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WORLD EXPO 2006

ZEROSHIFT

How will it help you win?

Richard Thompson

Senior Design Engineer (Motorsport)



PRESENTATION OVERVIEW

- Concept
- Considerations for an instant gearshift
- Development
- Managing a 'Zeroshift'
- Data collection and analysis
- Benefits

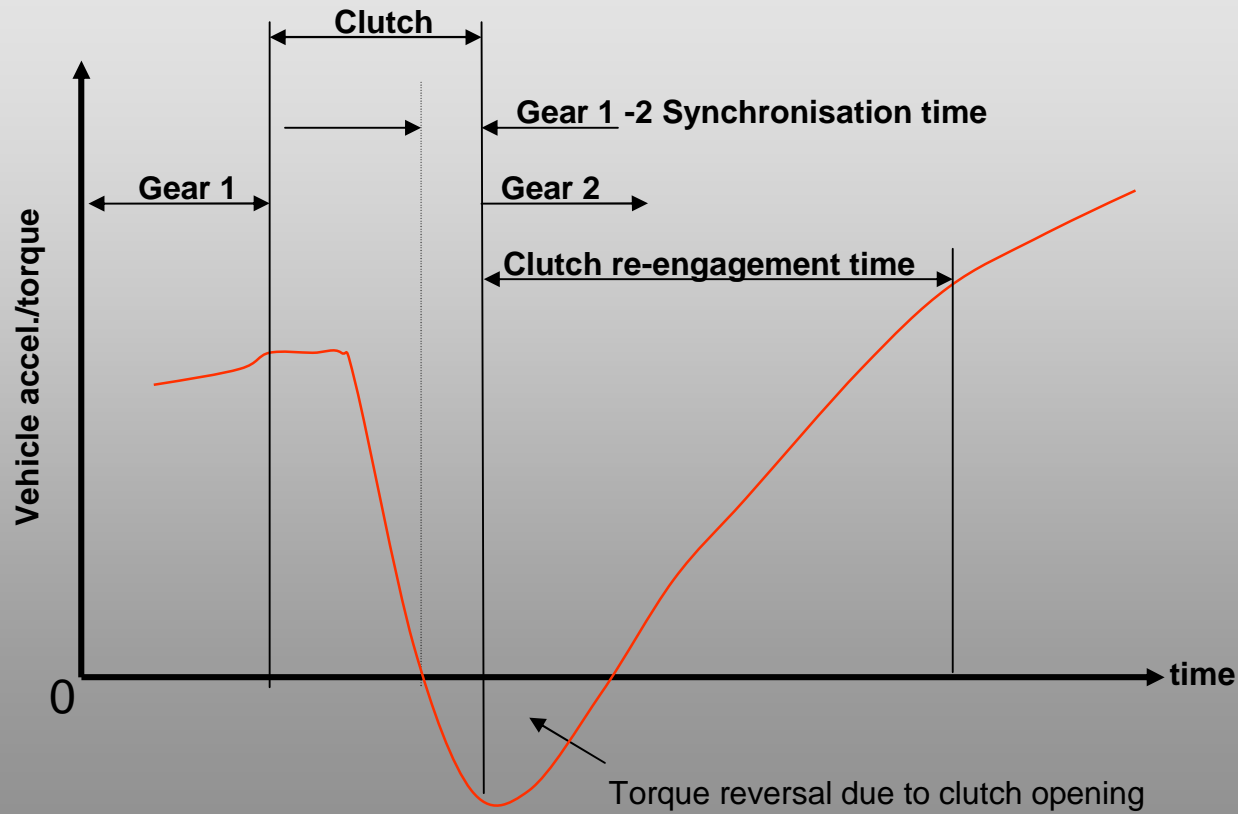
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CONCEPT

