GDC

Vehicle Feel Masterclass

Balancing Arcade Accessibility with Simulation Depth

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Criterion

GAME DEVELOPERS CONFERENCE® | MARCH 19–23, 2018 | EXPO: MARCH 21–23, 2018 #GDC18

UBM

Criterion Games

- Vehicle Design Philosophy
  - Arcade vs Simulation
  - Physical Simulation
  - Input Layer and Assists

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Arcade vs Simulation

Intuitive Controls	Immersive Controls
Lower Realism	Higher Realism
Many Mechanics	Few Mechanics

Arcade

Simulation

Motorsport Realism
Some Assists and Accessibility options
High learning curve

Arcade

Sim-Cade

Simulation

Hollywood Realism Tone
Assisted, Exaggerated Drifts
Weapons and Boost Mechanics

Arcade — Sim-Cade — Simulation

Stylised Fantasy Tone
Mechanical Drift-Boost and Weapons
Very Accessible Gameplay

Arcade

Sim-Cade

Simulation

Gameplay Mechanics
Accessible Fun

Real-World Physics
Serious Competition

Arcade

Sim-Cade

Simulation

Gameplay Mechanics
Accessible Fun

Real-World Physics
Serious Competition

Satisfying Frequency of Input

Considerations

- Target Player Expectation
- Game Setting and Tone
- Desired Mechanic Density
- Managed Actions Per Minute

Considerations

- Target Player Expectation
- Game Setting and Tone
- Desired Mechanic Density
- Managed Actions Per Minute
- Physical Simulation Detail
- Accessibility and Assists

Vehicle Design Philosophy

- Physicality First – Simulation gives Depth
- Assist Layer – Gives Accessibility
- Tuning is a delicate balance
- Easy to Learn, Hard to Master

- Vehicle Design Philosophy
  - Arcade vs Simulation
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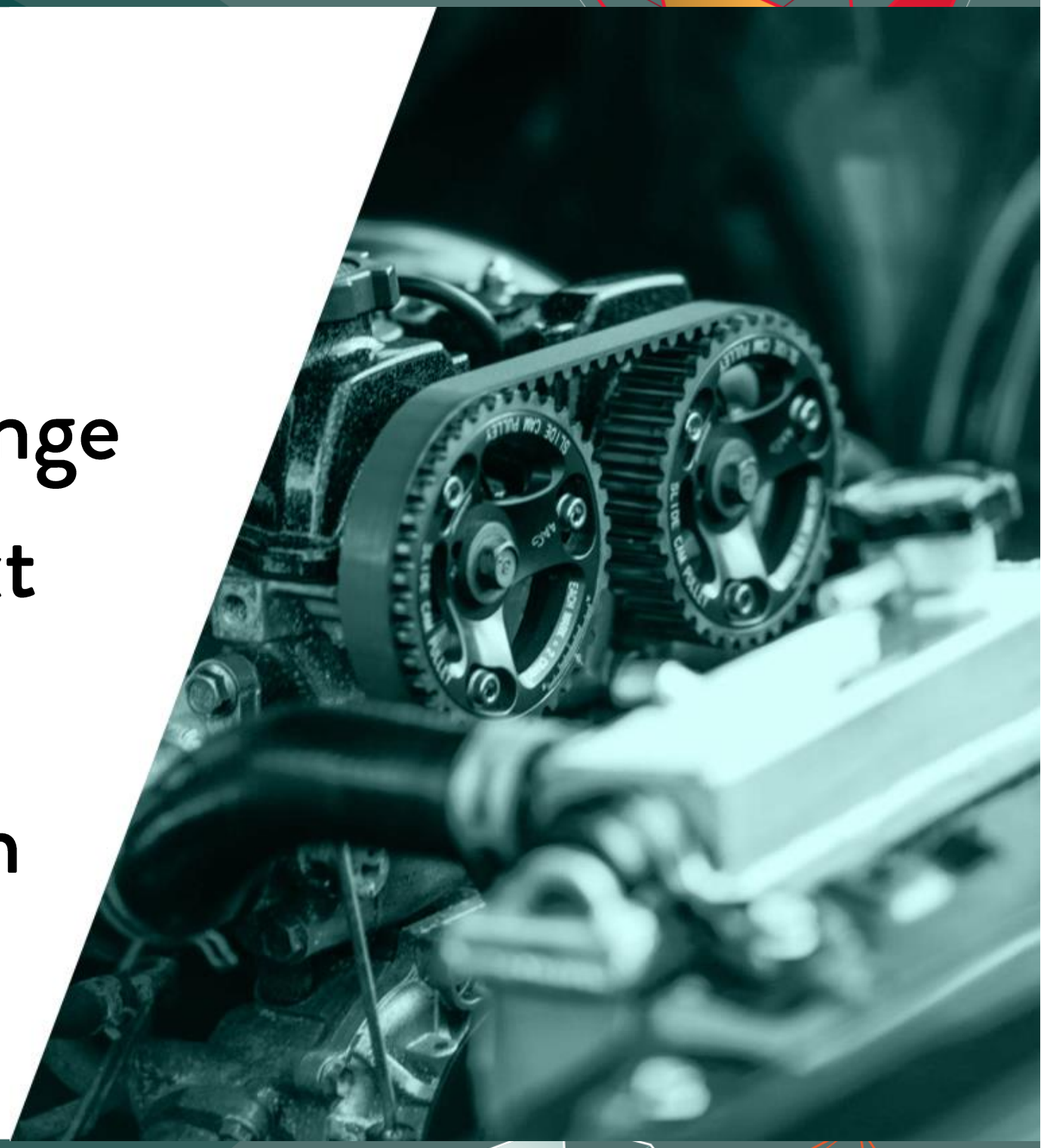
Physical Simulation

- Foundation for mastery and challenge
- Should complement Game Context
- Use real-world systems as a basis
- Look for the ‘play’ in the simulation



Game Context

- What is the Environment?
- What is the player's goal?
  - Winning a Race
  - Landing Stunts
  - Transport across the world
  - Complex terrain traversal

Racing - Sim

- Race Track / Highway
- Winning a Race
  - Cornering Effectively
  - Overtaking
  - Drafting

Racing - Arcade

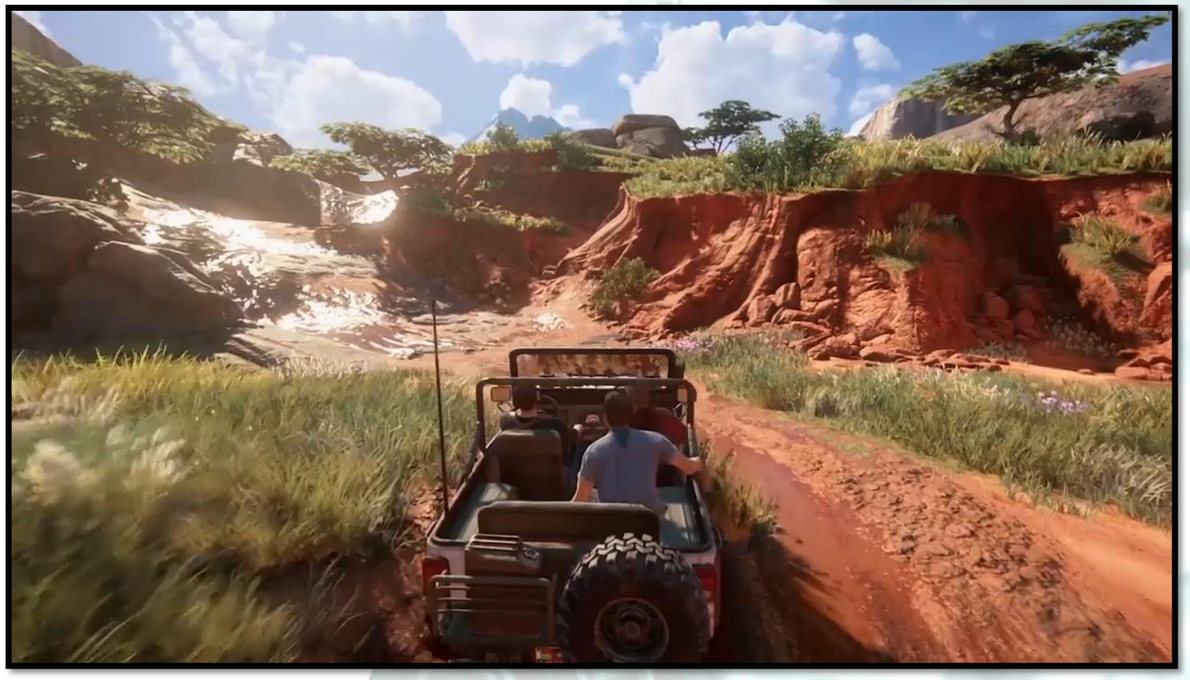
- Urban Roads
- Racing / Score Attack
  - Cornering Effectively
  - Overtaking
  - Earning/Spending Boost
  - Landing Stunts

Transport

- Open Terrain
- Closed Corridors
- Getting from A to B
  - Navigation
  - Avoiding collisions

Complex Traversal

- Open Terrain
- Rocky Mudslides
- Getting from A to B
  - Picking effective route
  - Learn grip profiles



Context

- Different Context = Different Vehicle
- Transport Vehicle isn't for Racing

Context

- Different Context = Different Vehicle
- Transport Vehicle isn't for Racing
- Be aware of shifting contexts

Physical Simulation for Motorsport

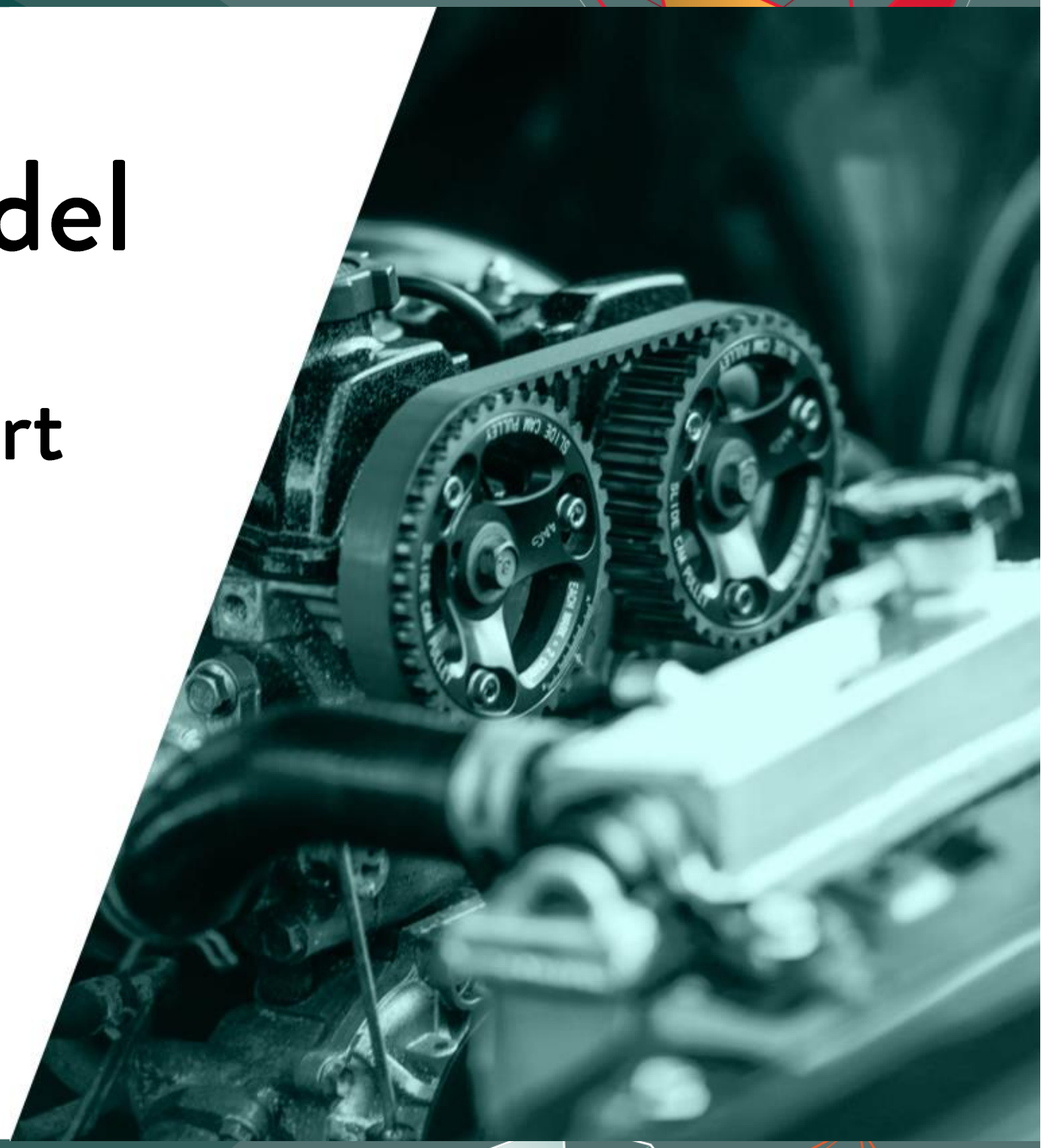
- Real-world Accuracy and expectation
- Play with limits of grip
- Variety in Acceleration Profiles
- Every car handles differently
- Use real-world data for Tuning

