

ITE'S PROPOSED RECOMMENDED PRACTICE GUIDELINES PROBLEMS AND SOLUTIONS

MATS JÄRLSTRÖM



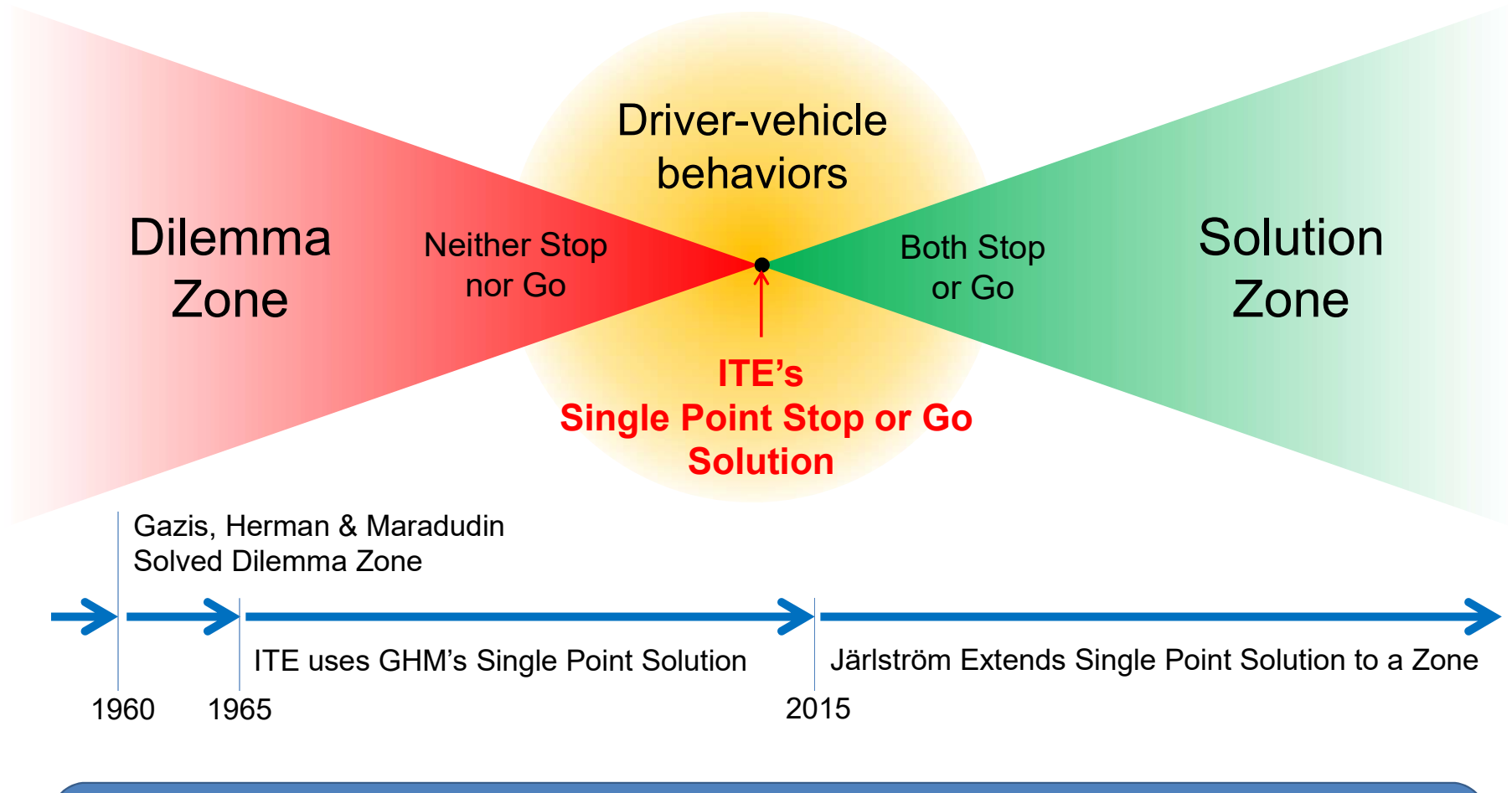
Advice from Dr. Alexei A. Maradudin

De "...the duration of the amber cycle, and your
suggestions for correcting them, are based on
oc simple physics principles and on the careful
du observations you have carried out. As a
si consequence, it is difficult to argue against
co them without violating physics."
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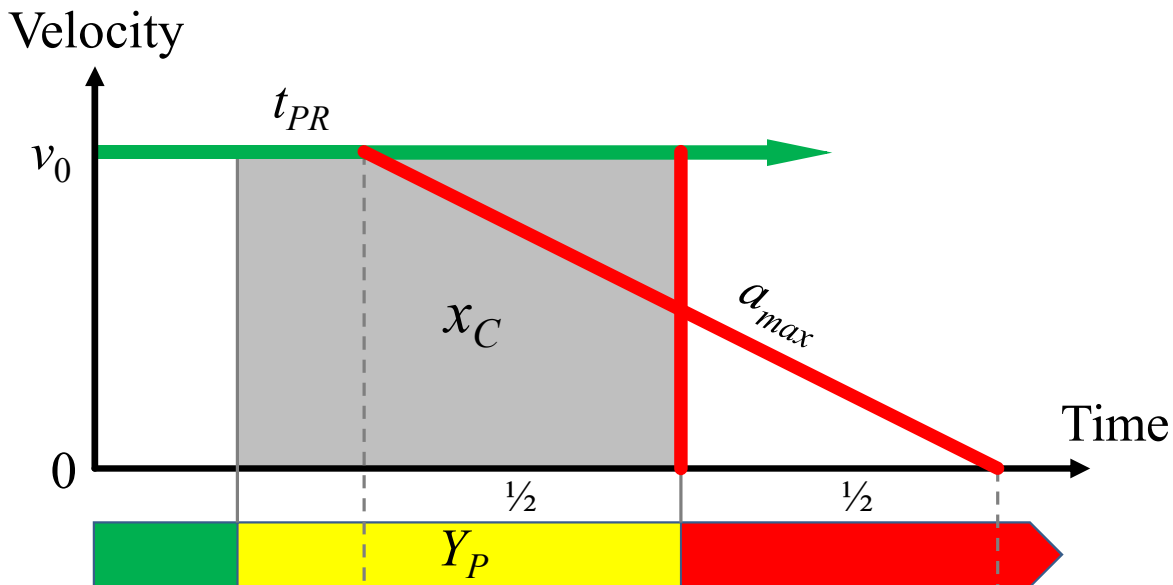
Best regards,