Synchromesh engagement transmission



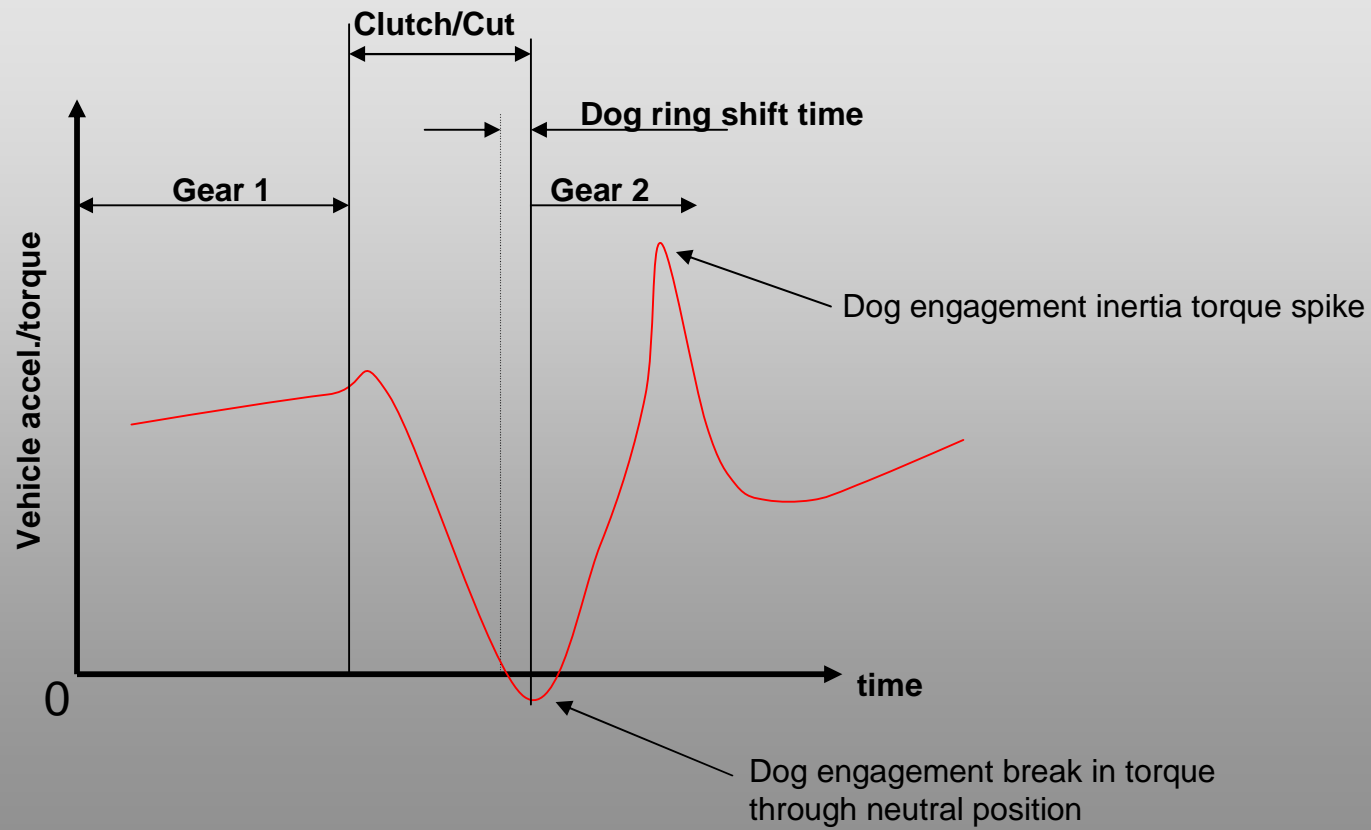
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CONCEPT

Dog engagement transmission



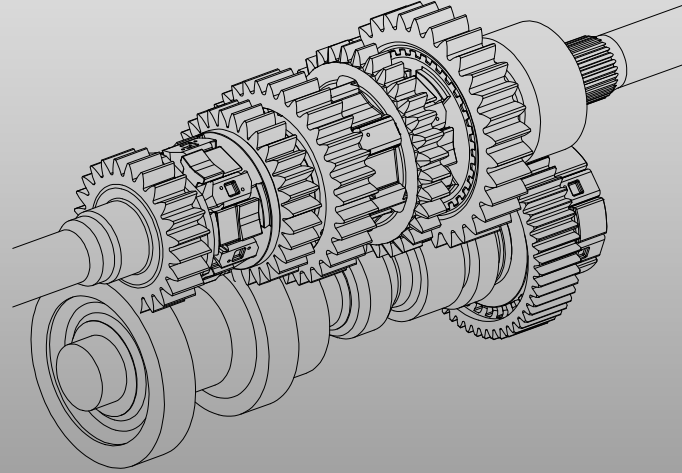
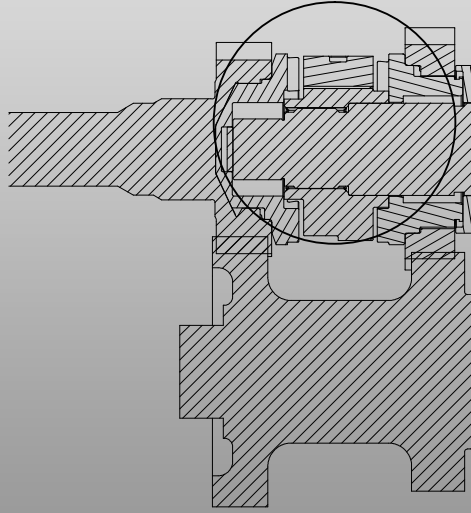
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CONCEPT