Trivial Physical Model

- Basic Frictionless Rigidbody
- Force to accelerate
- Torque to turn
- Too Abstract
- Needs Real World Inspiration

Improving the Physical Model

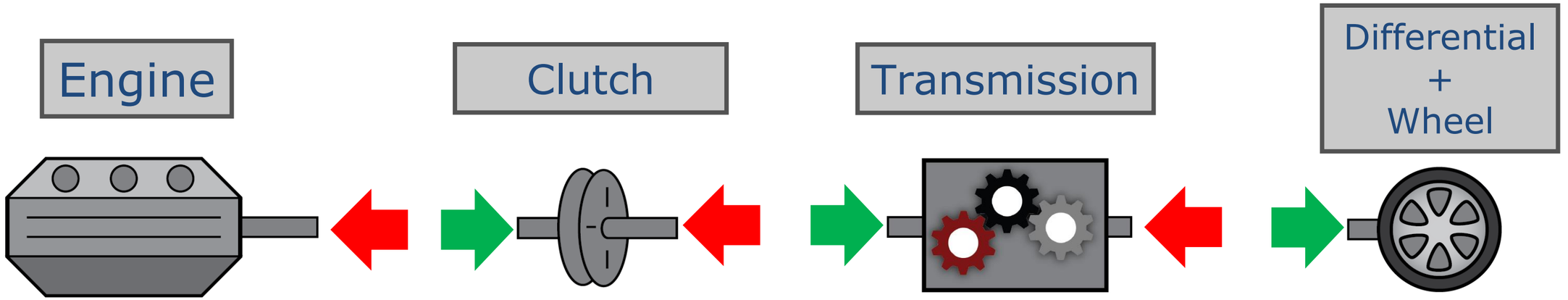
- Real World Systems – Motorsport
- Improved Model – Power Train
- Improved Model – Tyre Friction
- Need for Speed Demo



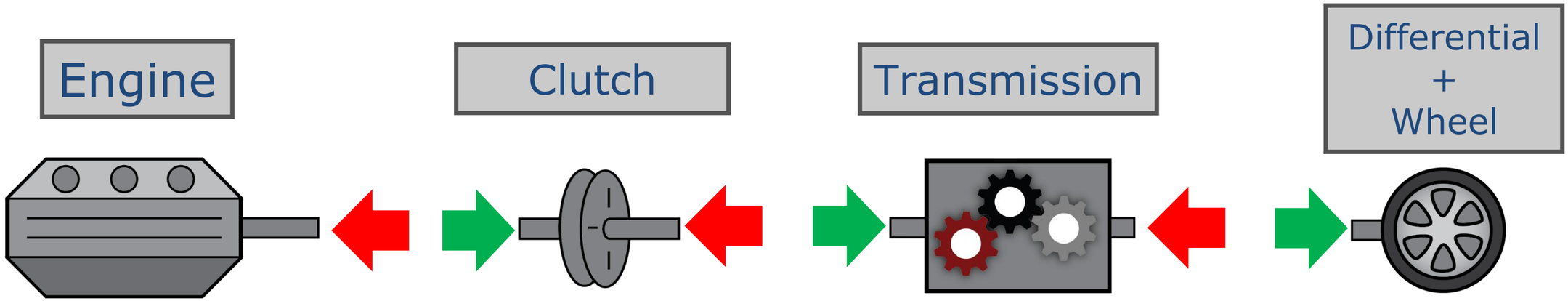
Real World Systems - Motorsport

- Power Train
- Tyre Friction
- Camber Effects
- Suspension
- Anti Roll Bar
- Load Distribution
- Ackermann Steer
- Road Surfaces
- Body Aero Drag

Improved Model – Power Train



Improved Model – Power Train



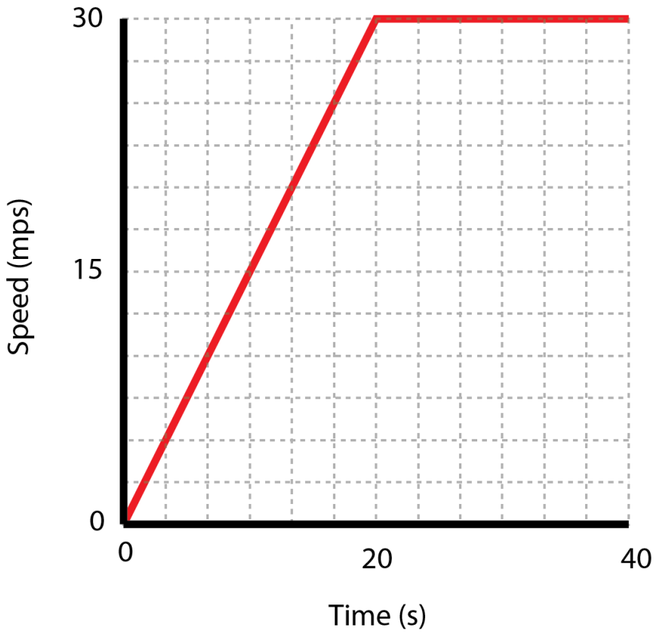
- RPM->Torque Curve
- Mechanical Inertia

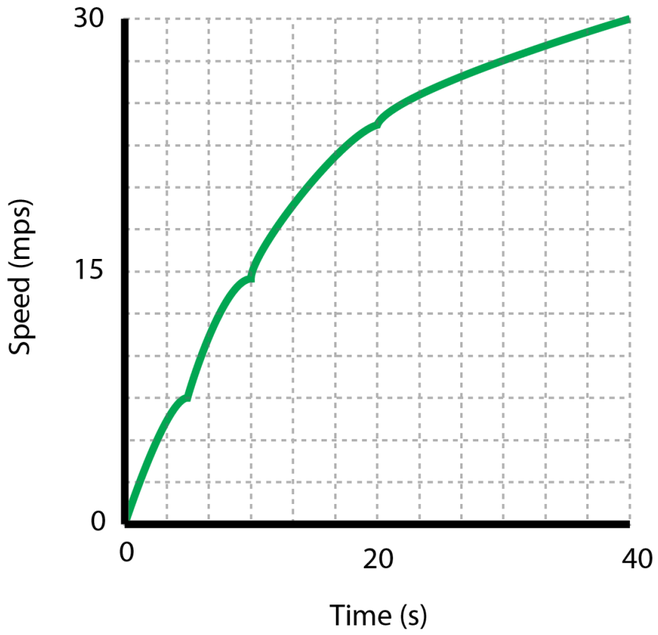
- Inertia
- Efficiency vs RPM

- Gear Ratios
- Gear Change Time

- Tyre Friction

Comparison – Power Train





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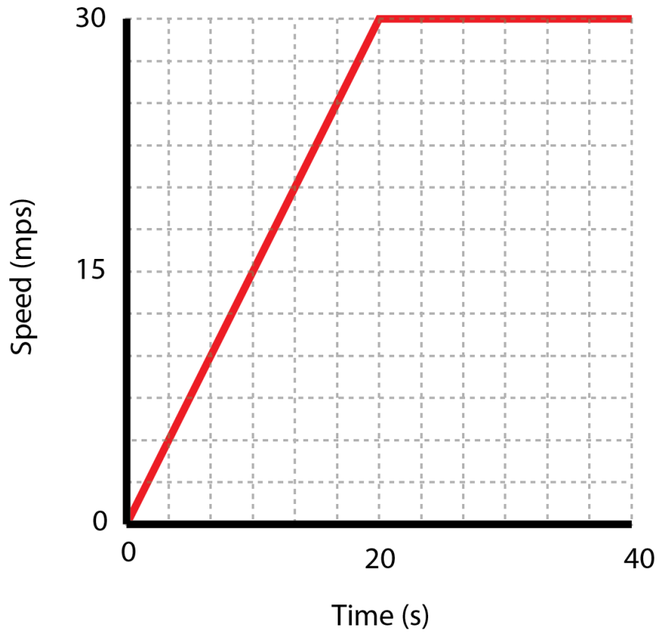
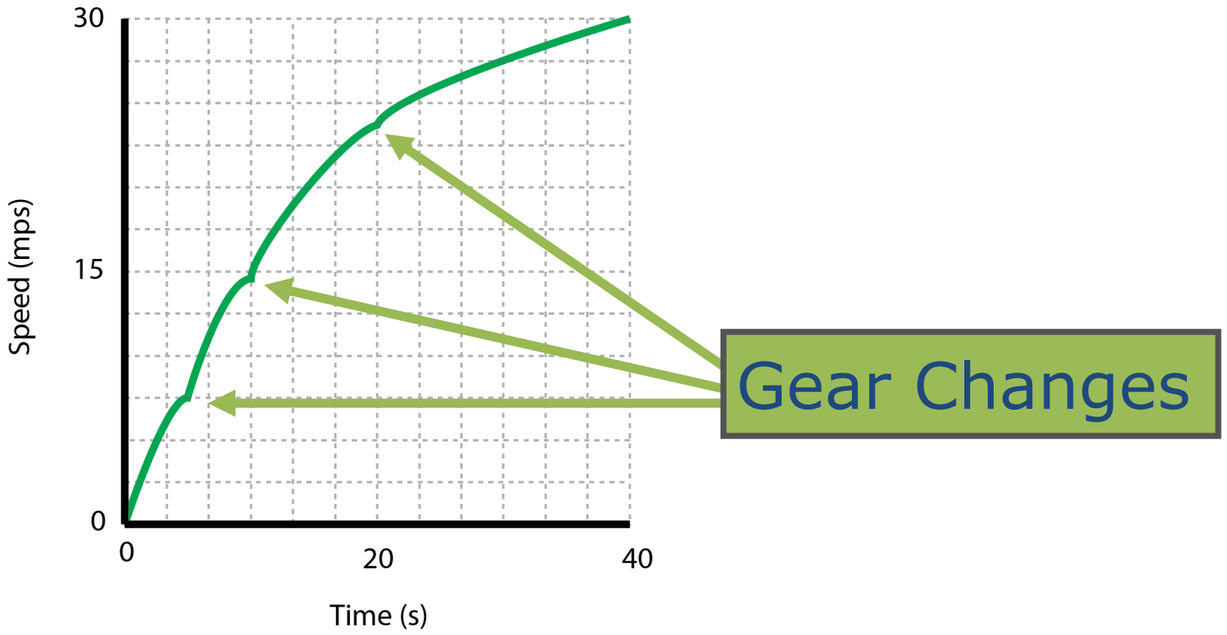
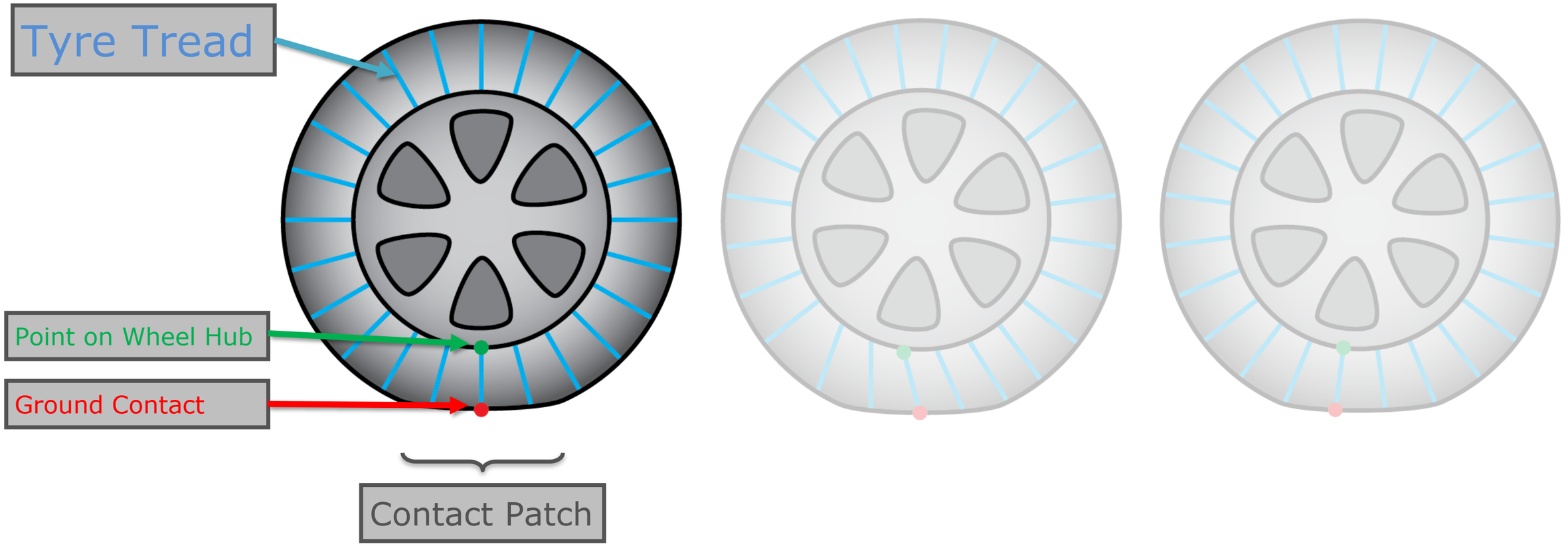




