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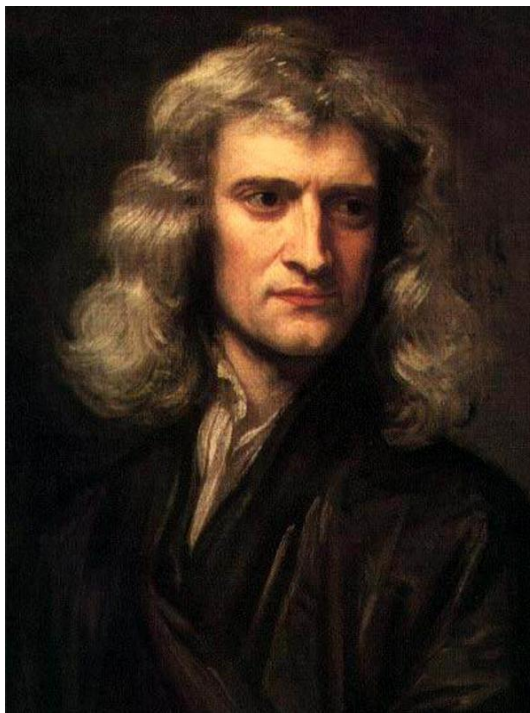
Isaac Newton vs. Red Light Cameras

Failure Groups of Traffic Signals
Town of Cary, North Carolina

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Introduction

The Town of Cary introduced red light cameras in 2004.   The Town of Cary operates them all illegally.

For one reason or another, every intersection either has engineering defects in the yellow light durations, or its traffic signal plan is not signed, or both.   Most intersections have these problems, not just the intersections with red light cameras.

The reason why most people haven't heard about this is because it took the red light cameras to flush out the problem.   The cameras in themselves are precision measuring devices.   They independently monitor the intersections.   The data the cameras collect are called citation statistics.   The statistics are not only useful for issuing citations, but also useful for measuring the accuracy of the traffic signals themselves.

Disparity from one intersection to another indicates engineering defects—not careless drivers.   In the case of the Town of Cary, the widely disparate data taken by the cameras illustrates that there is not a single intersection that works right.   All fall short.   Some are worse than others.   The various North Carolina laws, Town of Cary charter, or the Canute[1] legal precedent, invalidate every intersection. In the end, there is not a single red light camera citation that the Town of Cary has issued that is legal.

This document describes three failure groups.   All intersections in Cary fall into one of these groups. The red light cameras operating in the first group are illegal because they do not follow the traffic signal plans as required by North Carolina Session Laws and Town of Cary Charter.   The red light cameras in the second group are illegal because they violate the law of momentum.   The red light cameras in the third group are illegal because the equation behind the setting of the yellow light duration has a false premise in it—a premise which establishes a gamble and bias which guarantees that people will run red lights.   Traffic engineers are aware of the last group.   They even have a name for it: the dilemma zone.

There is a common theme among the failures.   The NCDOT sets the yellow light durations too short. Group 1 has yellow lights which are too short because of a bureaucratic problem.   Group 2 and 3 yellow durations are too short because engineers intentionally made them that way.   Without realizing they have violated basic laws of physics, rationalizing the durations by establishing the goals of traffic capacity over traffic safety, blindly following "standards" or setting yellows short to profit the town and its business partners, engineers have botched up the yellow light durations of all signals in Cary.

The more and more a DOT shortens a yellow light duration, the more and more cars will run red lights, and the more and more cars will have accidents.   It has gotten so bad, that after a fatal accident caused by short yellow, one town was charged and convicted of wrongful death.