Synchromesh/Dog envelope

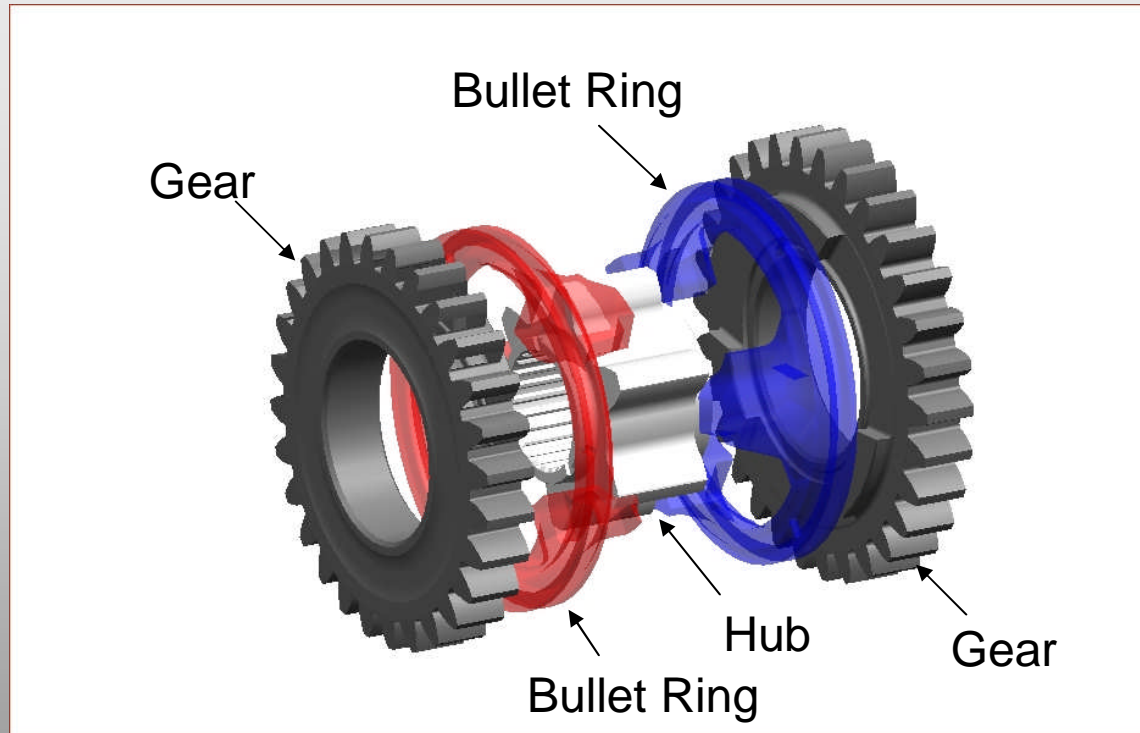


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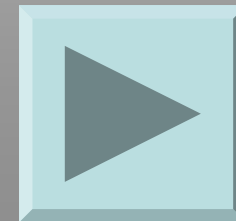
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CONCEPT