Improved Model – Tyre Friction



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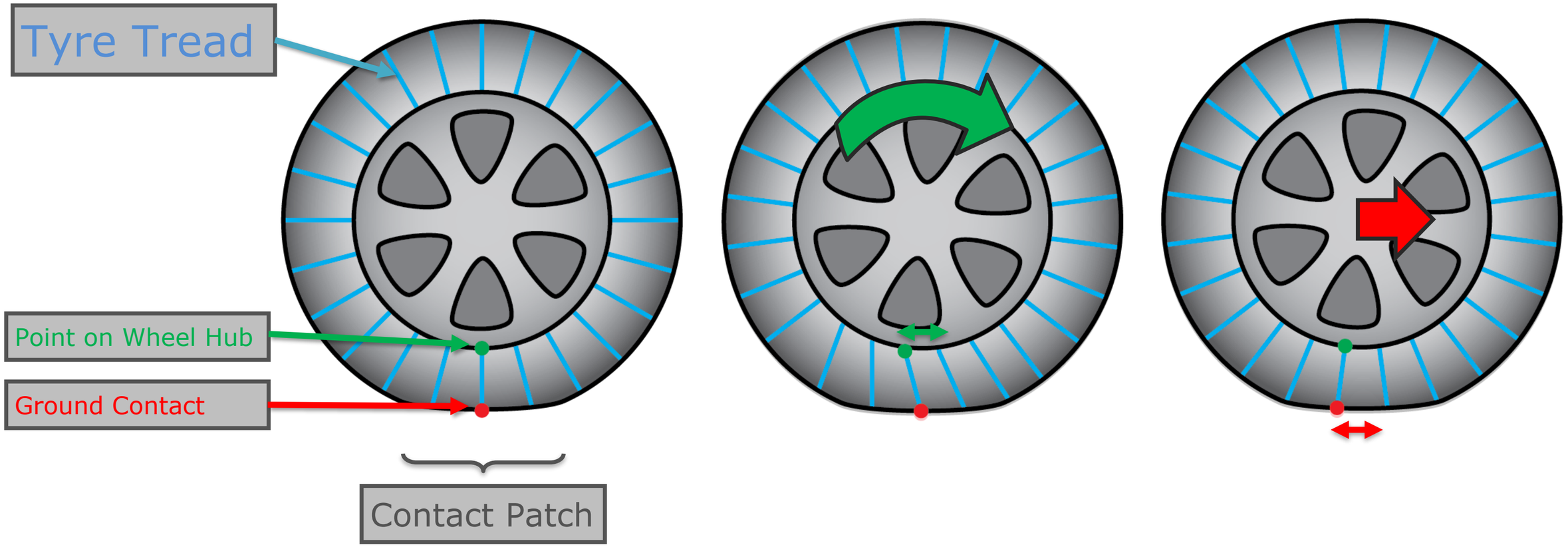
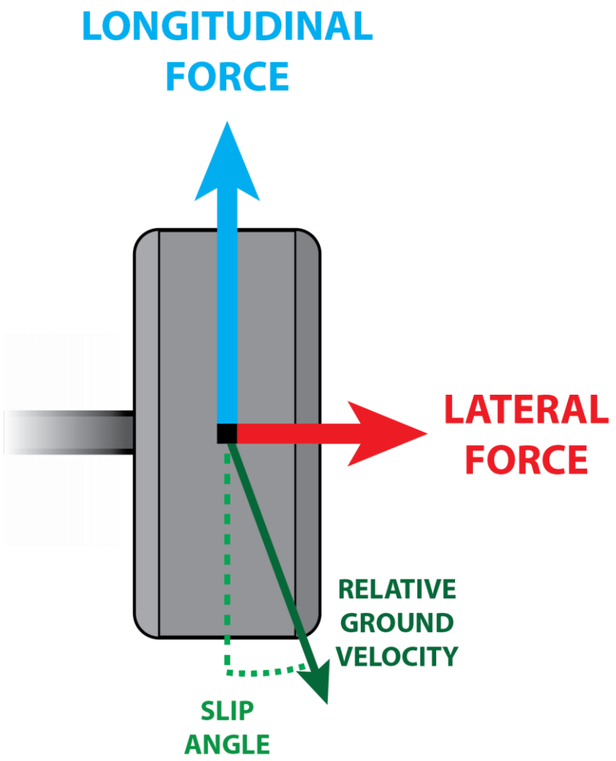
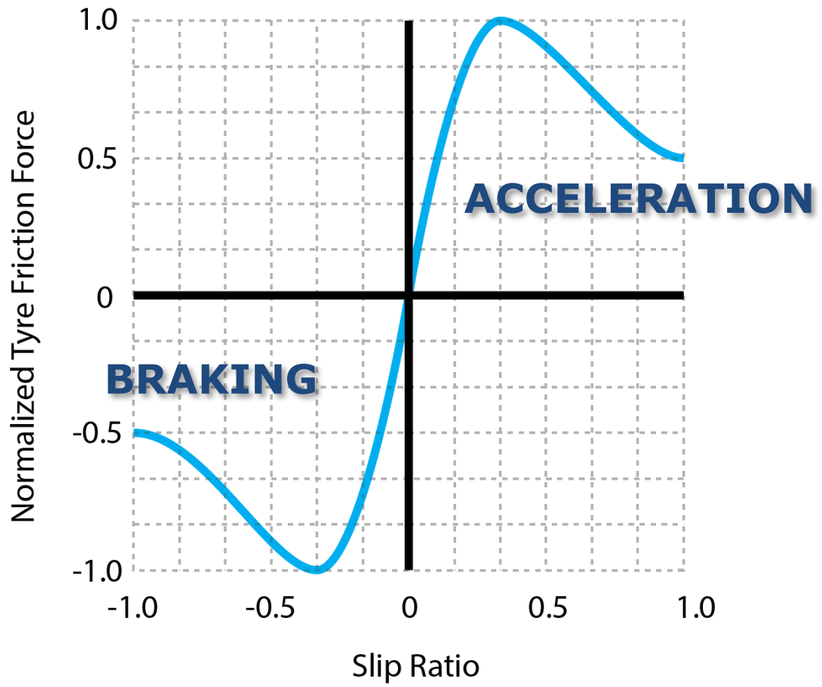


