

Lab #3: Vehicle-Actuated Signal Control

Due: April 9, 2008

Characteristics of Fully-Actuated Operation:

In fully-actuated operations, all signal phases are controlled by detector actuations. In general, the minimum and maximum green times are specified for each NEMA phase. Maximum green does not begin timing until there is a serviceable, conflicting call (pedestrian or vehicle). In this type of control, cycle length and green times vary considerably from cycle to cycle as well as from time-of-day (TOD) to TOD. Certain phases in the cycle may be skipped entirely if no demand is present.

Problem Statement

Shown below in Figure 1 is a particular four-legged intersection being operated in a fully actuated mode. The timing sheet is shown in Figure 2. Shown in Figure 3 is the pattern of vehicle arrivals at the intersection; the time of each arrival is indicated by the symbol \otimes . In this figure, time is referenced to the system master (i.e., in “global time”). The row labeled “Initial Display” indicates the status of the signal display for the time period $t < 51$ secs for each NEMA movement; “G” \Leftrightarrow Green, “Y” \Leftrightarrow Yellow, “AR” \Leftrightarrow All Red, “R” \Leftrightarrow Red. Assume that these initial displays have been indicated for an indefinite time prior to $t = 51$ secs. On this same sheet it is also indicated the active status of the signal displays for all NEMA movements that result from the arrival pattern show in Figure 2.

Also, we indicate in the column labeled “Action,” the controller operation that caused any transition from Green, using the following key:

“G.O.” \Leftrightarrow Gap Out
“M.O.” \Leftrightarrow Max Out

Using these same codes, complete the Table in Figure 2 for the remaining time (i.e., to $t = 133$).

Simulation Tool for Traffic Signal Control Logic

An online application for signalized intersection simulation is created to help you understand the actuated signal control logic. You can access this simulation tool at:

<http://street.umn.edu/OASIS/SIS.html>

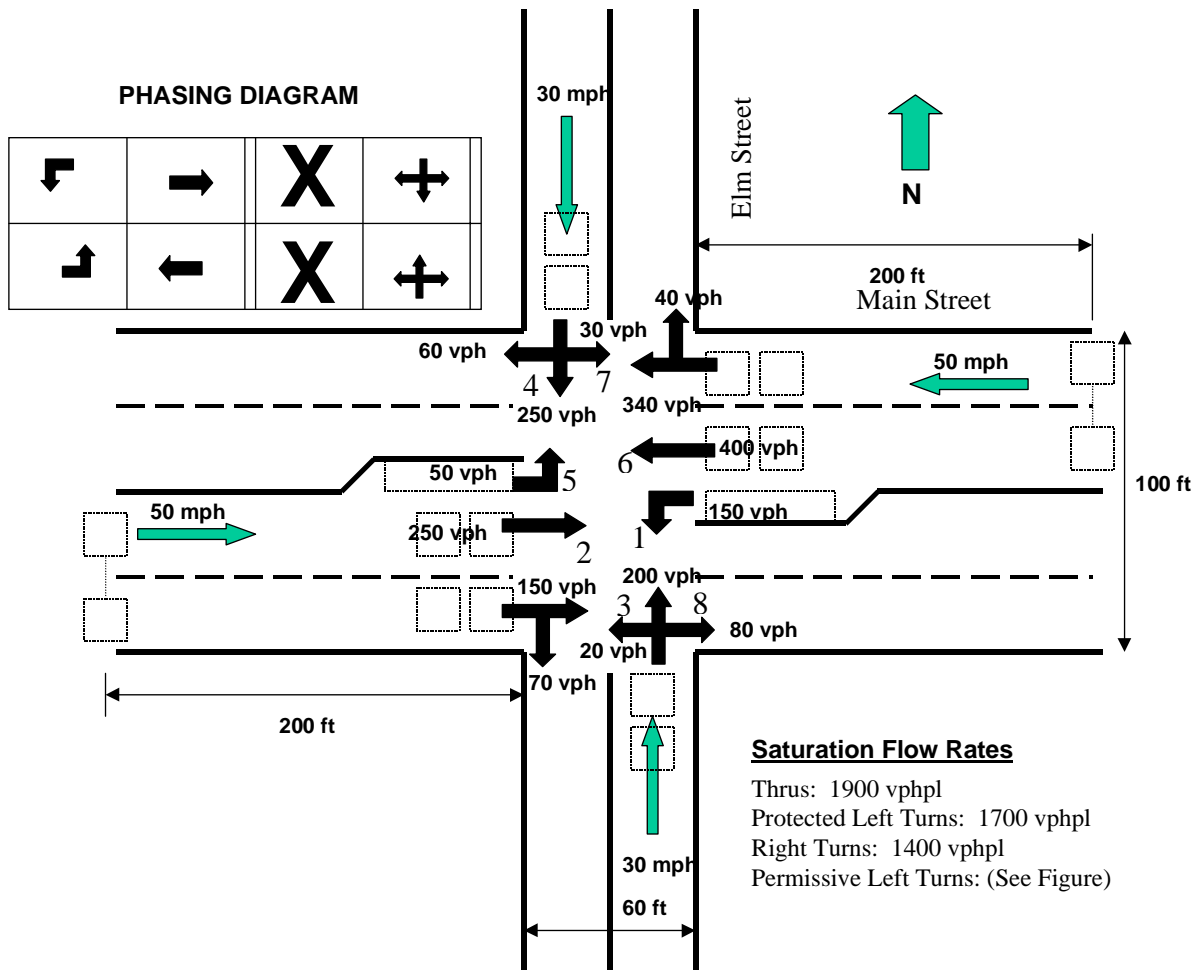


FIGURE 1. A Four-Legged Intersection

Phase Interval Times

Interval	Phase							
	1	2	3	4	5	6	7	8
Initial	6	20		10	6	15		10
Extension	2.0	3.0		2.0	2.0	3.0		2.0
Max1	15	60		40	15	60		40
Max2								
Yellow	3	5		4	3	5		4
Red Clearance	1	1		1	1	1		1
Permit	√	√		√	√	√		√
Max Recall								
Min Recall		√				√		
Lag Phase		√				√		

FIGURE 2. TIMING SHEET

Interpretation of Timing Sheet:

- Minimum green = Initial
- Max = Maximal Green Time
- Permit - determines what phases to service.
- Lag - specifies which phase follows for each phase pair in the dual ring diagram.
- Min Recall - places a call to time minimum green, regardless of demands.
- Max Recall - places a call to time maximum extension, regardless of gap and traffic.

FIGURE 3. PATTERN OF VEHICLE ARRIVALS AND CONTROLLER RESPONSES

Time	Arrivals								Signal Display								Conflicting Calls	Governing Clock Status				Controller Action
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8		Phase	Initial	Extension	Max	
Initial Display									R	G		R	R	G		R		2 6	0 0	3.0 3.0	60 60	
51									R	G		R	R	G		R		2 6	0 0	3.0 3.0	60 60	
52						⊗			R	G		R	R	G		R		2 6	0 0	3.0 3.0	60 60	
53									R	G		R	R	G		R		2 6	0 0	3.0 3.0	60 60	
54		⊗							R	G		R	R	G		R		2 6	0 0	3.0 3.0	60 60	
55				⊗					R	G		R	R	G		R	4	2 6	0 0	3.0 3.0	60 60	
56									R	G		R	R	G		R	4	2 6	0 0	2.0 2.0	59 59	
57		⊗		⊗					R	G		R	R	G		R	4	2 6	0 0	3.0 1.0	58 58	
58									R	G		R	R	G		R	4	2 6	0 0	2.0 0.0	57 57	
59									R	G		R	R	G		R	4	2 6	0 0	1.0 0.0	56 56	
60		⊗			⊗				R	G		R	R	G		R	4.5	2 6	0 0	3.0 0.0	55 55	
61									R	G		R	R	G		R	4.5	2 6	0 0	2.0 0.0	54 54	
62				⊗					R	G		R	R	G		R	4.5	2 6	0 0	1.0 0.0	53 53	
63						⊗			R	G		R	R	G		R	4.5	2 6	0 0	0.0 3.0	52 52	
64						⊗			R	G		R	R	G		R	4.5	2 6	0 0	0.0 3.0	51 51	
65									R	G		R	R	G		R	4.5	2 6	0 0	0.0 2.0	50 50	