PLAY ANIMATION



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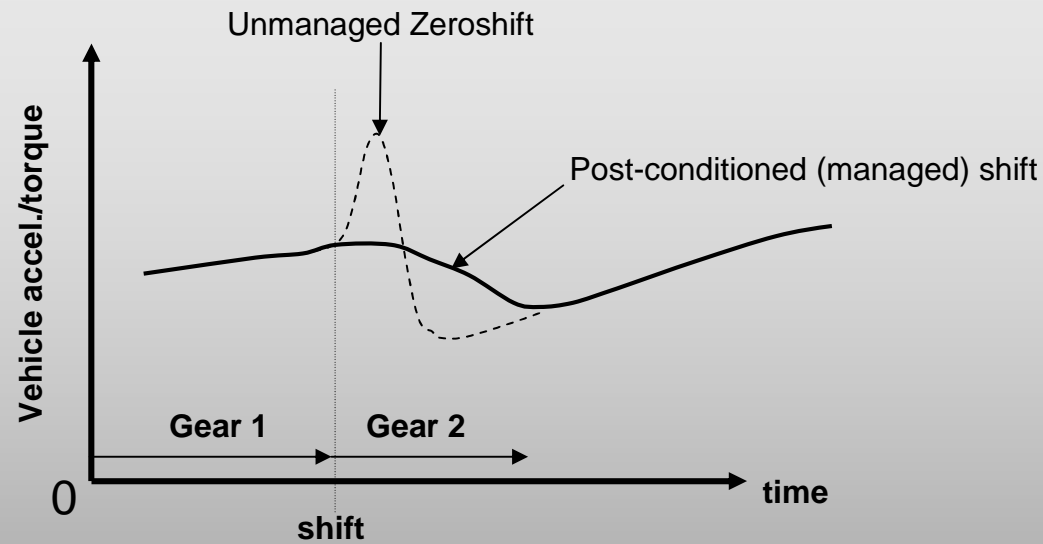
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CONSIDERATIONS FOR AN INSTANT GEARSHIFT

- Shift event



- Engine inertia torque
- Driveability and shift quality

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DEVELOPMENT

Development car

Ford Mustang V6 4.0L

Configuration V6

Output 210 bhp @ 5300 rpm $.7355 = 154 \text{ kW}$

Torque 240 lb.ft @ 3500 rpm $\times 1.356 = 325 \text{ Nm}$

Kerb weight 1500 kg

HP/Kerb weight 140 bhp per tonne

Length 4765 mm

Height 1384 mm

Width 1877 mm



New Zeroshift Transmission ZS01

6-speed sequential AMT

Single-plate dry clutch

Closed loop electro-mechanical clutch control

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DEVELOPMENT

Controls and Electronics

- Zeroshift TCU (Zeroshift hardware and software)
- In-house transmission control algorithms
- Electro-pneumatic, Electro-hydraulic and Electric-mechanical shift systems.
- High-speed (kHz) datalogging of transmission internal speeds, driveline torques and vehicle CAN data

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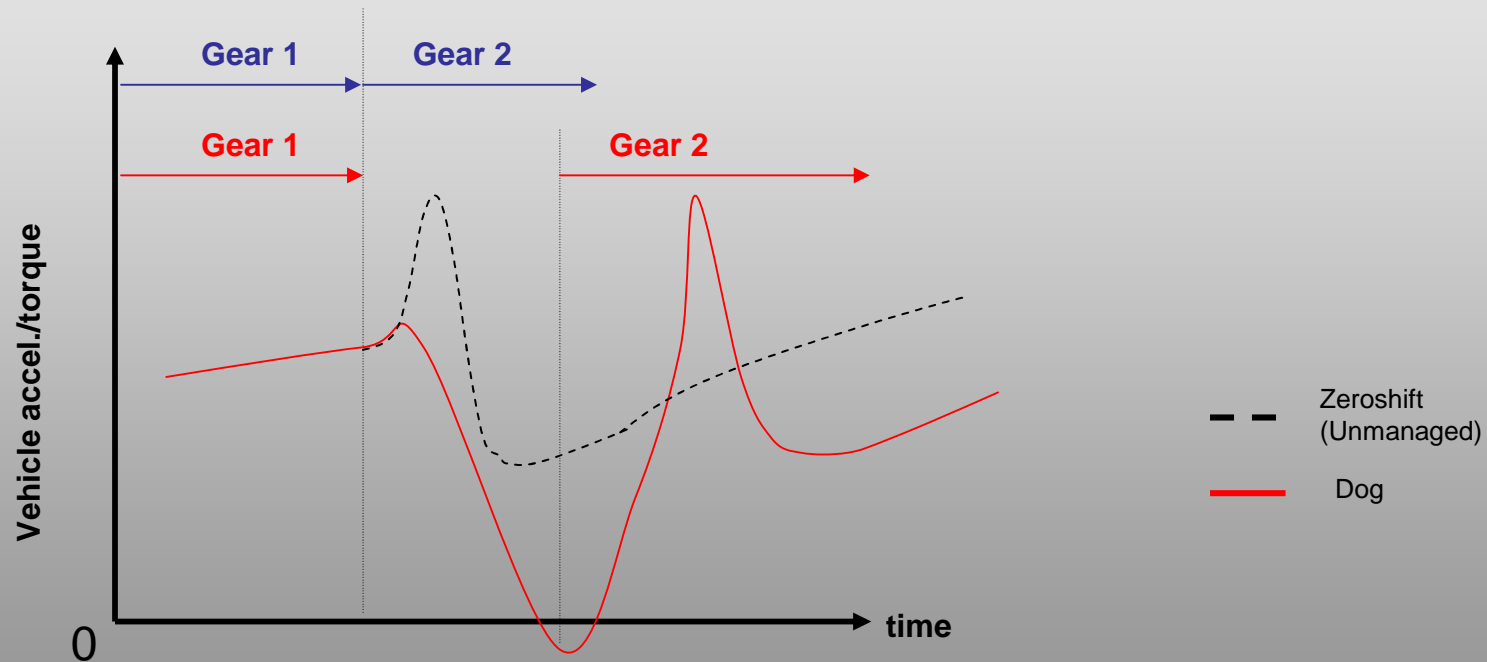
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MANAGING A 'ZEROSHIFT'