Pacejka Tyre Friction





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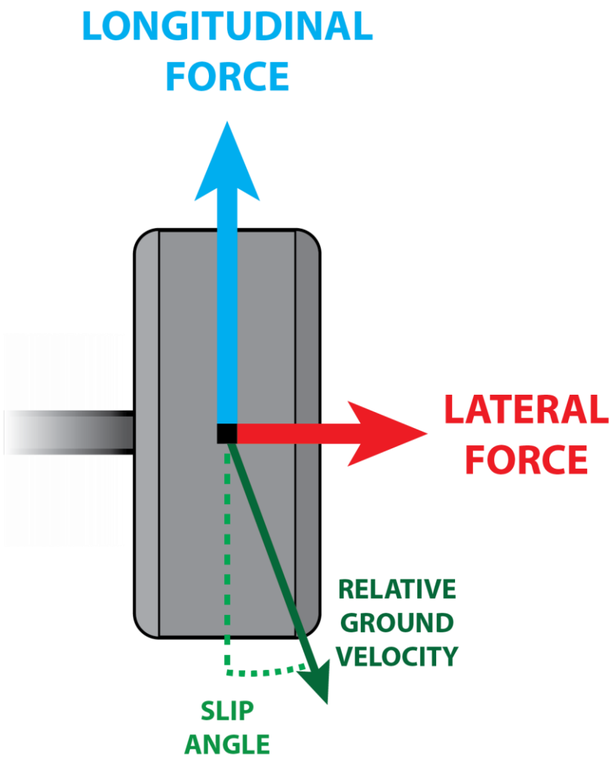
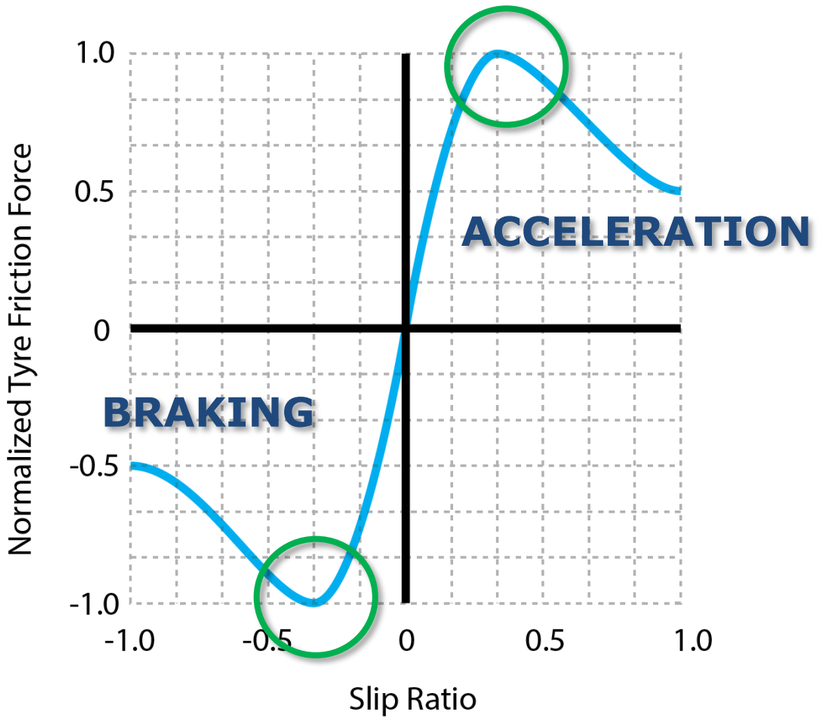
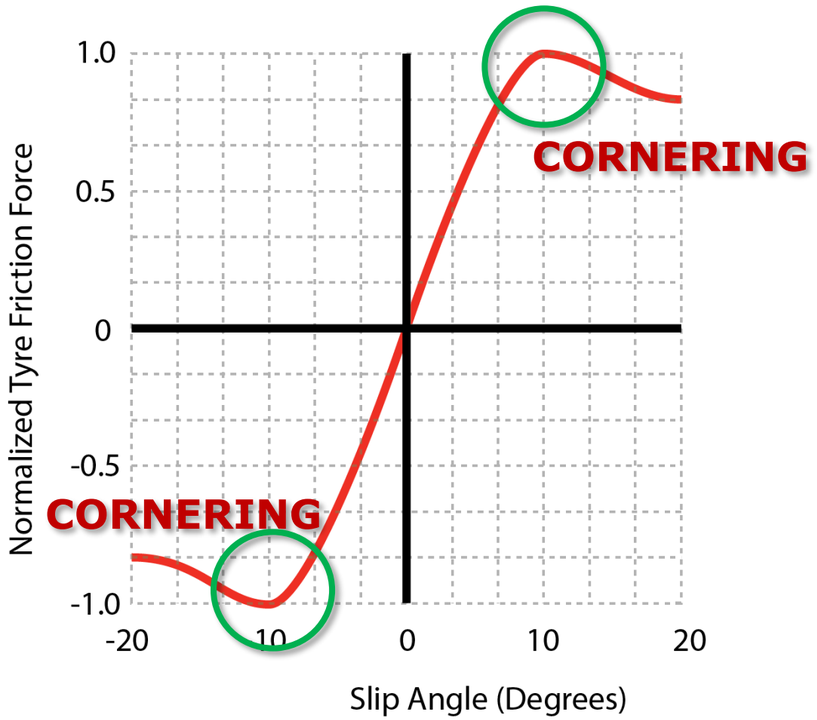


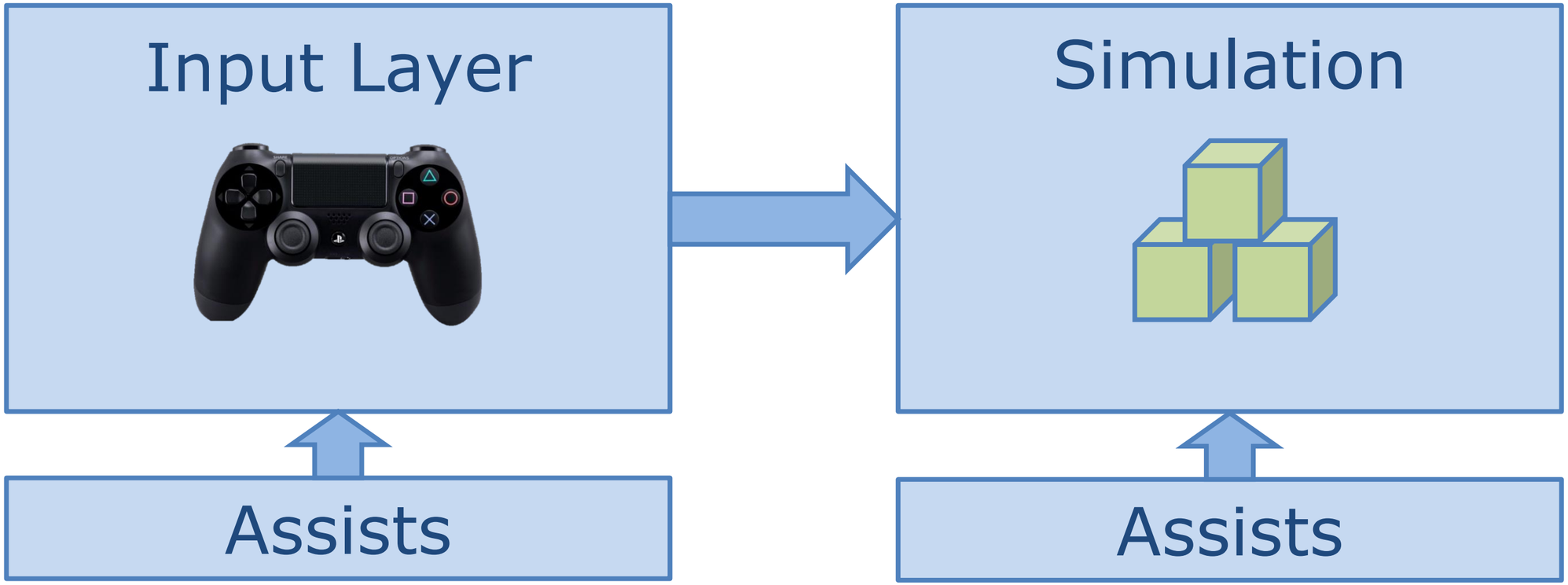





EASYDRIVE
NEW
MCCLANE
MALONE STREET
NEED4SPD
0
MPH
3.1
MI

- Vehicle Design Philosophy
  - Arcade vs Simulation
  - Physical Simulation
  - Input Layer and Assists
  - Camera
- Worked Example: Starfighters

Input Layer Structure



Why add Assists?

- Reduce Input Complexity
- Achieve Arcade-Simulation balance
- Exaggerate Simulation Effects

Why add Assists?

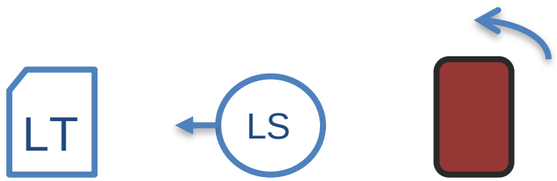
- Reduce Input Complexity
- Achieve Arcade-Simulation balance
- Exaggerate Simulation Effects
- Reduce Simulation Anomalies
- Improve Clarity to Player
- Accessibility Options

Categories of Assist

- Player Intention
- Driver
- Physical
- Real World
- Feedback

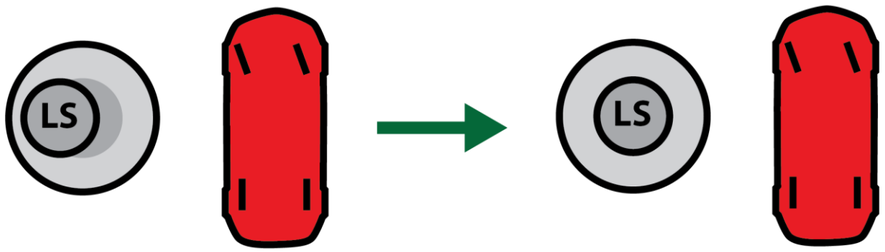
Player Intention Assists

- Player Intention vs Input
- Use simulation to inform
- Brake Tap to Enter Drift



Driver Assists

- Intuition of an Ace Driver
- Force feedback of
  Yaw Torque During a Drift
- Recalibrate ‘Centre Input’



Physical Assists

- Add Physics Forces to Vehicle
- Emphasise for Hyper-Real
- Want a deep, stable Drift
- Maintain Speed Force

Real World Assists

- Real vehicle mechanism
- E.g Anti-lock Braking System
- Turn off ABS during drift
- Reactivate ABS when Straightening up

Feedback Assists

- Non-handling assist
- Shows player UI to Feedback Game State
- Not Real-World
- E.g Forza Braking Lines

Guidelines

- Don’t mask Simulation Nuance
- Fade Assists In/Out (non-binary)

Guidelines

- Don’t mask Simulation Nuance
- Fade Assists In/Out (non-binary)
- Player can find ‘Optimal’ Assist Strength
- Smooth Learning Curve with Feedback
- Lots of Debug for Designers
- Auto-Test the Physics

- Vehicle Design Philosophy
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Camera = Handling

Camera-led vs Vehicle-led

- Player controls Camera, Vehicle Follows
- Player controls Vehicle, Camera Follows

Camera-led

- Shooter Input Paradigm
- Responsive Aiming
- Loss of handling Precision
- Unexpected Motion

Vehicle-Led

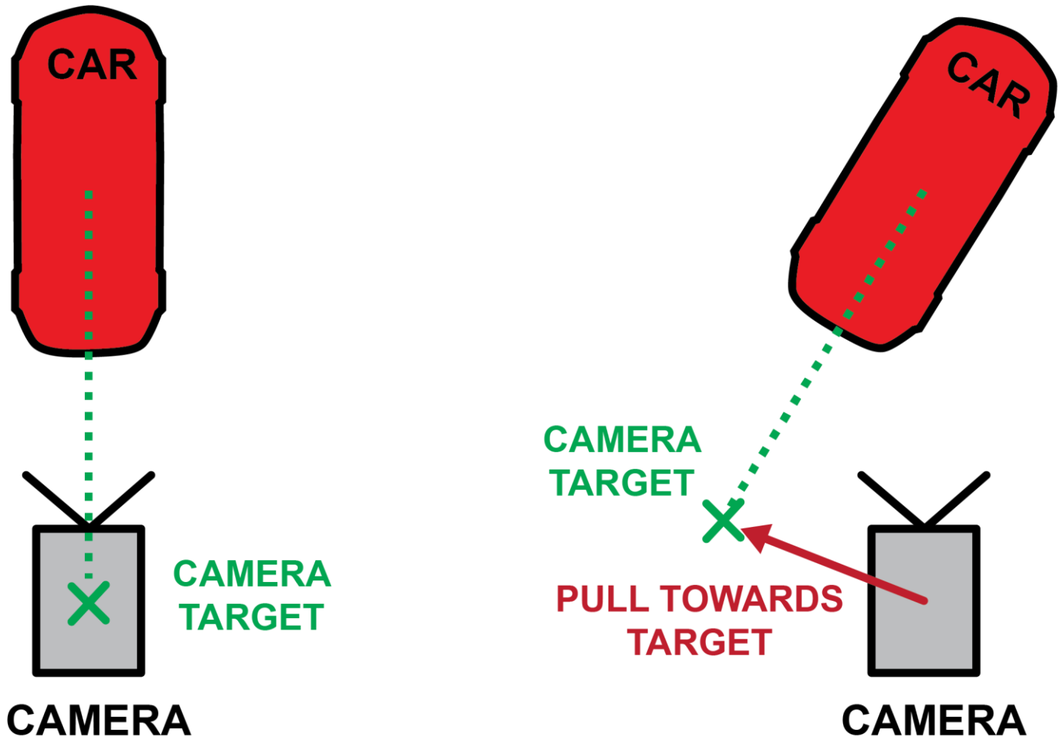
- Driving Input Paradigm
- Precise handling feel
- Lower camera response
- Look-Behind-Camera