Alex

Timeline of the State of the Art



ITE's Minimum Permissive Yellow Model



Area = traveled distance

$$x_C = v_0 \cdot Y_P$$

GHM's critical distance

$$x_C = v_0 \cdot t_{PR} + \frac{v_0^2}{2a_{max}}$$

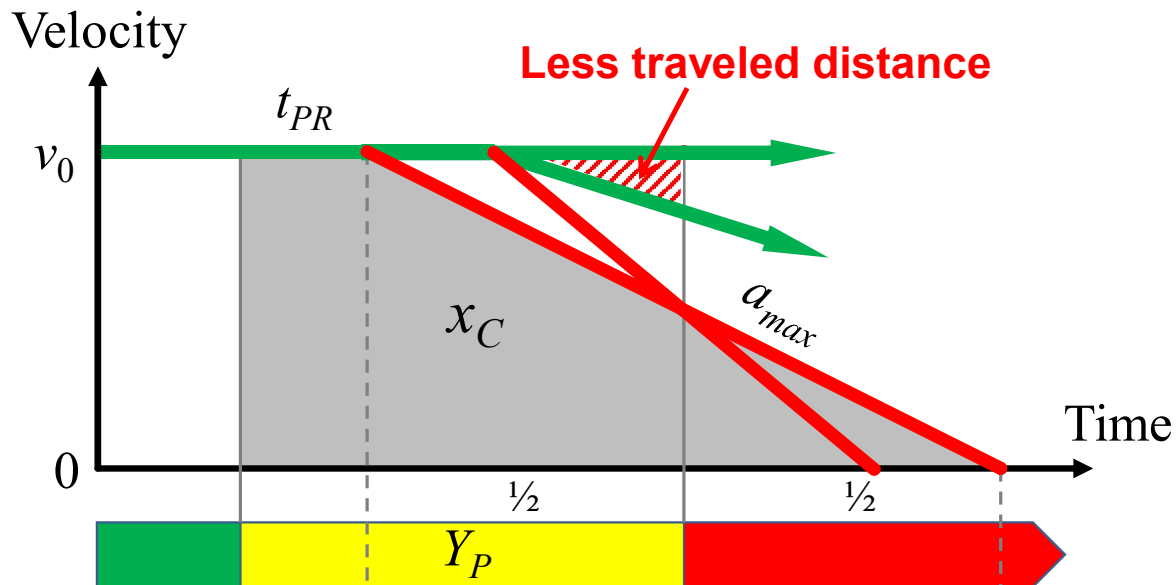
Set the two distances equal

$$v_0 \cdot Y_P = v_0 \cdot t_{PR} + \frac{v_0^2}{2a_{max}}$$

Solve for Y_P (Divide by v₀)

