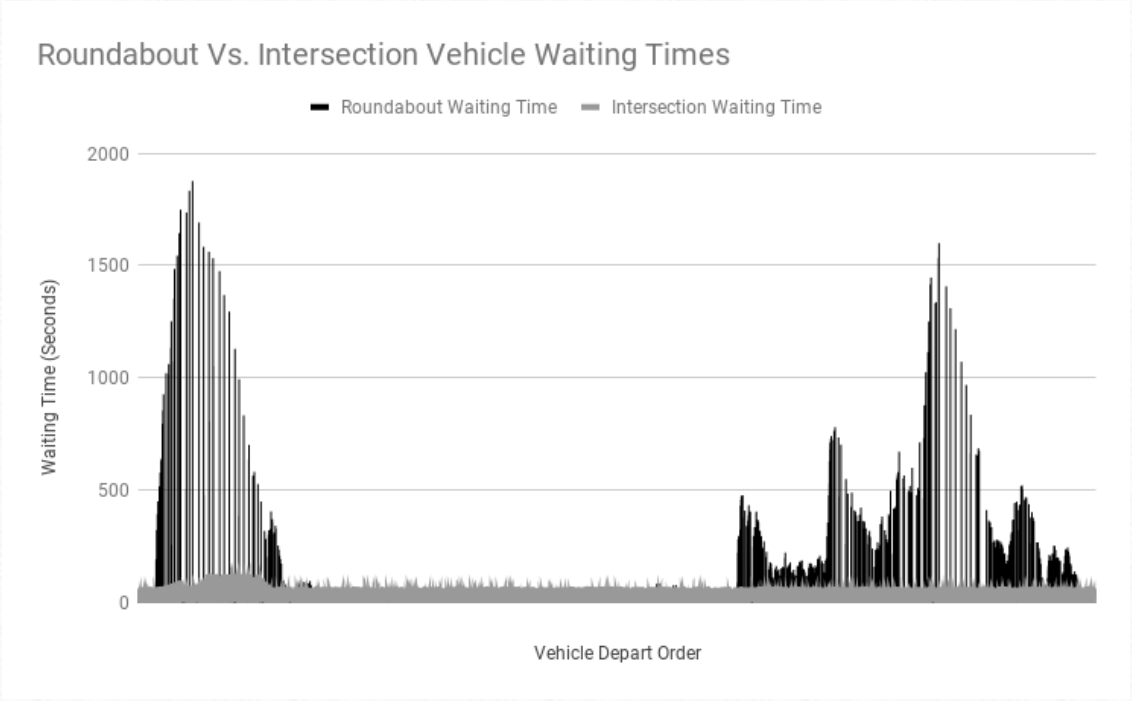
Status: Standard Roundabout



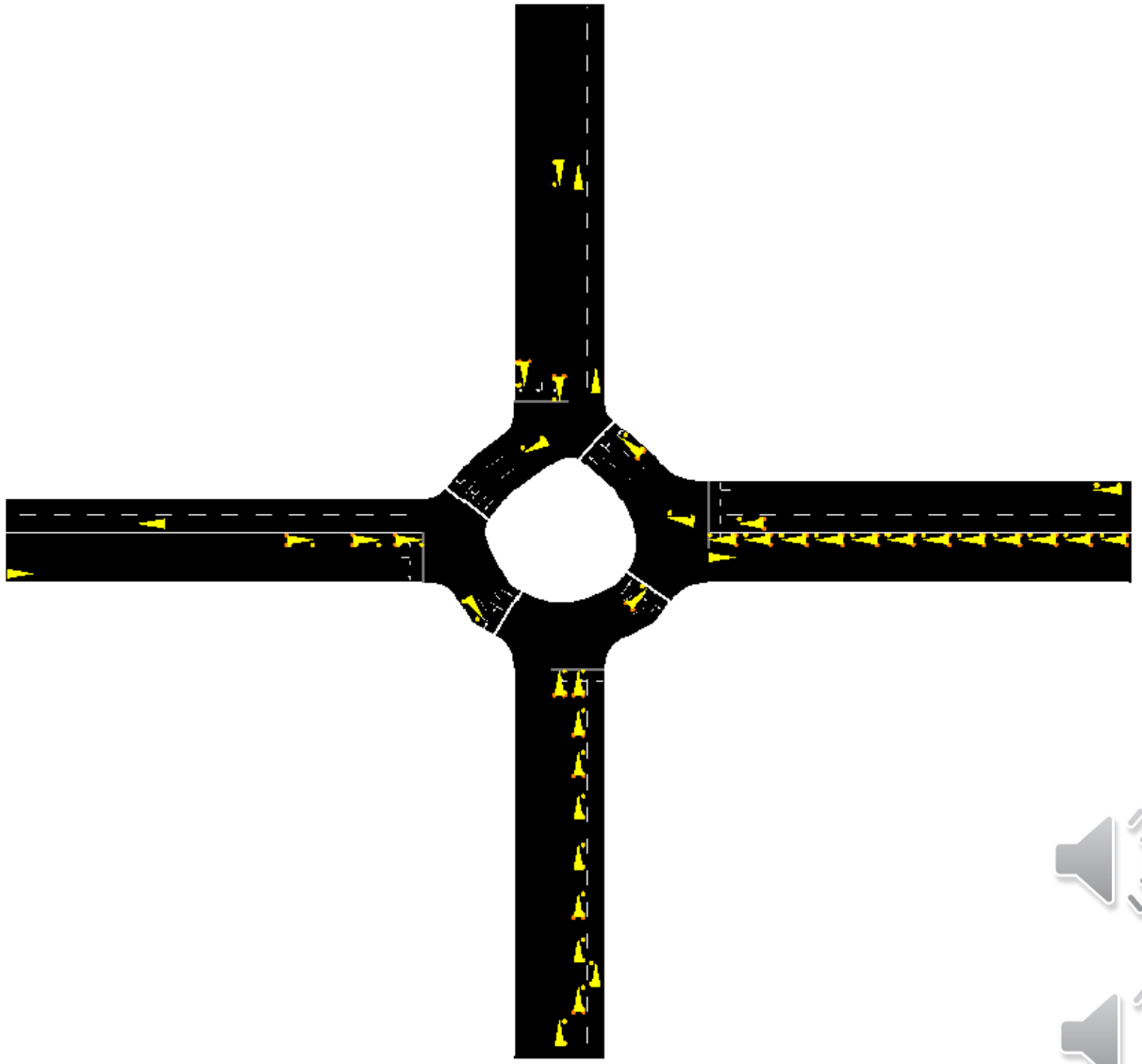
Results

Interval #	Traffic Light	Roundabout
Interval 1	30.25403467	25.18469815
Interval 2	34.60238806	16.68656716
Interval 3	23.39820896	5.795820896
Interval 4	21.92	0.8388059701
Interval 5	22.67343284	1.109850746
Interval 6	23.01970149	1.448955224
Interval 7	23.18985075	2.577910448
Interval 8	23.58746269	12.34328358
Interval 9	24.6280597	21.45850746
Interval 10	24.55104478	25.47462687
Interval 11	25.40298507	21.77492537
Interval 12	24.61259655	14.80926916
All	25.15755163	12.46275193