Here are the three failure groups:

Group	Name	Failure
1		a. The traffic signal plan does not match the intersection.
	Obsolete Signal Plan	The NCDOT has a blueprint for every intersection. The blueprint is called a signal plan. Among the things on the plan are the speed limits for the roads and the intervals for the yellow lights. On the plan, the intervals for the yellow lights are the result of a math equation based on the speed limit. But when the plan is obsolete, the actual road may have a speed and interval which do not correspond to each other. Take the case of Cary Town Blvd. and Convention. 19 years ago, the NCDOT initially set up the traffic intersection according to the signal plan. The signal plan calls for a 35 mph speed limit with a yellow light interval of 4.0 seconds. 4.0 seconds is the result of the yellow light equation for a 35 mph road. After several years, the NCDOT decided that traffic can move faster on Cary Town Blvd. So they returned to the Cary Town Blvd. and replaced the 35 mph signs with 45 mph signs. They did not change the yellow light interval. The yellow light interval remained 4.0 seconds. A 45 mph road requires a 4.5 second interval. The yellow is 0.5 seconds short. That mere half second doubled the number of red light runners to about 1200 per year. A boon to RedFlex Camera Company and a safety hazard to everyone. The case of Cary Parkway at High Meadows (Westbound) is a case where the signal plan says the yellow interval is 4.5 seconds and the grade of the road is a 1% incline. But the actual yellow interval is 4.4 seconds and the grade of over the safe braking distance is both a decline and an incline. An incline enables Cary to shorten the yellow interval, but the decline should force Cary to lengthen the interval. Cary did the former but did not consider the latter. The Town of Cary requires that in order to operate a red light camera, the yellow intervals have to be at least the result of that yellow light equation. The Town Charter additionally says that *all* yellow intervals at an intersection, not just the ones monitored by red light cameras, must be at least the result of the yellow light equation.

		b. A less important problem is that an engineer did not sign and seal the traffic signal plan. According to Session Law 2004-141, traffic signal plans at red light camera intersections have to be signed and sealed by a professional engineer.
2	**Arbitrary and Capricious**	a. Most yellow light intervals in left turn lanes are shorter than the yellows for the straight-thru lanes. There is no valid reason for this. It is arbitrary.

NCDOT does have an invalid reason.   They assume that cars in the left turn lane approach the intersection at 20 mph, even when the cars are still hundreds of feet from the intersection.   That's pretty dumb.   The only time cars approach an intersection at 20 mph is when there is a queue of cars waiting at the light.   When there is no queue, the driver has a clear path to the intersection.   The driver will approach the intersection at the speed limit.   Not until the driver arrives a few dozen feet before the intersection will he slow to turn.   By that time, if the light turns yellow, it is too late to stop or go.   He will run a red light.

The NCDOT sets the yellow to 3.0 seconds for a left turning car.   3.0 seconds is the interval for a 20 mph car.   The NCDOT does not care if the speed limit is 45 mph.   3.0 seconds is what you get at intersections such as Walnut and Meeting Place, and Cary Parkway and Kildaire Farms Rd.   Walnut and Kildaire Farms Rd. are 45 mph roads.

3.0 seconds is shorter than any driver going 45 mph can react to.   When the driver is closer to the intersection than the 45 mph safe braking distance, the driver will run the red light: He cannot traverse the distance to the intersection at the speed limit without the light turning red before he gets there.   He cannot stop because he is well inside the safe braking distance of a 45 mph car.   He will run the red light.

Walnut and Meeting Place is Cary's single biggest money maker.   Cary has collected $1.5 million dollars so far just on this one light.

Since January 2010, Cary decreased the length of two left turn yellows at Northbound and Westbound Kildaire Farms Rd at Cary Parkway to 3.0 seconds.   Cary increased the number of red light runners by 1000.00%.   These new signals have a double problem.   Doubly arbitrary left yellow durations.   There are now two left turn yellows appearing to Northbound traffic and two left turn yellows appearing to Westbound traffic.   Their intervals are different.   The first yellow interval comes at the |

end of the left-only green.   That yellow is 3.0 seconds long.
The second yellow interval comes before straight-thru traffic
stops.   That yellow is ~4.5 seconds long   Different.   Totally
arbitrary.   Totally illegal.