$$Y_P = t_{PR} + \frac{v_0}{2a_{max}}$$

ITE's Minimum Permissive Yellow Model



Exceeding a_{max}

Area = traveled distance

$$x_C = v_0 \cdot Y_P$$

GHM's critical distance

$$x_C = v_0 \cdot t_{PR} + \frac{v_0^2}{2a_{max}}$$

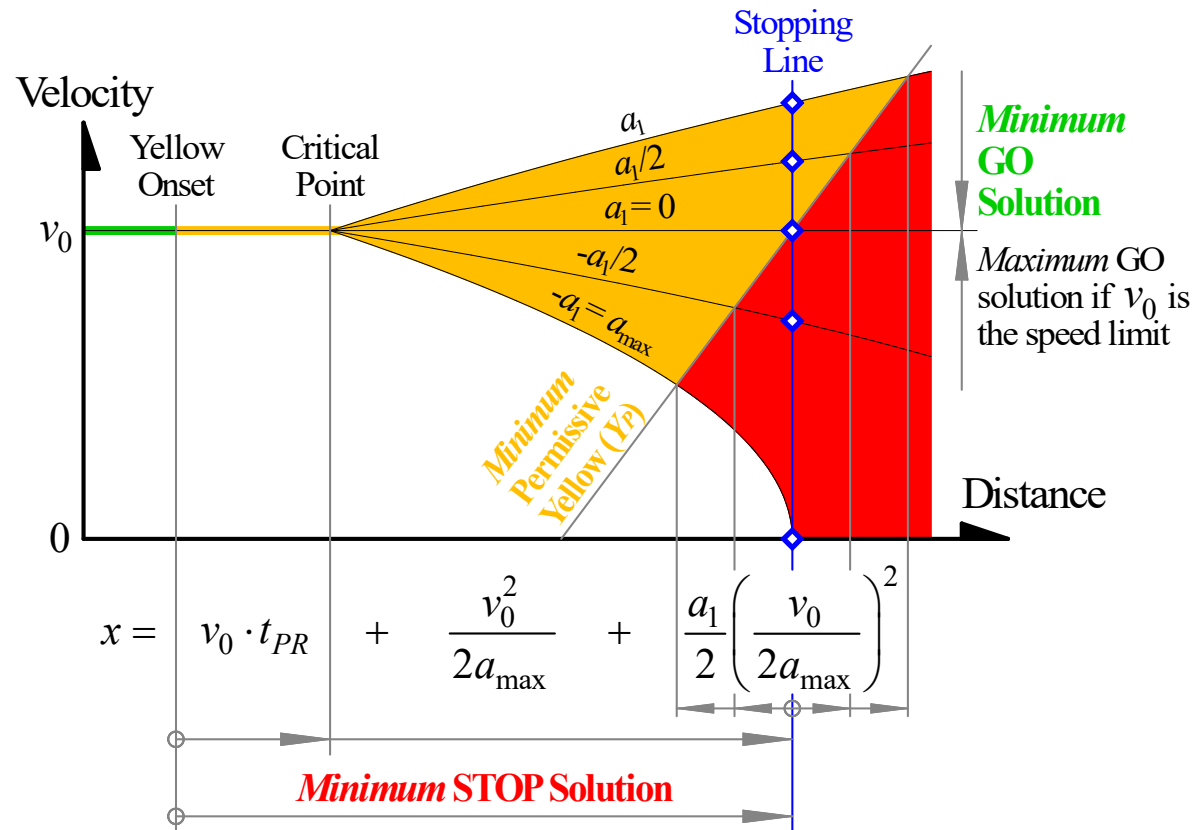
Set the two distances equal

$$v_0 \cdot Y_P = v_0 \cdot t_{PR} + \frac{v_0^2}{2a_{max}}$$

Solve for Y_P (Divide by v_0)

$$Y_P = t_{PR} + \frac{v_0}{2a_{max}}$$