Camera Requirements

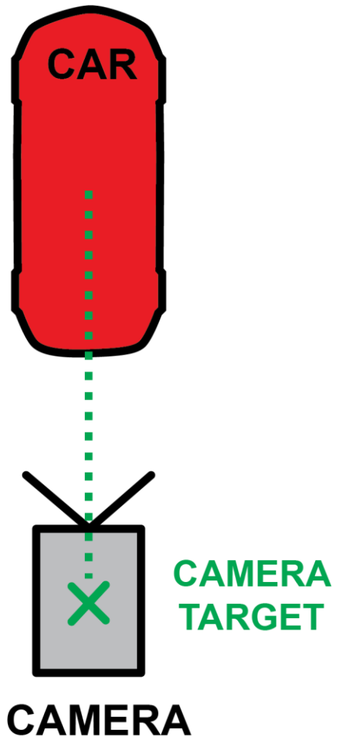
- Give Simulation Feedback
- Respond to Player Needs
- Sell Physicality

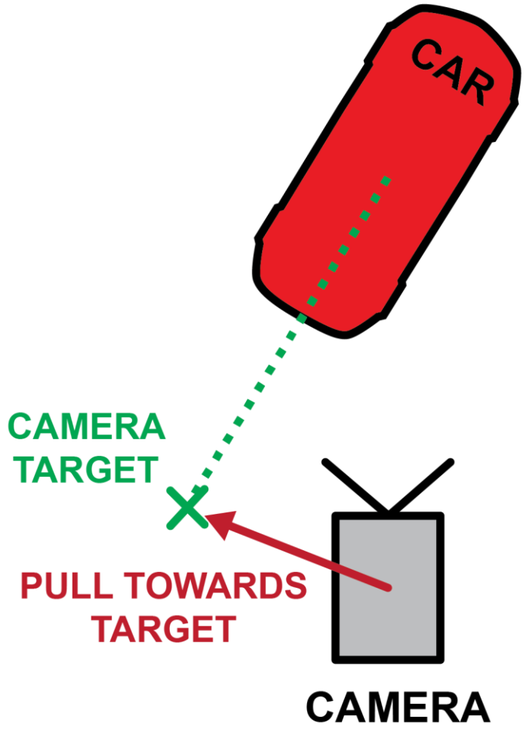

Rigid Locked Camera

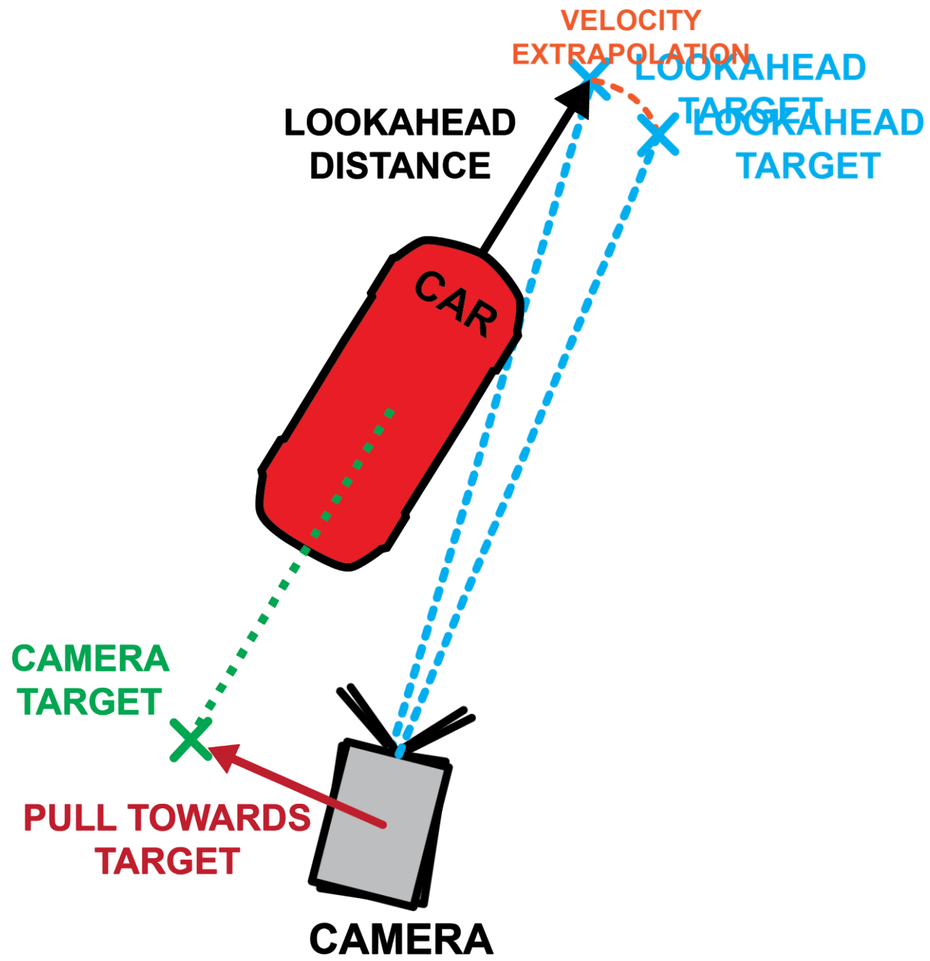
Sprung Camera



Sprung Camera



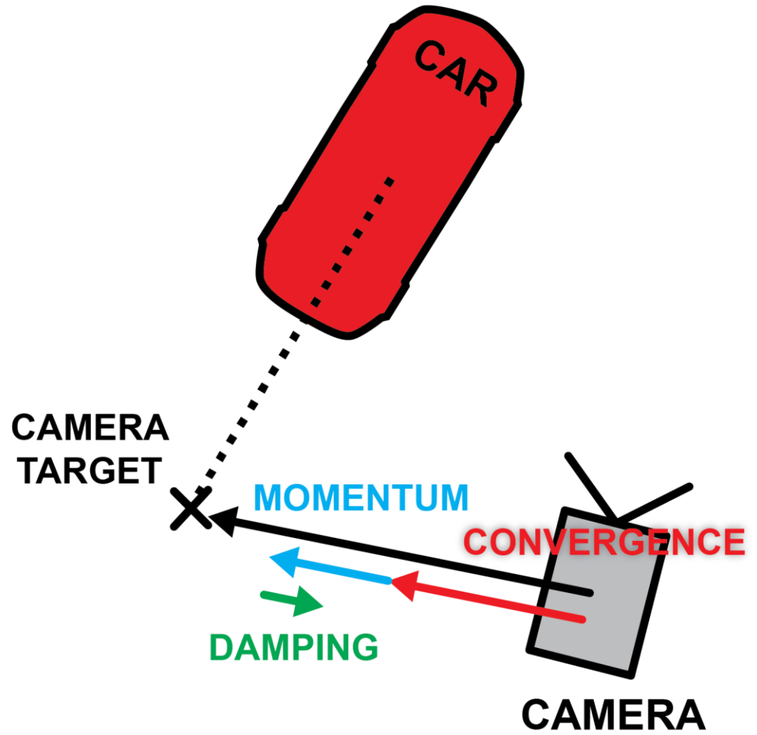





Sprung Camera

Sprung Camera Parameters

- Convergence –
  Move Camera to Target
- Momentum –
  Faster Camera Movement
- Damping –
  Camera Speed Limit




Strong Convergence

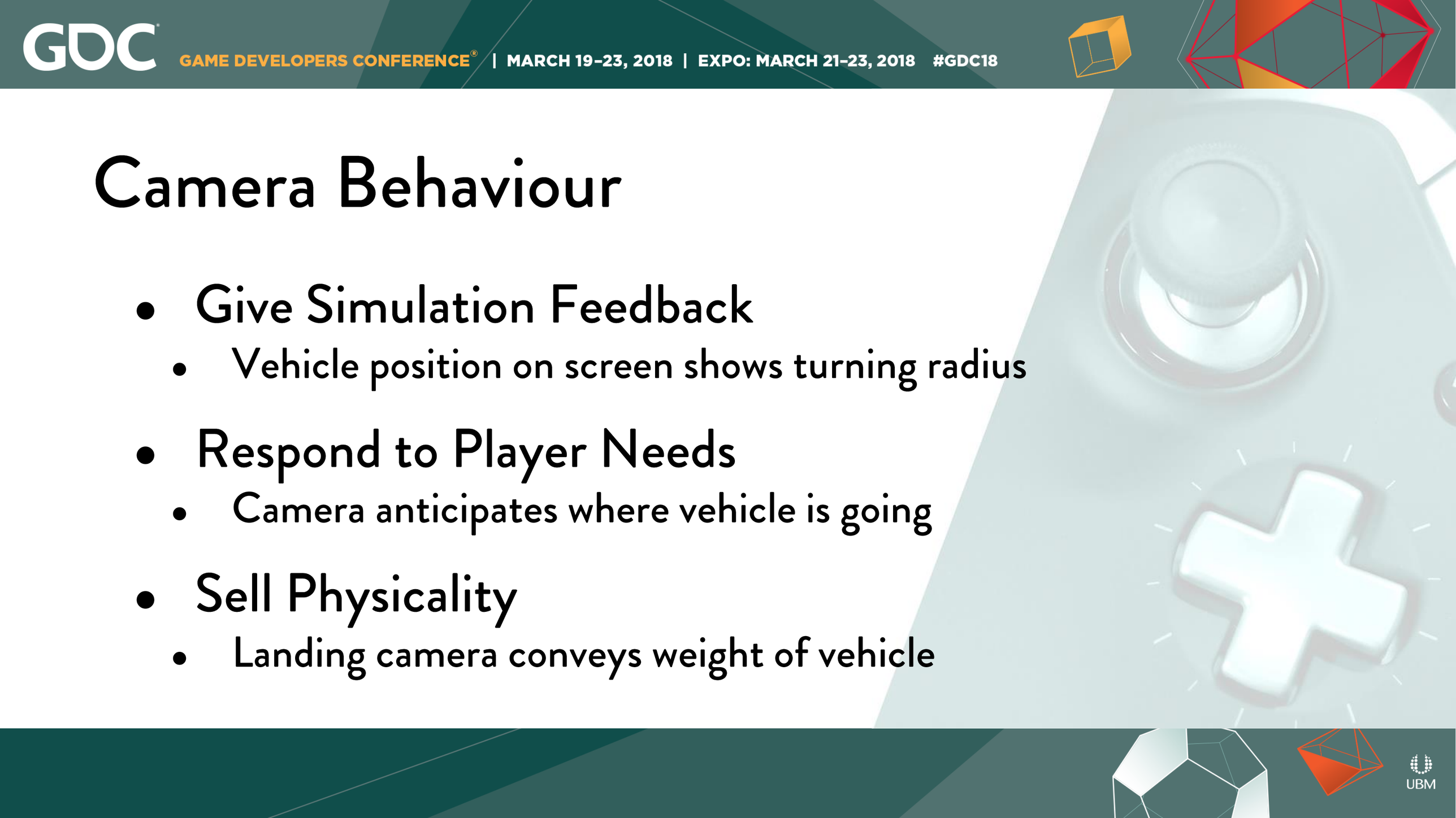
Landing Camera - Physicality

- Massive 4.7 tonne vehicle can leap off hills
- Camera can sell physicality of Heavy Landing
- Add Camera Shake on Landing
- Use Momentum with low Damping for exaggerated motion


Default Behaviour

Camera Behaviour

- Give Simulation Feedback
  - Vehicle position on screen shows turning radius
- Respond to Player Needs
  - Camera anticipates where vehicle is going
- Sell Physicality
  - Landing camera conveys weight of vehicle



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Battlefront 2

- “Feel like an Ace Pilot”
- Improve Handling over Battlefront 1
- Full Space Battles
- Larger Scale than Battlefront 1