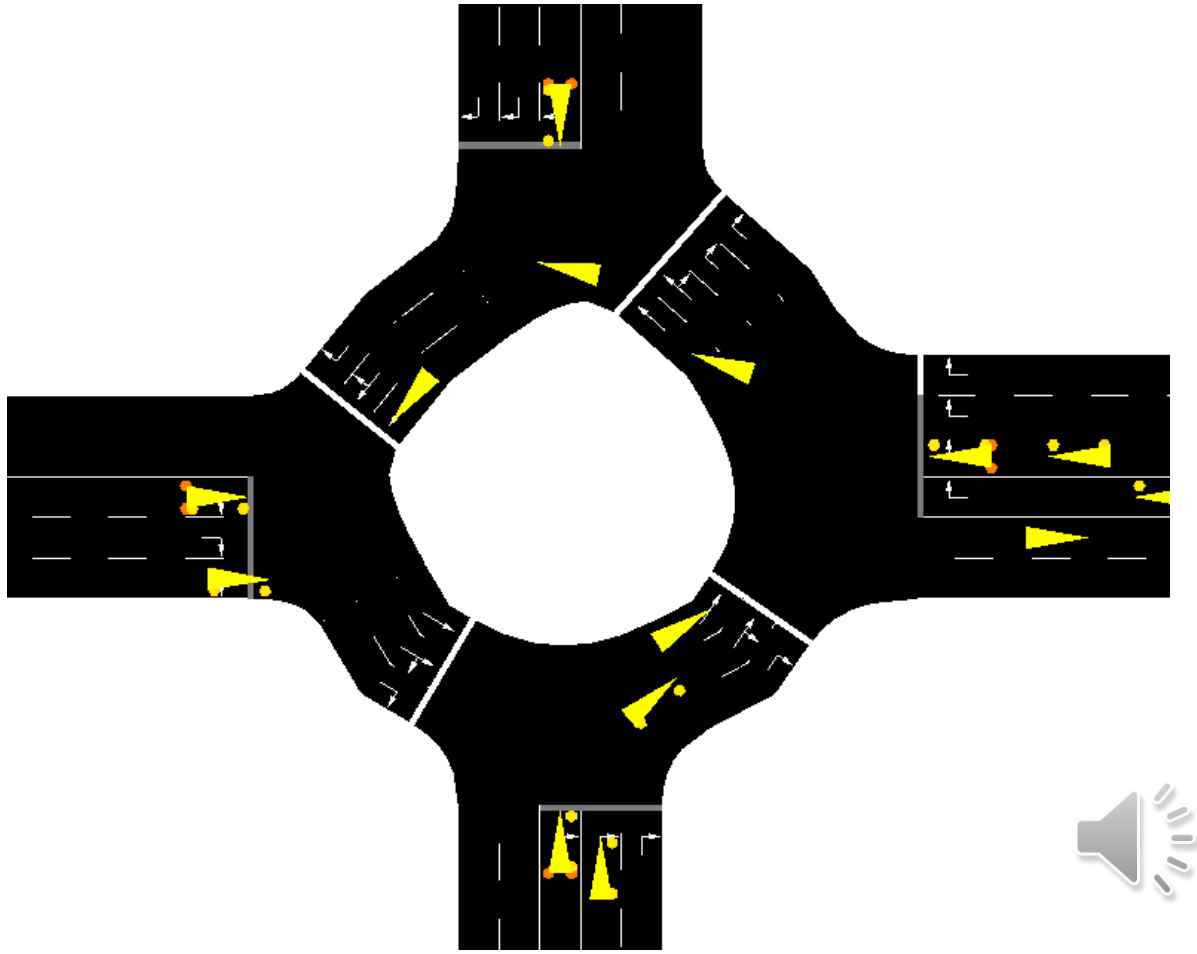
Results


Roundabout Vs. Intersection Vehicle Waiting Times
Roundabout Waiting Time
Intersection Waiting Time
2000
1500
1000
500
0
Waiting Time (Seconds)
Vehicle Depart Order