ITE's ZERO Tolerance Solution - Problem

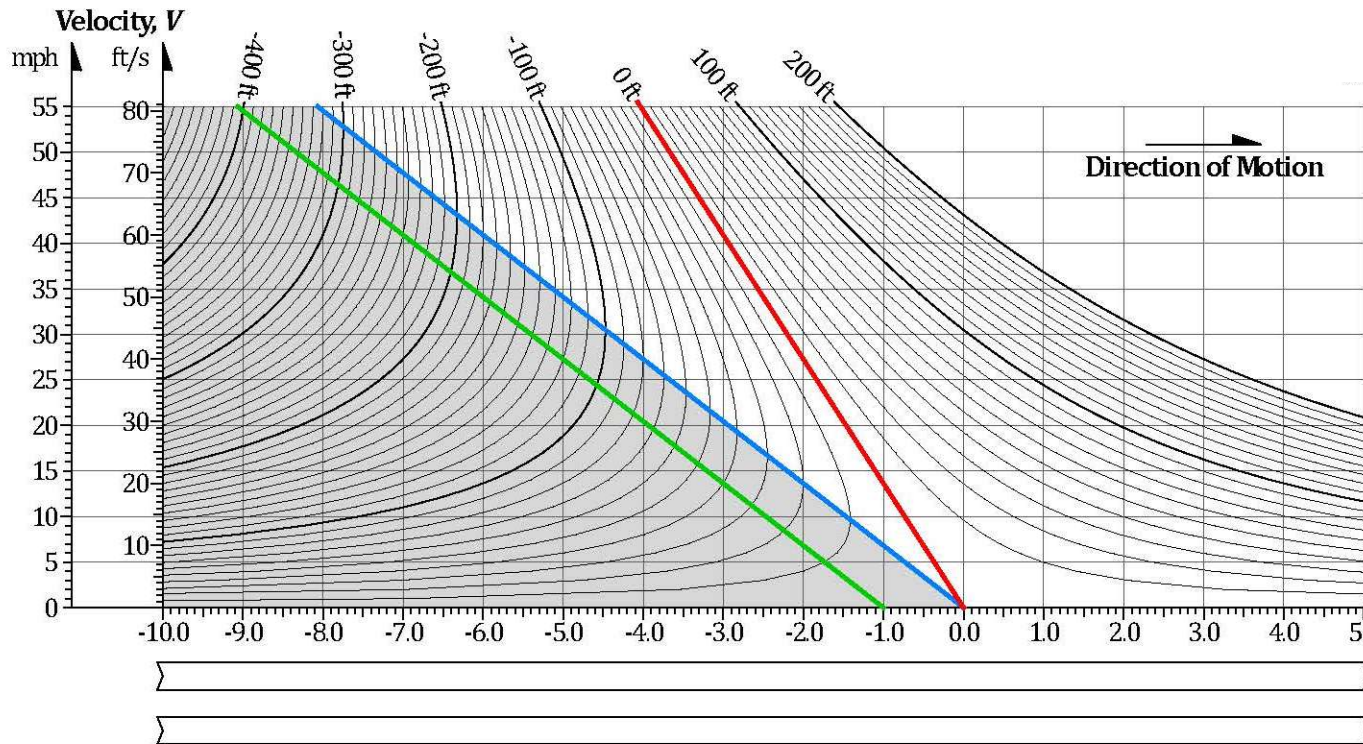


Entry Dilemma

Universal Graph Solution

Minimum Yellow Change Interval and Vehicle Motion Graph

By
Mats Järström • Beaverton, Oregon, USA • March 3, 2016 • Rev. A



Permissive
Entry Distance
Term

$$\text{"Permissive", } Y_P \geq t + \frac{V_L}{a} - \frac{V_E}{2a} + \frac{d_E}{V_E}$$

$$\text{"Restrictive", } Y_R \geq t + \frac{V_L}{a} - \frac{V_E}{2a} + \frac{d_{CE}}{V_E}$$