Dog vs Zeroshift (unmanaged)



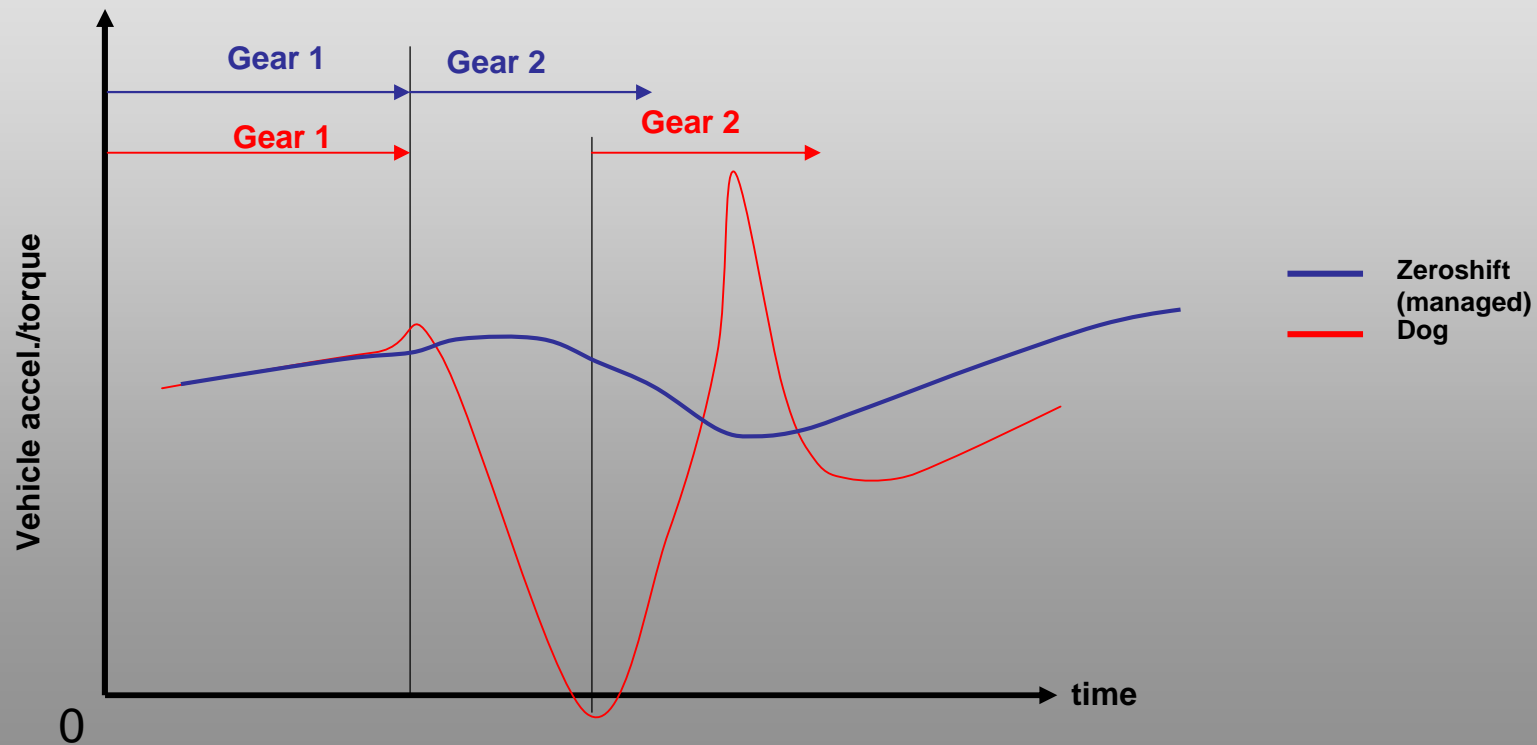
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MANAGING A 'ZEROSHIFT'