66				⊗					R	G		R	R	G		R	4,5	2 6	0 0	0.0 1.0	49 49	
67		⊗							R	G		R	R	G		R	4,5	2 6	0 0	3.0 0.0	48 48	
68									R	G		R	R	G		R	4,5	2 6	0 0	2.0 0.0	47 47	
69		⊗							R	G		R	R	G		R	4,5	2 6	0 0	3.0 0.0	46 46	
70		⊗							R	G		R	R	G		R	4,5	2 6	0 0	3.0 0.0	45 45	
71									R	G		R	R	G		R	4,5	2 6	0 0	2.0 0.0	44 44	
72						⊗			R	G		R	R	G		R	4,5	2 6	0 0	1.0 3.0	43 43	
73									R	G		R	R	G		R	4,5	2 6	0 0	0.0 2.0	42 42	
74									R	G		R	R	G		R	4,5	2 6	0 0	0.0 1.0	41 41	
75		⊗							R	G		R	R	G		R	4,5	2 6	0 0	3.0 0.0	40 40	
76									R	G		R	R	G		R	4,5	2 6	0 0	2.0 0.0	39 39	
77									R	G		R	R	G		R	4,5	2 6	0 0	1.0 0.0	38 38	
78							⊗		R	G		R	R	G		R	4,5,8	2 6	0 0	0.0 0.0	37 37	G.O.
79									R	Y		R	R	Y		R	4,5,8	2 6	20 15	3.0 3.0	60 60	
80									R	Y		R	R	Y		R	4,5,8	2 6	20 15	3.0 3.0	60 60	
81									R	Y		R	R	Y		R	4,5,8	2 6	20 15	3.0 3.0	60 60	
82				⊗		⊗		⊗	R	Y		R	R	Y		R	4,5,8,6	2 6	20 15	3.0 3.0	60 60	
83						⊗			R	Y		R	R	Y		R	4,5,8,6	2 6	20 15	3.0 3.0	60 60	
84	⊗			⊗		⊗			R	AR		R	R	AR		R	4,5,8, 6,1	2 6	20 15	3.0 3.0	60 60	
85	⊗					⊗			R	R		G	R	R		G	5,1, 6	4 8	10 10	2.0 2.0	40 40	
86									R	R		G	R	R		G	5,1, 6	4 8	9 9	1.0 1.0	39 39	

87									R	R		G	R	R		G	5,1, 6	4 8	8 8	0.0 0.0	38 38	
88									R	R		G	R	R		G	5,1, 6	4 8	7 7	0.0 0.0	37 37	
89	⊗								R	R		G	R	R		G	5,1, 6	4 8	6 6	0.0 0.0	36 36	
90						⊗			R	R		G	R	R		G	5,1, 6	4 8	5 5	0.0 0.0	35 35	
91									R	R		G	R	R		G	5,1, 6	4 8	4 4	0.0 0.0	34 34	
92									R	R		G	R	R		G	5,1, 6	4 8	3 3	0.0 0.0	33 33	
93									R	R		G	R	R		G	5,1, 6	4 8	2 2	0.0 0.0	32 32	
94				⊗					R	R		G	R	R		G	5,1, 6	4 8	1 1	2.0 0.0	31 31	
95									R	R		G	R	R		G	5,1, 6	4 8	0 0	1.0 0.0	30 30	
96				⊗		⊗			R	R		G	R	R		G	5,1, 6	4 8	0 0	2.0 0.0	29 29	
97								⊗	R	R		G	R	R		G	5,1, 6	4 8	0 0	1.0 2.0	28 28	
98									R	R		G	R	R		G	5,1, 6	4 8	0 0	0.0 1.0	27 27	
99				⊗					R	R		G	R	R		G	5,1, 6	4 8	0 0	2.0 0.0	26 26	
100									R	R		G	R	R		G	5,1, 6	4 8	0 0	1.0 0.0	25 25	
101		⊗						⊗	R	R		G	R	R		G	5,1, 6,2	4 8	0 0	0.0 2.0	24 24	
102				⊗					R	R		G	R	R		G	5,1, 6,2	4 8	0 0	2.0 1.0	23 23	
103								⊗	R	R		G	R	R		G	5,1, 6,2	4 8	0 0	1.0 2.0	22 22	
104									R	R		G	R	R		G	5,1, 6,2	4 8	0 0	0.0 1.0	21 21	
105									R	R		G	R	R		G	5,1, 6,2	4 8	0 0	0.0 0.0	20 20	G.O.
106									R	R		Y	R	R		Y	5,1, 6,2	4 8	10 10	2.0 2.0	40 40	