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09:59
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DEFEAT THE ENEMY FIGHTERS

Battlefront 1 Player Feedback

- Players loved the Fantasy Fulfilment
- Very Accessible Gameplay
- Auto-Aim made the game Shallow
- Felt imprecise to fly
- Toy-like springy behaviour
- Players wanted manual Roll

Battlefront 2

- Shooter-like Aiming
- Precise vehicle control
- Physical-feeling Camera
- Full 3-Axis Control


140
0%
ENGAGE ENEMY FIGHTERS - AWAIT FURTHER ORDERS
900
vecchia94 Defeated
Shihskaa Defeated
100 | TEAMPLAY
2x
+290 | BATTLE POINTS

Battlefront 2 Reception

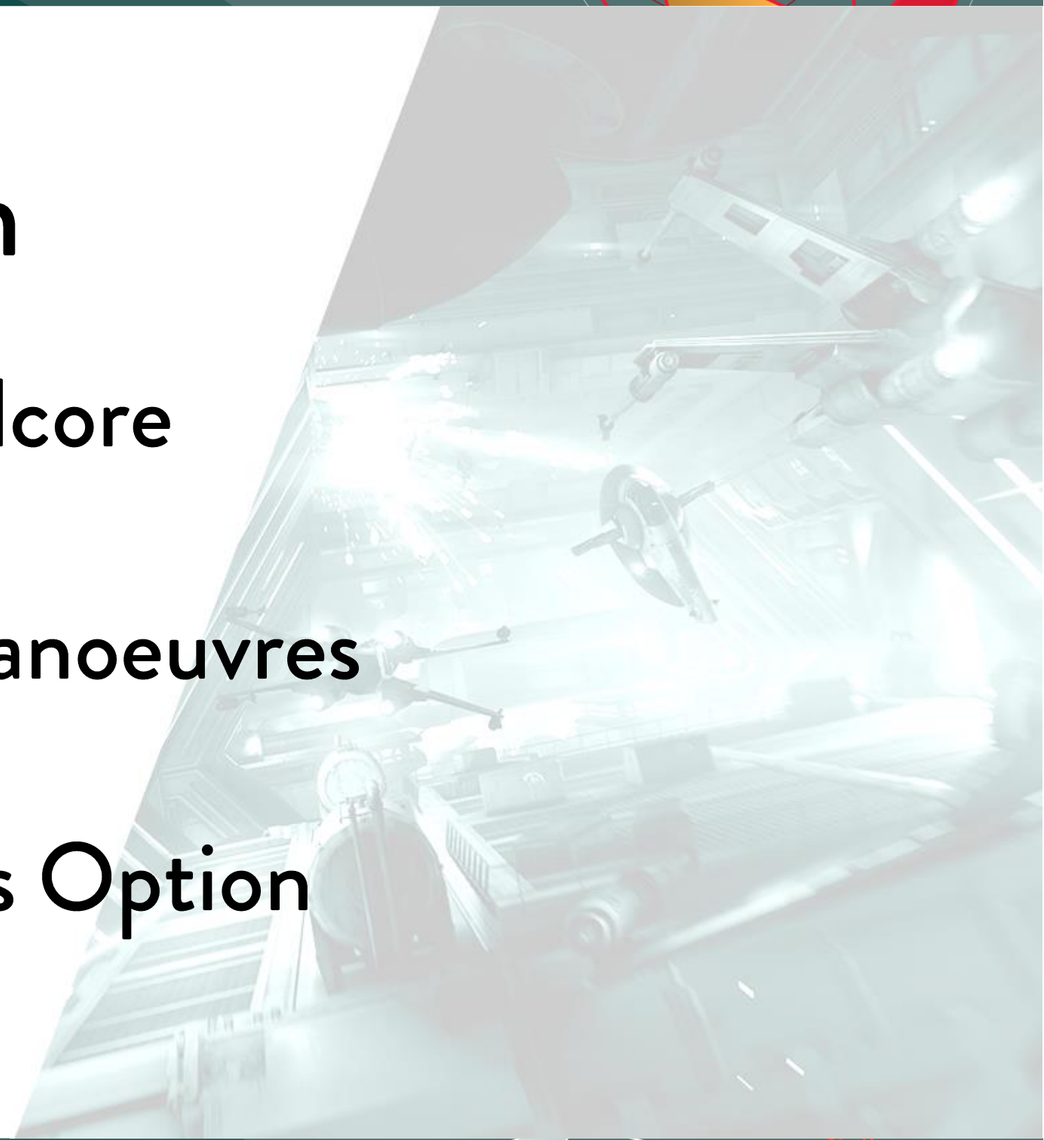
Starfighter Assault is the absolute shining star of Battlefront 2
– *Trusted Reviews*

Most Clean, Crisp, Buttery, Responsive and Satisfying Controls Ever
– *Downward Thrust*

Starfighter Assault mode is so good it should be its own game
– Kotaku

Battlefront 2 – Arcade/Sim

- Split Audience – Casual + Hardcore
- Intuitive Pitch + Yaw
- Full Roll Control for Evasive Manoeuvres
- Shooter Input Paradigm
- Flight Sim Paradigm as Settings Option



Starfighter Simulation

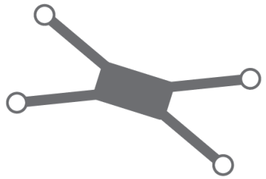
Fighter Plane	Starfighter
Airfoils	Simple Anti-Grav
Banked Turns	Horizon-Steering

Starfighter Simulation

Fighter Plane	Starfighter
Airfoils	Simple Anti-Grav
Banked Turns	Horizon-Steering
Prop/Jet Engine	Simple Engine Thrust
Body Aero Drag	‘Air’ Brake

Horizon Steering

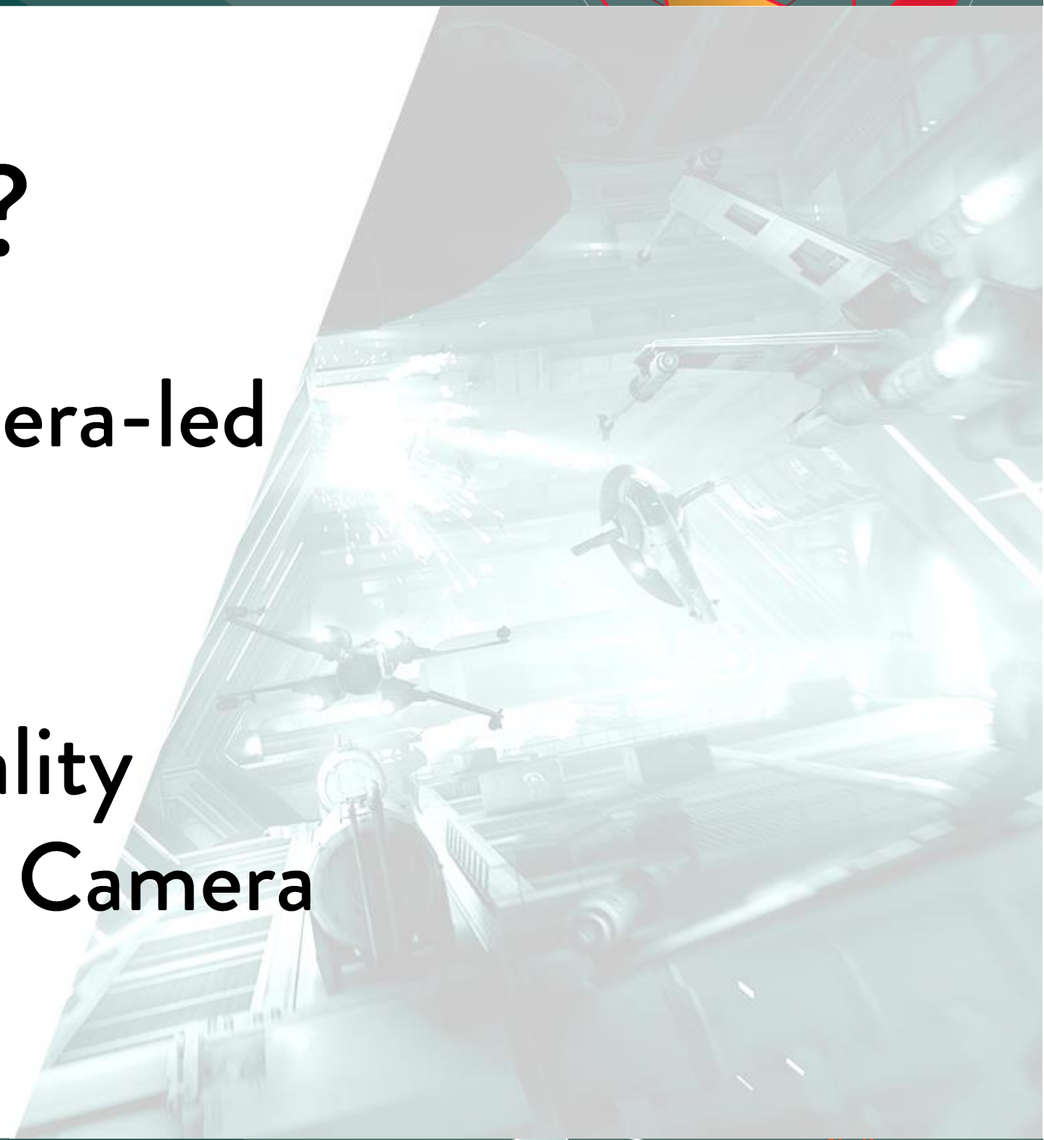
Vehicle



Horizon Line

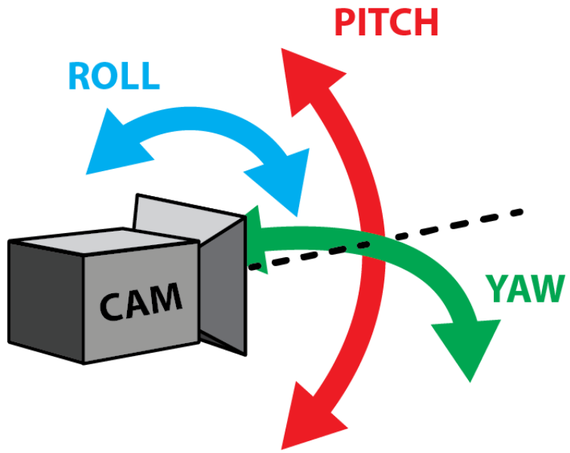
Camera-led or Vehicle-led?