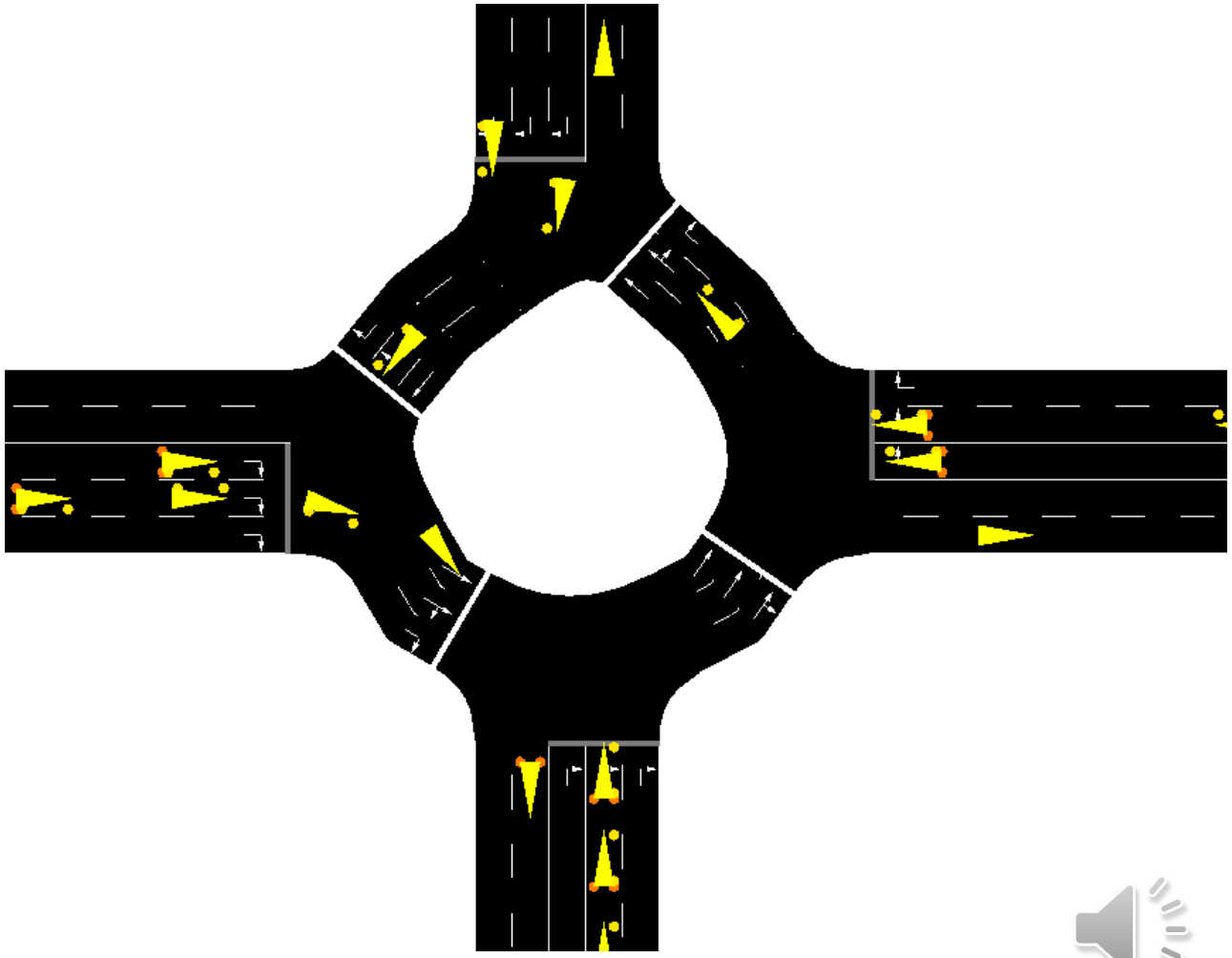
Status: Standard Roundabout



Status: Extended Lane Roundabout



Status: Reduced Lane Roundabout



Results

Interval #	Traffic Light	Roundabout	Roundaboout Extended	Roundabout Reduced
Interval 1	30.25403467	25.18469815	11.41183503	5.704722056
Interval 2	34.60238806	16.68656716	17.8161194	9.690149254
Interval 3	23.39820896	5.795820896	0.8555223881	0.6029850746
Interval 4	21.92	0.8388059701	0.687761194	0.5820895522
Interval 5	22.67343284	1.109850746	0.7946268657	0.72
Interval 6	23.01970149	1.448955224	0.8328358209	0.7868656716
Interval 7	23.18985075	2.577910448	1.332537313	1.177313433
Interval 8	23.58746269	12.34328358	3.299104478	2.674626866
Interval 9	24.6280597	21.45850746	5.278208955	3.799402985
Interval 10	24.55104478	25.47462687	8.108059701	7.211940299
Interval 11	25.40298507	21.77492537	13.63940299	9.460298507
Interval 12	24.61259655	14.80926916	3.461081402	2.683303624
All	25.15755163	12.46275193	5.624782284	3.756805175

Accomplished Work

- Accomplished Work:
- We have produced the intersection and collected the data for it
- We have produced 3 roundabouts and collected the data for them.

- We have compared the data
- We have complied our report and findings

Lessons Learned

- What Went Right:
  - Data Gathering -> Simulation production -> Data Analysis – Almost all tasks were completed without any alterations from our plan
- What Went Wrong:
  - Few progression challenges that we ultimately overcame
    - Lane Construction
    - Data Production
  - Java > Python for large data sizes.
- What we would do differently:
  - Complexity
  - Simplicity

Future Work

- Add surrounding roads to simulations
- Add different kinds of vehicles
- Be able to get data on other roads to see their impact on area tested and that area's impact on other roads.
- Retest intersection after adding extra lane.
- Retest with different high traffic flow rates and low traffic flow rates.

References

- [1] “Roundabout benefits,” WSDOT, 14-Sep-2018. [Online]. Available: https://www.wsdot.wa.gov/Safety/roundabouts/benefits.htm. [Accessed: 28-Jan-2020].
- [2] ACS Engineers, “Roundabouts vs Traffic Lights,” ACS Engineers, 22-Aug-2016. [Online]. Available: https://www.acsengineers.com.au/2016/08/22/roundabouts-vs-traffic-lights/. [Accessed: 28-Jan-2020].
- [3]“Intersection Safety - Safety: Federal Highway Administration,” Safety. [Online]. Available: https://safety.fhwa.dot.gov/intersection/innovative/roundabouts/. [Accessed: 28-Jan-2020].
- [4] Wimp.com. 2017. Mythbusters: Four-Way Stop Vs. Roundabout.. [online] Available at: <https://www.wimp.com/mythbusters-four-way-stop-vs-roundabout/> [Accessed 7 May 2020].