The Canute ruling.   *One cannot enact legislation which
countermands the Laws of Nature*.   The Town of Cary cannot
pass a law preventing water to freeze any more than they can
pass a law preventing inertia.   Yet the latter is exactly what
they did.   A shorter left violates the Laws of Physics,
specifically Newton's Second Laws of Motion.   The Second Law
of Motion simply says that cars of equal weight all going 45 mph
need the same amount of time to stop.   They must have the
same yellow time.

b. Sometimes the NCDOT sets a yellow interval, not necessarily a
left turn yellow, to some arbitrary value other than the result
from the math function.   They may use a different standard
for that.

One of these standards is the 85th percentile rule.
Unfortunately the NCDOT's version of the 85th rule is a
perversion of AASHTO's (American Association of State Highway
and Transportation Officials) 85th percentile rule.   AASHTO says
to measure the average speed of 85 percent of the cars, and
then set the **speed limit** to that measurement (Geometric Design
of Highways and Streets, p. 655 AASTHO 2004).   NCDOT, on
the other hand, says to measure the average speed of 85
percent of the cars, and then set **the yellow light interval**
according to that measurement.   (This perversion of the 85th
percentile rule may be the origin of the 3.0 left turn yellow.)

That allows NCDOT to ignore the actual speed limit.   But
wait!   Cars can legally travel at the speed limit.   So the NCDOT
forces these remaining cars, a whopping 15% who are abiding by
the law, to run red lights.

3		a.	All traffic signals fail because the math equation which the NCDOT uses to compute yellow intervals has physics mistakes.
	Dilemma Zone		The nature of the mistake deserves its own papers. I address this safety issue in two papers: *Dilemma Zone* and *The Derivation of the Yellow Light Equation*. These papers describe the extent to which traffic engineers sacrifice safety in the name of traffic flow.

The traffic engineer's purpose of the yellow light is the physics error. The problem starts at the very beginning, before the equation. The corrupt math equation is a result of a corrupt premise that "Yellow light means GO!" For decades, you, I and every driver's manual have believed that "Yellow light means brake." But that is wrong! That is not the traffic engineer's premise! It is the opposite: Yellow means go. What we have suspected all these decades is true. When we see a light turn yellow, it means "floor it." That is what the math of the yellow light equation predisposes us to do. Because . . .

It is impossible to stop within the time the light is yellow. *The yellow time is shorter than the time it takes us to stop our car.* This sets up conditions where if we try to brake, we will run the red light. We can be penalized for braking. We can see the light turn to yellow, brake, but then skid through the intersections on a red. *The yellow time is shorter than the time it takes us to stop our car.*

In the end, the math both 1) makes us guess what to do and 2) gives us no option which guarantees us avoidance of running a red light and 3) disposes us to run the red light because the yellow time is shorter than the stopping time. It is Russian roulette. The traffic engineers personally have loaded our guns.

Red light camera programs love it. People will run red lights because the math will eventually make them run red lights. The citation statistics prove this. The existence of the red light camera industry proves this.

The State of Georgia has caught on. Georgia requires that the yellow light intervals get one additional second at all red light camera intersections. What Georgia does not yet understand is why that is so effective. It is effective because the closer the yellow interval comes to the stopping time, the closer to zero is the number of red light runners.

If the DOTs actually put "yellow Light means brake" into their math, no one would run red lights except for the occasional drunk.

b. Some yellow light intervals do not meet the minimum requirement of NCDOT's own erroneous equation. This failure, like group 1a, are explicit violations of Session Laws 2004-141 and 2001-286.

King Cnut

[1]King Cnut was a Viking King of Norway, Denmark and England in the years before the Norman invasion of England.   Henry of Huntingdon, the 12th century chronicler, tells how Cnut set his throne by the sea shore and commanded the tide to halt and not wet his feet and robes.   But the tide failed to stop. According to Henry, Cnut leapt backwards and said, "Let all know how empty and worthless is the power of kings, for there is none worthy of the name, but He whom heaven, earth, and sea obey by eternal laws."   He then hung his gold crown on a crucifix, and never wore it again.   Forester, T. (ed. & trans.), *The Chronicle of Henry of Huntingdon*, Bohn, 1853 (reprinted Llanerch, 1991) p. 199.