- Aiming precision favoured Camera-led
- BF1 was Camera-led
- Vehicle-led for Flight Precision
- Vehicle-led for Camera Physicality
- Decided on Vehicle-led Sprung Camera

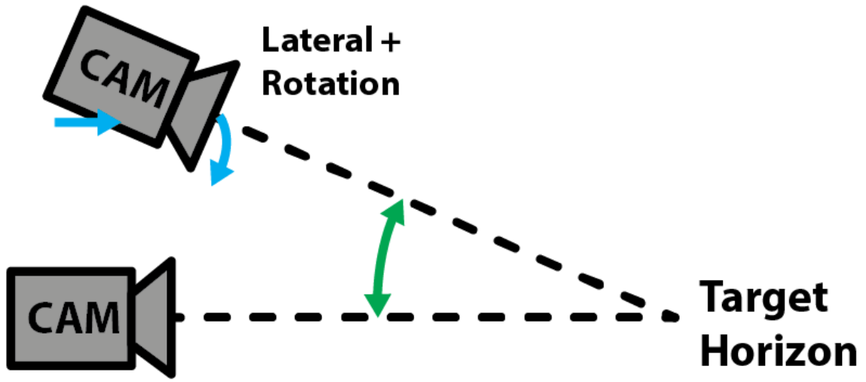



226
100%
DESTROY THE SHIELD PROJECTORS
ALLIED Y-WINGS ARRIVING IN 5 SECONDS
Defeated
1x
430m

Orbit Camera Shake



Conventional Shake



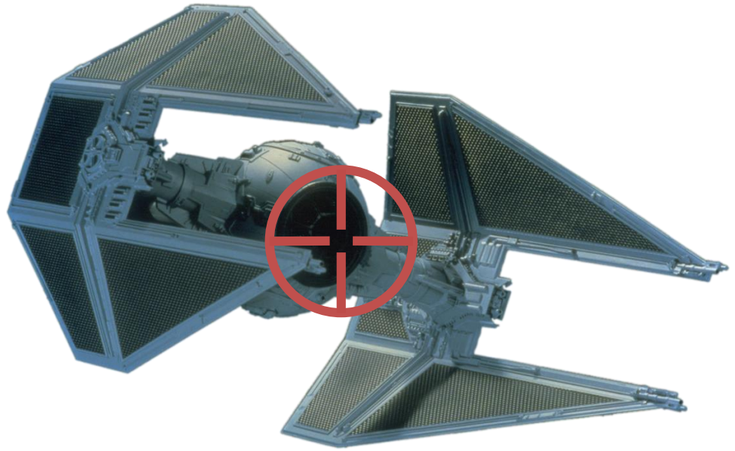
Orbit Shake


118
54%
DESTROY THE IMPERIAL DEFENSES
Conventional Shake
360m
748
260m
L
Q
F

Control Assists – Auto-Roll

- Auto-Roll to Horizon
- Activates on Zero Input
- Subtle when almost Level
- Allow Inverted Flight (20-degree window)
- Toggleable setting

Shooting Complexities



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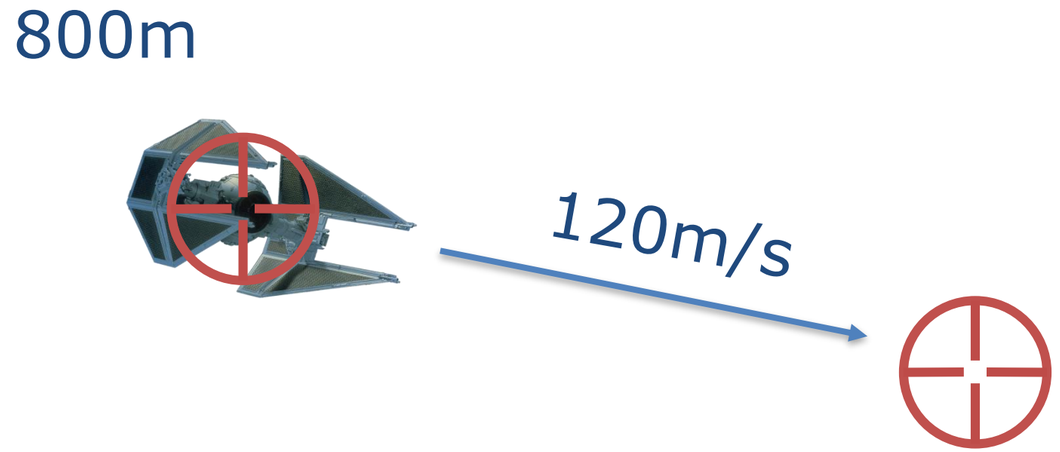
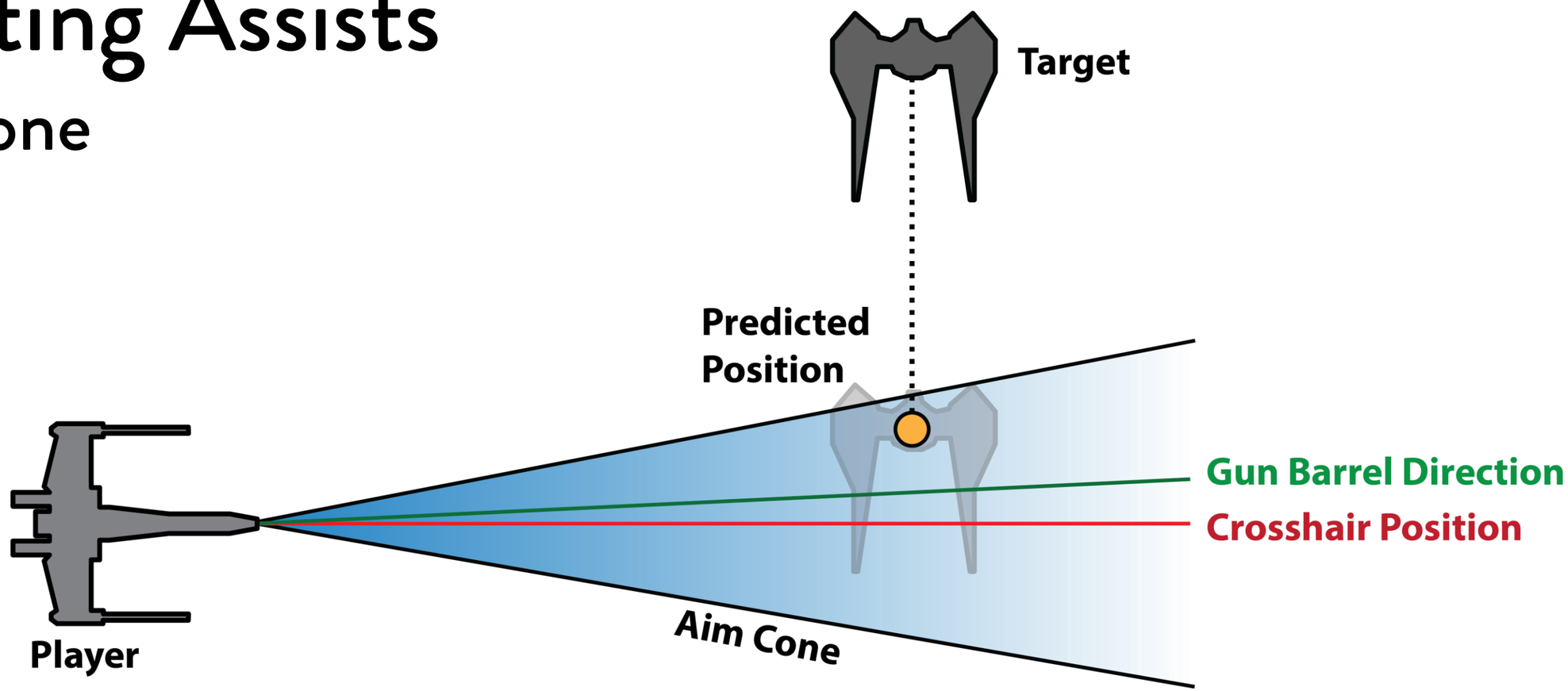


Shooting Assists

Aim Cone



Shooting Assists

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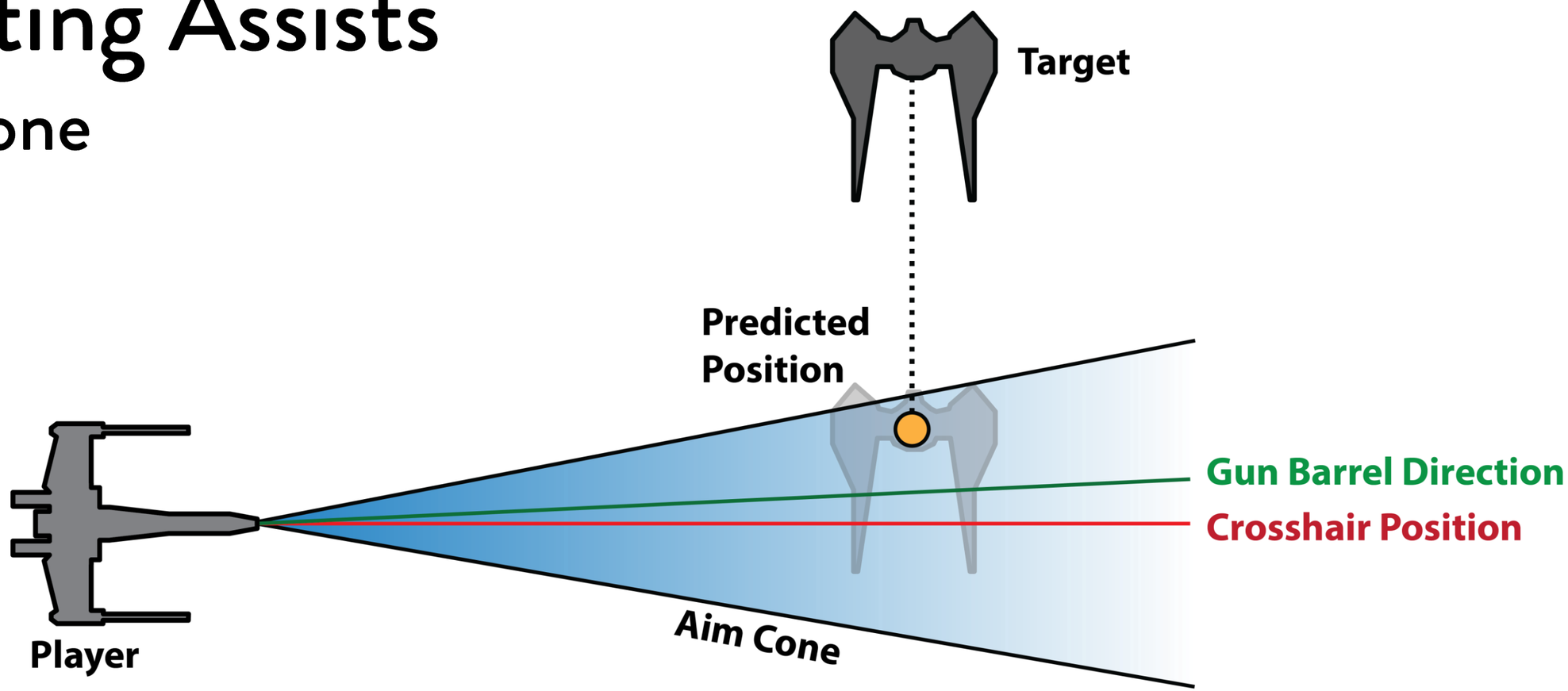
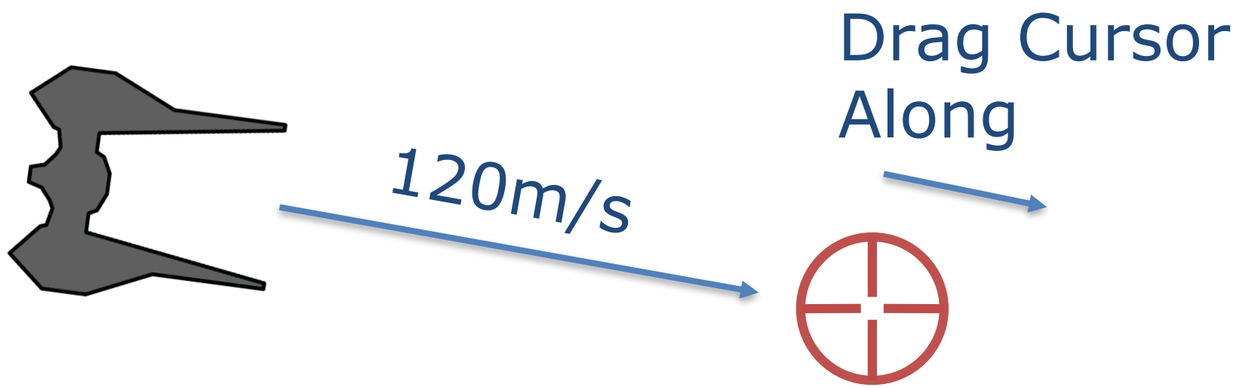