Where $V_L \geq V_E > 0$ and:

d_E = Legal definition of vehicle entry distance

d_{CE} = Legal definition of vehicle clearance and exit distance

($V_E = V_L$ yields GHM's original solution)

Sir Isaac Newton's Laws of Motion States:

First law :

"A body at rest will remain at rest, and a body in motion will remain in motion unless it is acted upon by an external force."

Second law:

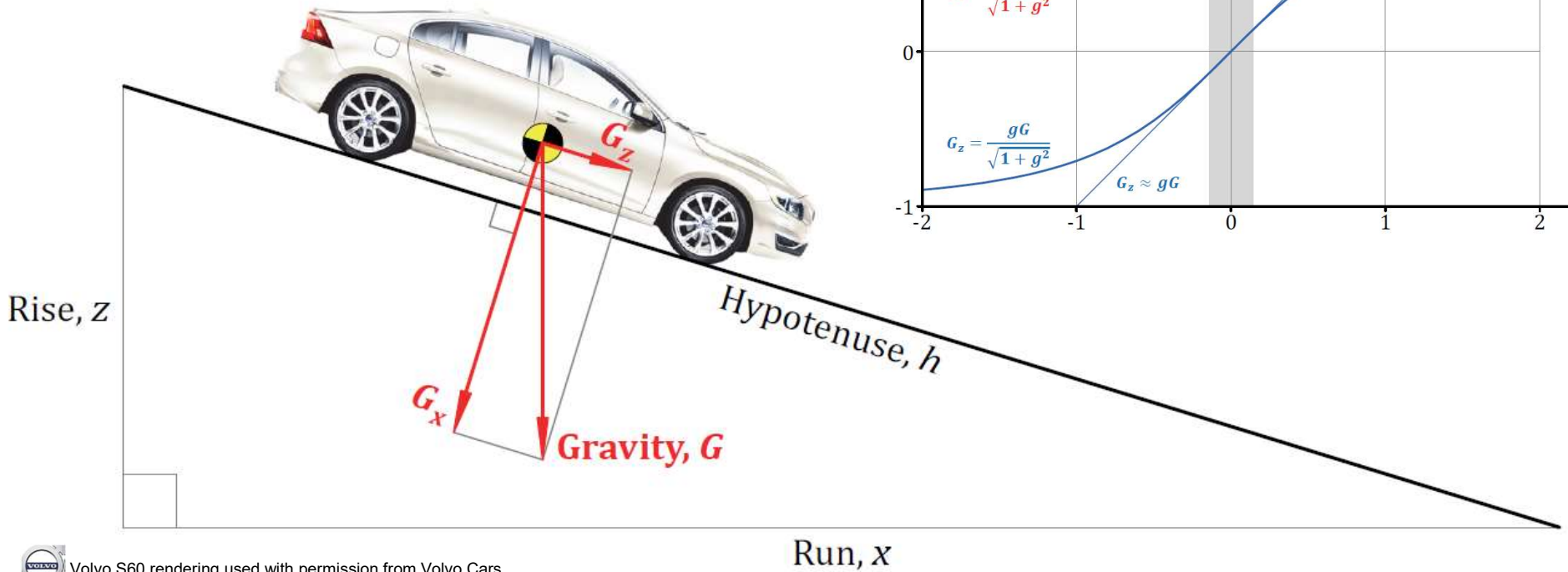
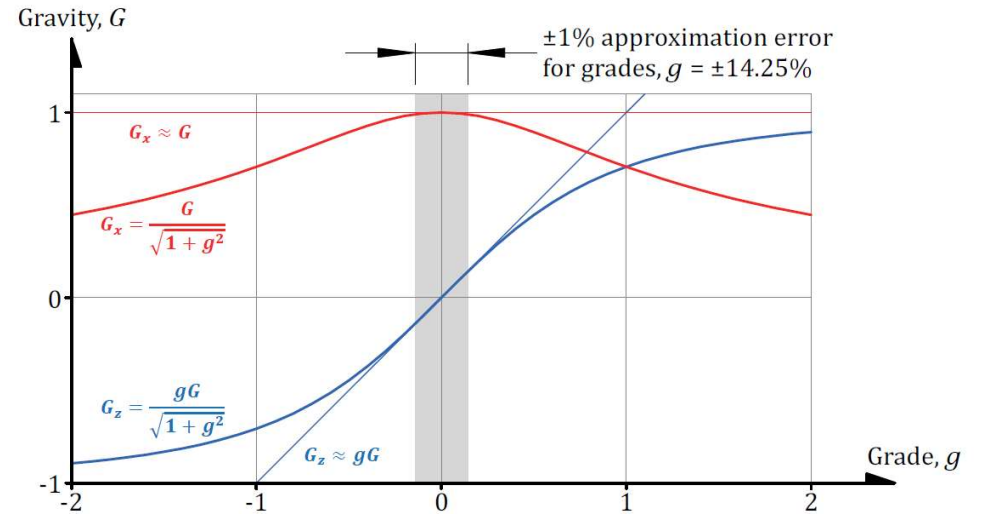
"The force acting on an object is equal to the mass of that object times its acceleration."

