W99 Car Following Model
How It Works

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Overview

W99demo.com
Traffic simulation on a webpage
Adjust model parameter in real time

How I built it
How you can build it

Car Following Model & W99
What is W99, and why you should care
W99 Car Following Model - How It Works

A demonstration of Wiedemann 99 Car Following Model, inspired by this video. Created by Guanghui Liu.

Simulation Control
- Start
- Step Forward
- Pause
- Reset

Vehicles and Drivers
- Number of Cars: 4, 8, 12, 16
- Spacing: Evenly Spaced, Closely Lined Up

Model Parameters
- cc0: Standstill Distance - m
- cc1: Spacing Time - sec

Simulation

Vehicle Status

System Status
How it began
Watch this Cat Car Video on Youtube

https://youtu.be/7wm-pZp_mi0
What just happened?
“Flow Breakdown”

Critical Density

Uncongested ↔ Congested

Turbulence reaches critical level and breaks down traffic

“Flow Breakdown”

Critical Density

Uncongested ↔ Congested

Turbulence reaches critical level and breaks down traffic

Can we do it on a webpage?
Let's draw a track...
... and some cars!
... and some cars!
... and some cars!
3, 2, 1, Go!!
High school physics

\[ x = x_0 + v \cdot t \]

\[ v = v_0 + a \cdot t \]
High school physics

\[ x = x_0 + v \times t \]
\[ v = v_0 + a \times t \]
High school physics

\[ x = x_0 + v \times t \]
\[ v = v_0 + a \times t \]
a - acceleration

How do we determine it?
a - acceleration

How do we determine it ?!
Car Following Model

Define how vehicles interact with each other

How car “follows”

Goal: Avoid Collision

... and how car not follow

Goal: Drive at desired speed
...and then there is micro-simulation
W99 Car Following Model

Wiedemann's Car Following Models

Vissim's favorite car following model

“Psycho-Physical” Model
“Psycho-Physical” Model

**Acceleration/Free Driving**
Speed not constrained by other vehicles

**Following**
Maintain speed and distance with leader

**Deceleration**
Approaching slower vehicle

**Emergency Deceleration**
To avoid collision
W99 Car Following Model - Parameters

AX – stationary distance
BX – min following distance
CLDV – perception threshold (near): speed higher than leader
SDV – perception threshold (far): speed higher than leader
OPDV – perception threshold: speed lower than leader
SDX – perception threshold: free acceleration
W99 Car Following Model - Parameters

- cc0 – standstill distance
- cc1 – headway time
- cc2 – following variation
- cc3 – threshold for entering “following”
- cc4 – negative “following” threshold
- cc5 – positive “following” threshold
- cc6 – speed dependency of oscillation
- cc7 – oscillation acceleration
- cc8 – standstill acceleration
- cc9 – acceleration at 80 km/h
Too many formulas for a human being!

(Stay tuned)
\[ x = x_0 + v \cdot t \]
\[ v = v_0 + a \cdot t \]

a from W99 model
\[ x = x_0 + v \times t \]
\[ v = v_0 + a \times t \]

a from W99 model
\[ x = x_0 + v \times t \]

\[ v = v_0 + a \times t \]

\( a \) from W99 model
\[ x = x_0 + v \times t \]

\[ v = v_0 + a \times t \]

*a from W99 model*
Putting it Together
Simulation Control
Start  Step Forward  Pause  Reset

Vehicles and Drivers
Number of Cars
- 4
- 8
- 12
- 16
Spacing
- Evenly Spaced
- Closely Lined Up

Model Parameters
Reset Default

cc0: Standstill Distance  -  m
cc1: Spacing Time  -  sec
cc2: Following Variation  -  m
cc3: Threshold for Entering “Following”  -  sec
cc4: Negative “Following” Threshold  -  m/s
cc5: Positive “Following” Threshold  -  m/s
cc6: Speed Dependency of Oscillation  -  10^-4 rad/s
cc7: Oscillation Acceleration  -  m/s^2
cc8: Standstill Acceleration  -  m/s^2
cc9: Acceleration at 60km/h  -  m/s^2

System Status
Normal
Speed - Average: 0.0 m/s
Speed - Standard Deviation: 0.0 m/s
Demo Time!
W99 Car Following Model - Parameters
W99 Car Following Model - Parameters

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cc7 – oscillation acceleration
cc8 – standstill acceleration
cc9 – acceleration at 80 km/h
Use it to learn, not to calibrate
Nerd Eyes Only

JavaScript + HTML5

~ 1000 lines of code

Source Control & Web Hosting: Github

MIT License
Thank you!
Visit W99demo.com