Shooting Assists – Sticky Targeting



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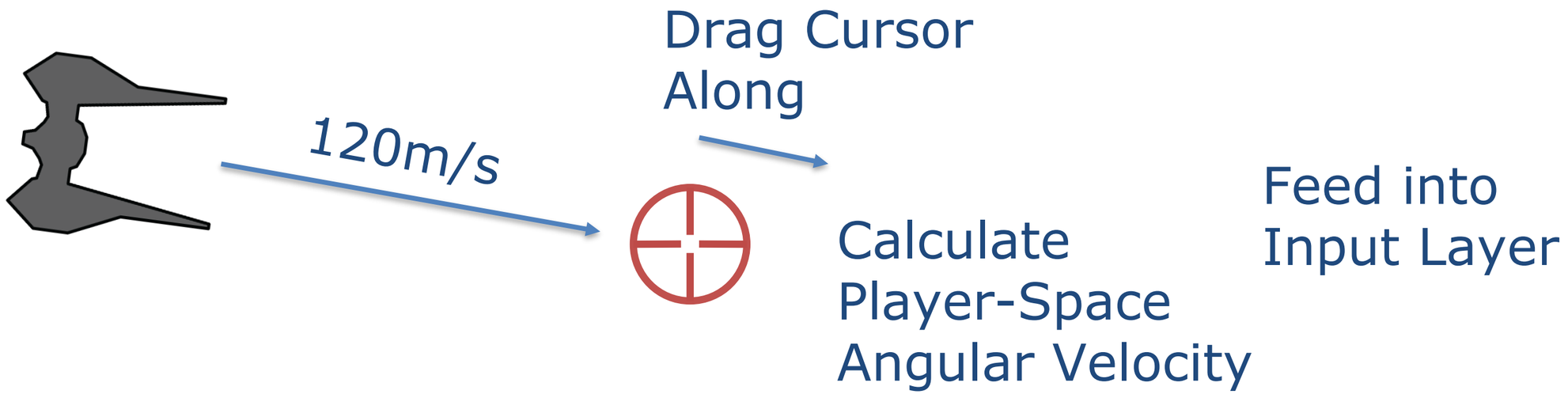

Battlefront 2 Wrap-up

- Hybrid Vehicle-Shooter Experience
- Simplified Physical Model
- Full 3-Axis Control for Hardcore Audience
- Vehicle-Led Camera for Handling Precision
- Added Assists for Shooting Precision

Summary

- Balance Arcade vs. Simulation
- Handling relies on Context
- Use Appropriate Simulation Detail
- Build Assists to retain Depth and Mastery
- Camera is Handling

Questions?

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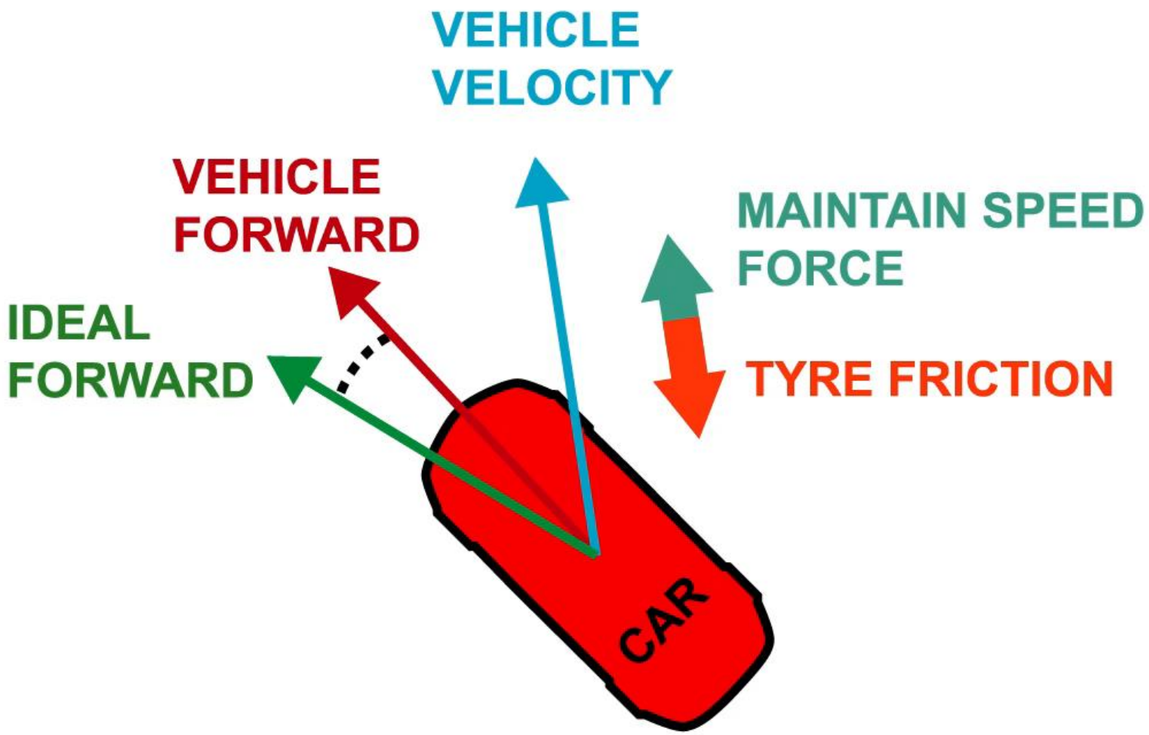
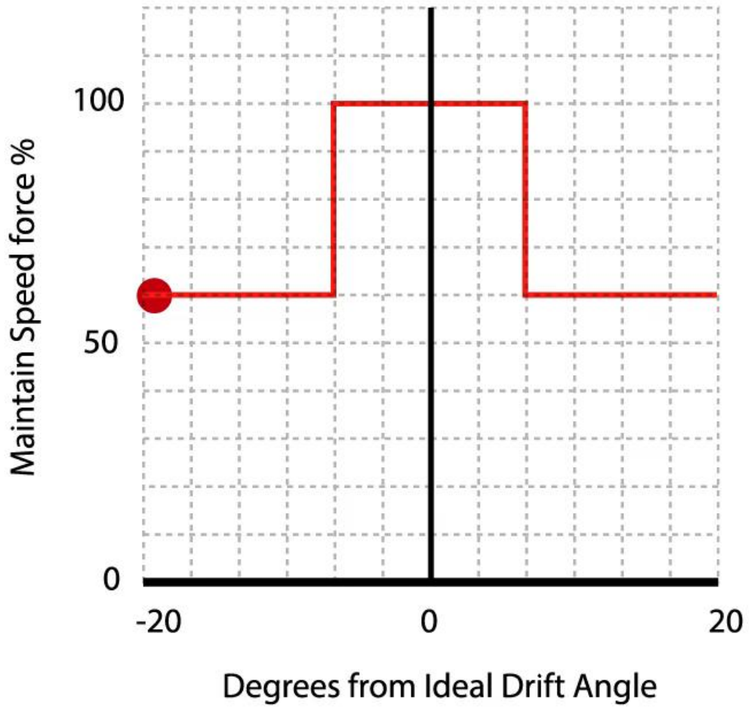
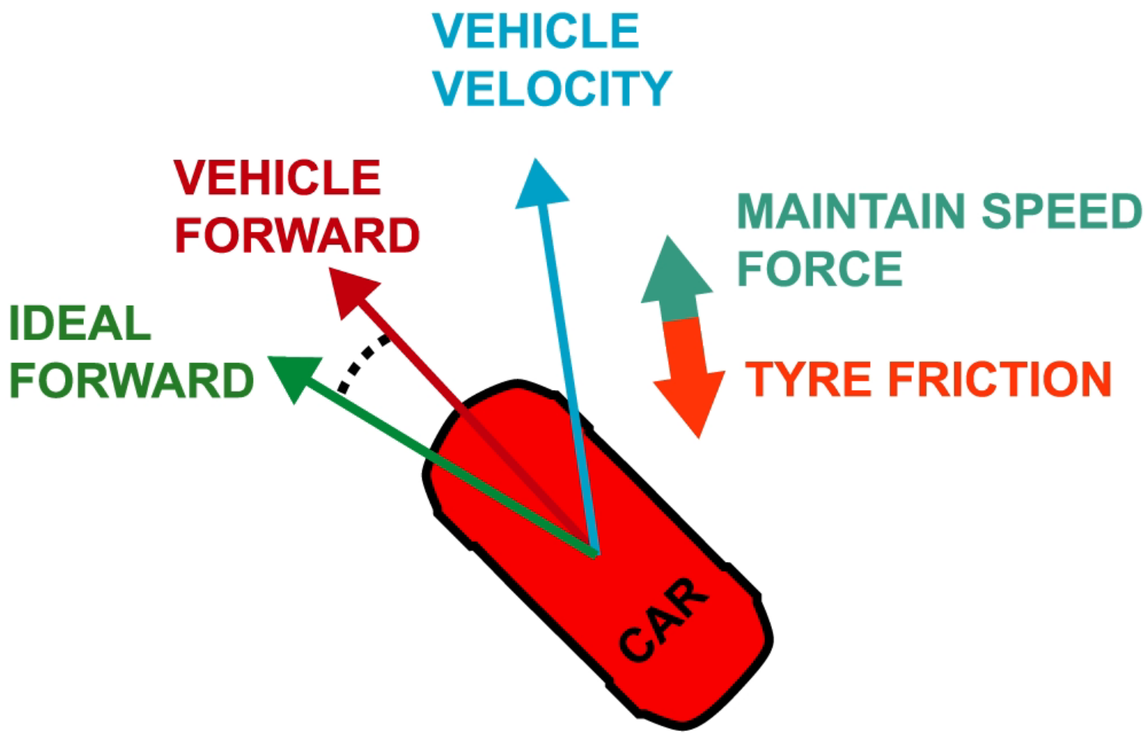
Special Thanks to Criterion Team, GDC Board and Clint Hocking

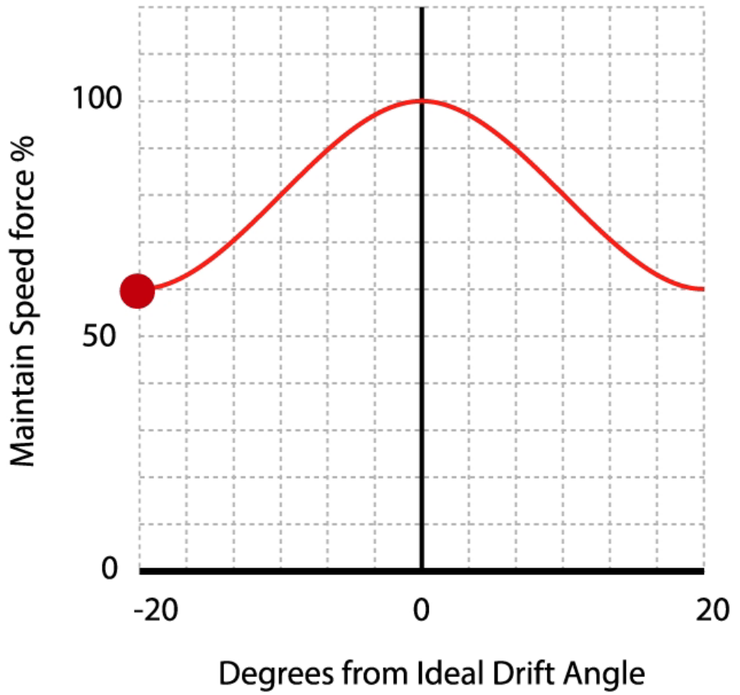
BONUS – Tuning Example





BONUS – Tuning Example





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