ITE's incorrect uphill grade implementation

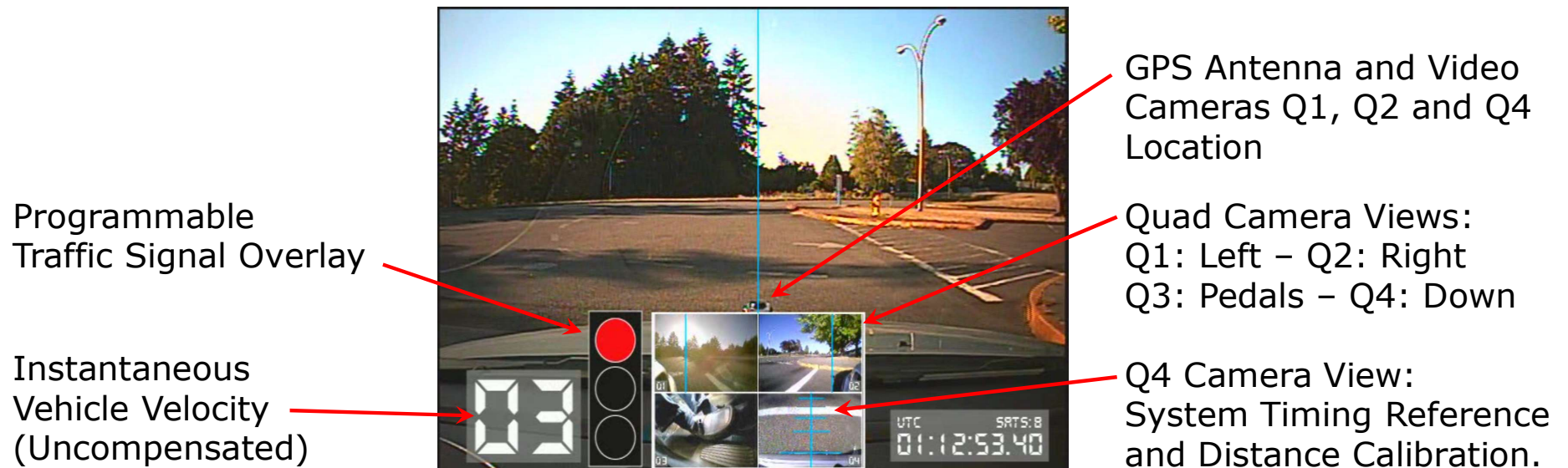
A Simplified Grade Solution

$$G_x = \frac{G}{\sqrt{1+g^2}} \approx G$$

$$G_z = \frac{gG}{\sqrt{1+g^2}} \approx gG$$



Vehicle Dynamics – VBOX Live Demo



Live **STOP**, **GO** and **RIGHT TURN** demo video (.avi) and data (.vbo) files:
http://www.jarlstrom.com/ite/VBOX_Live_Demo.zip (27 MB)

Free RACELOGIC analysis software, **Circuit Tools** (ver. 2):
<https://www.vboxmotorsport.co.uk/index.php/us/customer-area/software>

The following 10 pages show screen captures from the above files.