Citation Statistics 2004 – 2010, Town of Cary

	NCDOT	ITE Handbook						Town of Cary Red Light Camera Intersections and the Money To Be Refund...
Perception Time (s)	1.5	1.0						
Deceleration (ft/s2)	11.2	10.0						
Citation Charge ($)	$50.00							

			Times in seconds of the Yellow Light Duration						
Intersection	Speed Limit	Grade (%)	Left Turn	Pass-thru	NCDOT Min	ITE Handbook	Newton's Laws	Failure Groups	Plan Seal Date
Cary Town Blvd and Convention (EB) > Mar 2010	45	0	4.5	4.5	4.5	4.3	7.4	3a	March 19, 2010
Cary Town Blvd and Convention (EB) <= Mar 2010	45	0	4.0	4.0	4.5	4.3	7.4	1a, 3a, 3b	May 20, 1991
Kildaire Farm Road and High Meadow Drive (SB)	35	-0.04	4.5	4.5	4.1	4.0	6.7	3a	June 7, 1986
High House Road and Prestonwood Drive (WB) > Oct 2006	45	-0.05	5.0	5.0	5.0	5.0	8.4	3a	October 5, 2006
High House Road and Prestonwood Drive (WB) <= Oct 2006	45	-0.05	4.5	4.5	5.0	5.0	8.4	2a, 3a, 3b	February 24, 1999
NW Maynard Road and Chapel Hill Road (NB)	45	0.04	4.0	4.7	4.2	4.0	6.8	1b, 2a, 3a	Rev: 5/9/2003. Original plan 4/2000
Maynard Road and Walnut Street (SB)	35	0	4.0	5.2	3.8	3.6	6.1	1b, 3a	Rev: 10/2002. Original plan 3/10/2002
Tryon Road and Crescent Green Way (EB)	45	0.02	4.5	4.7	4.3	4.2	7.1	3a	January 2002
Tryon Road and Regency Parkway (WB)	45	-0.02	3.5	4.7	4.7	4.6	7.8	2a, 3a	May 9, 2005
Walnut Street and Dillard Drive (NB)	45	0.01	3.1	4.4	4.4	4.2	7.3	2a, 3a	July 20, 2007
Maynard Road and Kildaire Farm Road (WB)	35	0	3.0	3.8	3.8	3.6	6.1	2a, 3a	June 7, 2006
Kildaire Farm Road and Maynard Road (SB)	35	-0.02	3.0	3.7	4.0	3.8	6.4	2a, 3a, 3b	June 7, 2006
Cary Parkway and Kildaire Farm Road (WB) >= May 2009	45	0.01	3.0	4.4	4.4	4.2	7.3	2a, 3a	April 28, 2009
Cary Parkway and Kildaire Farm Road (WB) < May 2009	45	0	4.0	4.7	4.5	4.3	7.4	2a, 3a	March 6, 2003
Kildaire Farm Road and Cary Parkway (NB) >= May 2009	45	0	3.0	4.5	4.5	4.3	7.4	2a, 3a	April 28, 2009
Kildaire Farm Road and Cary Parkway (NB) < May 2009	45	0	4.0	4.7	4.5	4.3	7.4	2a, 3a	March 6, 2003
Cary Parkway and High House Road (NB)	45	0.023	3.0	4.3	4.3	4.1	7.1	2a, 3a	October 10, 2006
Harrison Avenue and Maynard Road (SB)	45	0.04	3.0	4.2	4.2	4.0	6.8	2a, 3a	September 5, 2006
Harrison Avenue and Weston Parkway (SB)	45	0	3.0	4.5	4.5	4.3	7.4	2a, 3a	January 29, 2009
Walnut Street and Meeting Street (SB)	45	0	3.2	4.5	4.5	4.3	7.4	2a, 3a	October 26, 2009
Ten-Ten Road and Kildaire Farm Road (EB)	45	0.02	3.0	4.3	4.3	4.2	7.1	2a, 3a	September 1, 2006
Cary Parkway and High Meadow (WB) >= Dec 2010	45	0.01	4.4	4.4	4.4	4.2	7.3	1a, 3a	December 2, 2010
Cary Parkway and High Meadow (WB) < Dec 2010	45	0.01	4.5	4.5	4.4	4.2	7.3	1a, 3a	May 9, 2006