107									R	R		Y	R	R		Y	5,1, 6,2	4 8	10 10	2.0 2.0	40 40	
108									R	R		Y	R	R		Y	5,1, 6,2	4 8	10 10	2.0 2.0	40 40	
109									R	R		Y	R	R		Y	5,1, 6,2	4 8	10 10	2.0 2.0	40 40	
110									R	R		AR	R	R		AR	5,1, 6,2	4 8	10 10	2.0 2.0	40 40	
111									G	R		R	G	R		R	2, 6	1 5	6 6	2.0 2.0	15 15	
112					⊗				G	R		R	G	R		R	2, 6	1 5	5 5	1.0 2.0	14 14	
113				⊗	⊗				G	R		R	G	R		R	2, 6, 4	1 5	4 4	0.0 2.0	13 13	
114									G	R		R	G	R		R	2, 6, 4	1 5	3 3	0.0 1.0	12 12	
115							⊗		G	R		R	G	R		R	2, 6, 4, 8	1 5	2 2	0.0 0.0	11 11	
116					⊗				G	R		R	G	R		R	2, 6, 4, 8	1 5	1 1	0.0 2.0	10 10	
117									G	R		R	G	R		R	2, 6, 4, 8	1 5	0 0	0.0 1.0	9 9	G.O. for 1
118					⊗				Y	R		R	G	R		R	2, 6, 4, 8	1 5	6 0	2.0 2.0	15 8	
119		⊗					⊗		Y	R		R	G	R		R	2, 6, 4, 8	1 5	6 0	2.0 1.0	15 7	
120					⊗				Y	R		R	G	R		R	2, 6, 4, 8	1 5	6 0	2.0 2.0	15 6	
121									R	R		R	G	R		R	2, 6, 4, 8	1 5	6 0	2.0 1.0	15 5	

122		⊗			⊗				R	G		R	G	R		R	6, 4, 8	2 5	20 0	3.0 2.0	60 4	
123					⊗				R	G		R	G	R		R	6, 4, 8	2 5	19 0	2.0 2.0	59 3	
124					⊗				R	G		R	G	R		R	6, 4, 8	2 5	18 0	1.0 2.0	58 2	
125					⊗				R	G		R	G	R		R	6, 4, 8,	2 5	17 0	0.0 1.0	57 1	
126									R	G		R	G	R		R	6, 4, 8	2 5	16 0	0.0 0.0	56 0	M.O. for 5
127									R	G		R	Y	R		R	6,4, 8	2 5	15 6	0.0 2.0	55 15	
128									R	G		R	Y	R		R	6,4, 8	2 5	14 6	0.0 2.0	54 15	
129									R	G		R	Y	R		R	6,4, 8	2 5	13 6	0.0 2.0	53 15	
130									R	G		R	R	R		R	6,4, 8	2 5	12 6	0.0 2.0	52 15	
131									R	G		R	R	G		R	4, 8	2 6	11 15	0.0 3.0	51 60	
132									R	G		R	R	G		R	4, 8	2 6	10 14	0.0 2.0	50 59	
133									R	G		R	R	G		R	4, 8	2 6	9 13	0.0 1.0	49 58	