Problems with ITE's Recommended Practice

Zero tolerance model creates driver dilemmas

Model does not apply to turning maneuvers

The “permissive” entry dilemma

Incorrect 1982 grade implementation

Conclusion: ITE's RP needs to be revised

Questions



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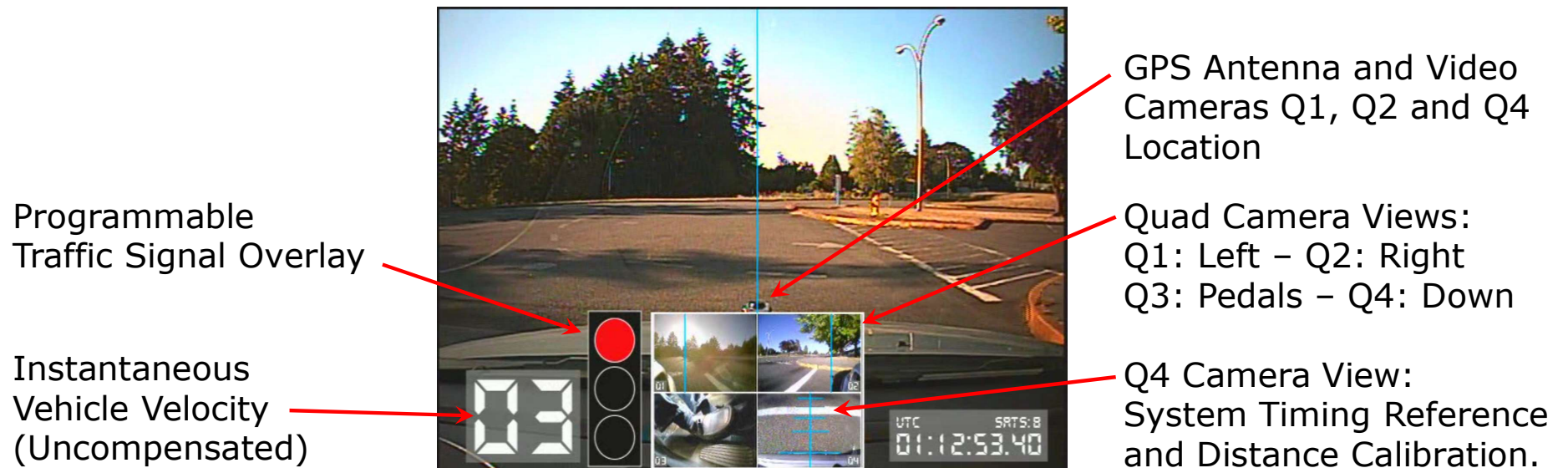
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Backup