Total

						Failure G	Meaning		

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Perception Time (s)				1a	Obsolete Traffic Signal Plan/Reality Not In Plan		
Deceleration (ft/s2)				1b	Traffic Plan Not Signed and Sealed		
				2a	Left Turn Yellow Arbitrary and Capricious		
				2b	85th Percentile Arbitrary and Capricious		
Citation Charge ($)				3a	Dilemma Zone		
				3b	Interval Falls Short of ITE's Equation		

Intersection	Number of Citations 2004	2005	2006	2007	2008	2009	2010	Total Citations	Failure Groups 1 & 2	Failure Group 3
Cary Town Blvd and Convention (EB) > Mar 2010	0	0	0	0	0	0	222	222	$0.00	$11,100.00
Cary Town Blvd and Convention (EB) <= Mar 2010	2128	1169	1086	1315	1333	1294	234	8559	$427,950.00	$427,950.00
Kildaire Farm Road and High Meadow Drive (SB)	126	513	412	322	421	363	280	2437	$0.00	$121,850.00
High House Road and Prestonwood Drive (WB) > Oct 2006	0	0	0	1442	876	781	560	3659	$0.00	$182,950.00
High House Road and Prestonwood Drive (WB) <= Oct 2006	1711	2325	1951	0	0	0	0	5987	$299,350.00	$299,350.00
NW Maynard Road and Chapel Hill Road (NB)	92	292	342	98	96	86	138	1144	$57,200.00	$57,200.00
Maynard Road and Walnut Street (SB)	53	356	327	251	470	324	223	2004	$0.00	$100,200.00
Tryon Road and Crescent Green Way (EB)	463	1096	574	253	370	373	267	3396	$0.00	$169,800.00
Tryon Road and Regency Parkway (WB)	871	435	420	364	361	732	507	3690	$184,500.00	$184,500.00
Walnut Street and Dillard Drive (NB)	246	321	342	533	879	543	355	3219	$160,950.00	$160,950.00
Maynard Road and Kildaire Farm Road (WB)	622	3107	1571	1468	2071	2791	2929	14559	$727,950.00	$727,950.00
Kildaire Farm Road and Maynard Road (SB)	127	1075	973	1012	1110	910	371	5578	$278,900.00	$278,900.00
Cary Parkway and Kildaire Farm Road (WB) >= May 2009	0	0	0	0	0	641	2232	2873	$143,650.00	$143,650.00
Cary Parkway and Kildaire Farm Road (WB) < May 2009	112	1184	1369	1321	1126	289	0	5401	$270,050.00	$270,050.00
Kildaire Farm Road and Cary Parkway (NB) >= May 2009	0	0	0	0	0	611	2422	3033	$151,650.00	$151,650.00
Kildaire Farm Road and Cary Parkway (NB) < May 2009	167	961	641	692	803	284	0	3548	$177,400.00	$177,400.00
Cary Parkway and High House Road (NB)	113	546	523	1418	2638	1130	798	7166	$358,300.00	$358,300.00
Harrison Avenue and Maynard Road (SB)	0	187	345	149	266	203	259	1409	$70,450.00	$70,450.00
Harrison Avenue and Weston Parkway (SB)	0	487	1469	2063	1138	1009	925	7091	$354,550.00	$354,550.00
Walnut Street and Meeting Street (SB)	0	3723	6020	3282	5639	8488	3541	30693	$1,534,650.00	$1,534,650.00
Ten-Ten Road and Kildaire Farm Road (EB)	0	109	258	27	0	0	0	394	$19,700.00	$19,700.00
Cary Parkway and High Meadow (WB) >= Dec 2010					0	0	91	91	$0.00	$4,550.00
Cary Parkway and High Meadow (WB) < Dec 2010					999	1239	950	3188	$0.00	$159,400.00
Total	6831	17886	18623	16010	20596	22091	17304	119341	$5,217,200.00	$5,967,050.00