Vehicle Dynamics – VBOX Live Demo

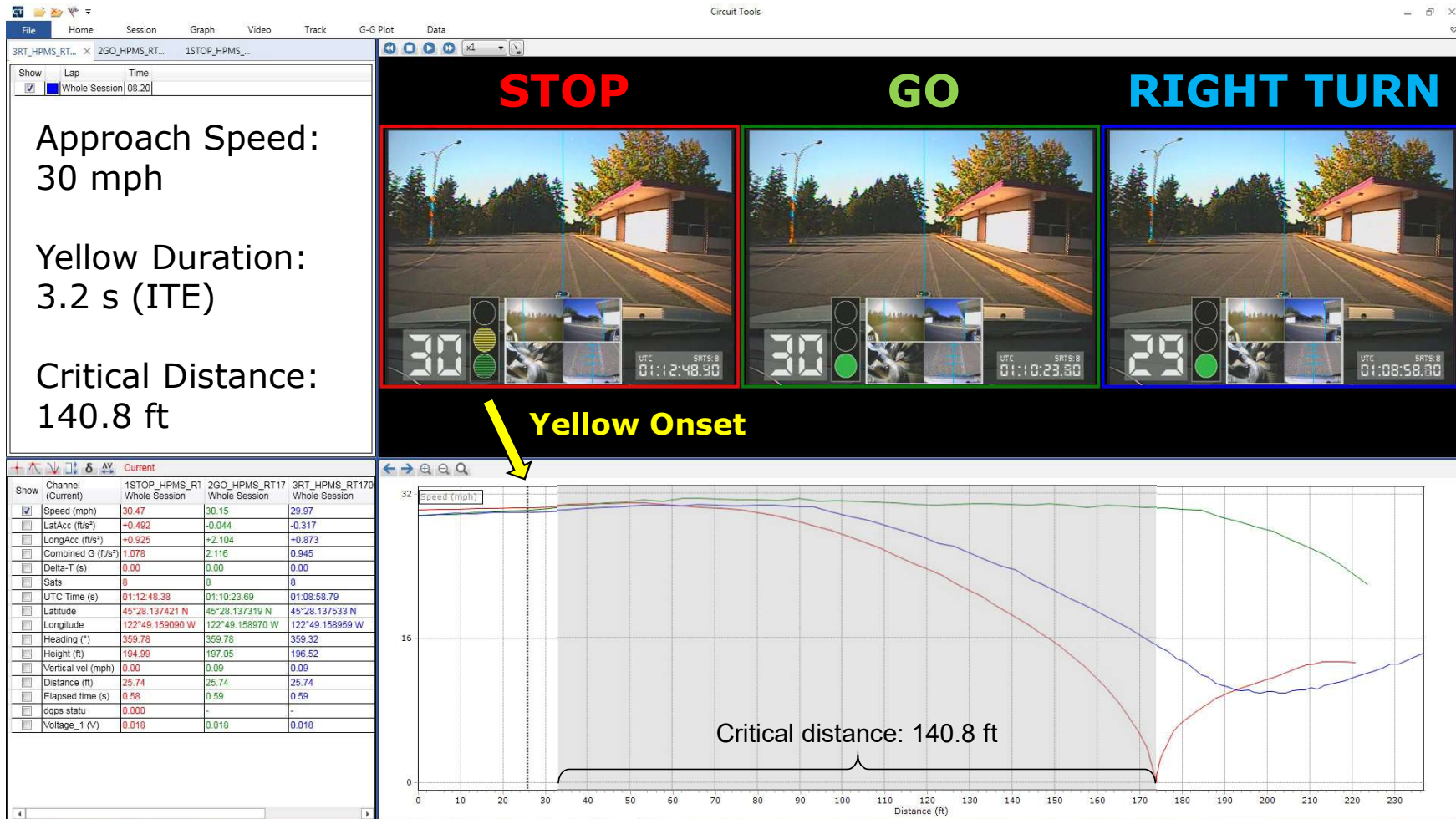


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The following 10 pages show screen captures from the above files.

DISTANCE – Yellow Onset: STOP



DISTANCE – Yellow Onset: GO



DISTANCE – Yellow Onset: RIGHT TURN



DISTANCE – Stop Bar: ALL (Reference)



TIME – Yellow Onset: STOP



TIME – Yellow Onset: GO



TIME – Yellow Onset: RIGHT TURN



TIME – Stop Bar: GO



TIME – Stop Bar: RIGHT TURN



TIME – Stop Bar: STOP



ITE's incorrect uphill grade implementation

Sir Isaac Newton's first law of motion states:

"A body at rest will remain at rest, and a body in motion will remain in motion unless it is acted upon by an external force."

Hence, an occupant of a vehicle moving at constant velocity in any spatial direction is not acted upon by an external force.

Sir Isaac Newton's second law of motion states:

"The force acting on an object is equal to the mass of that object times its acceleration."

Thus, an occupant of a vehicle will only experience an external force acted upon them if the vehicle is changing its motion in any spatial direction. The source to the change of vehicle motion can be from one or a combination of Earth's gravity on a grade or the vehicle's motor or its braking system or its steering mechanism.