Dog vs Zeroshift (managed)



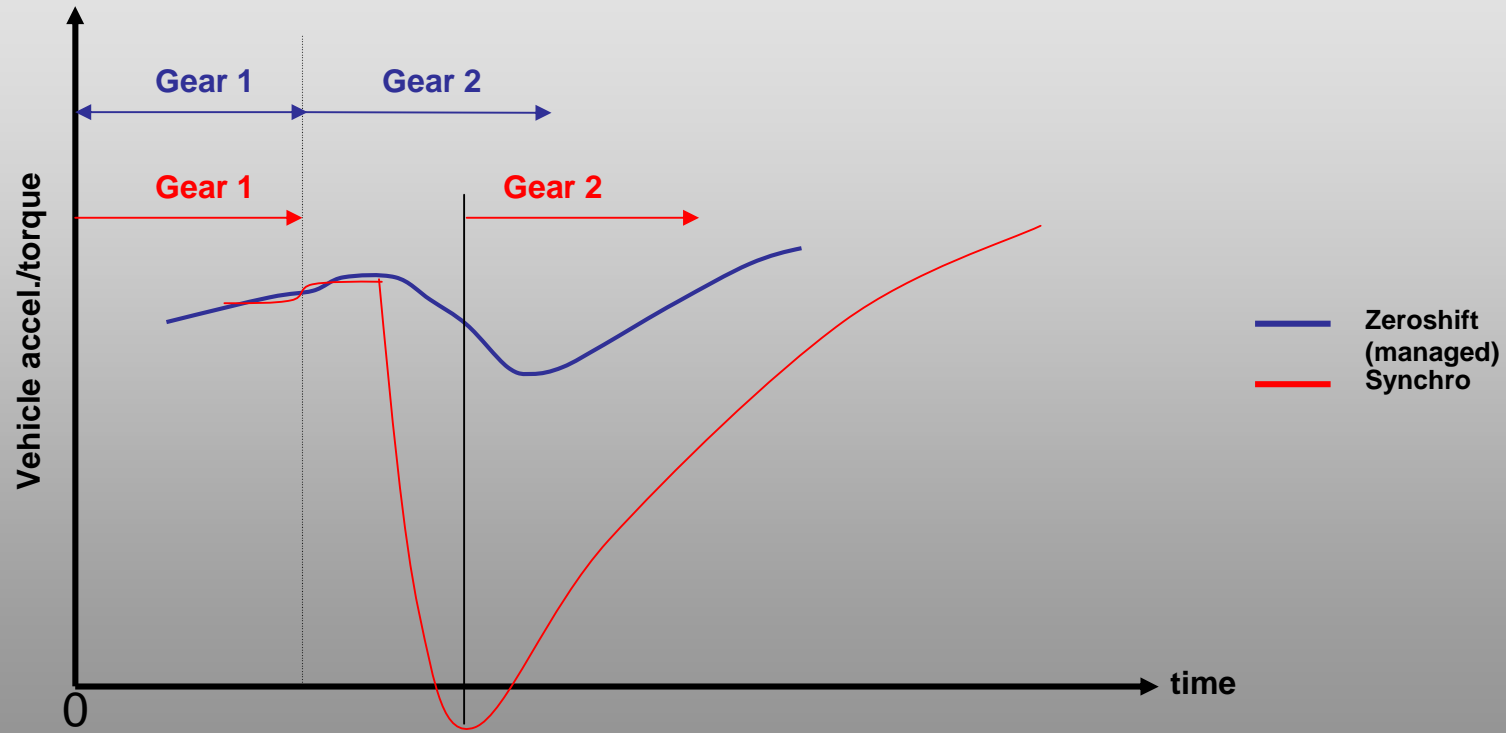
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MANAGING A 'ZEROSHIFT'

Synchro vs Zeroshift (managed)



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MANAGING A 'ZEROSHIFT'

- Shift event
 - Engine and clutch management
 - Driveline compliance
- Accelerating downshifts
 - Torque roll-off required
- Decelerating upshifts
 - Throttle 'blip' required

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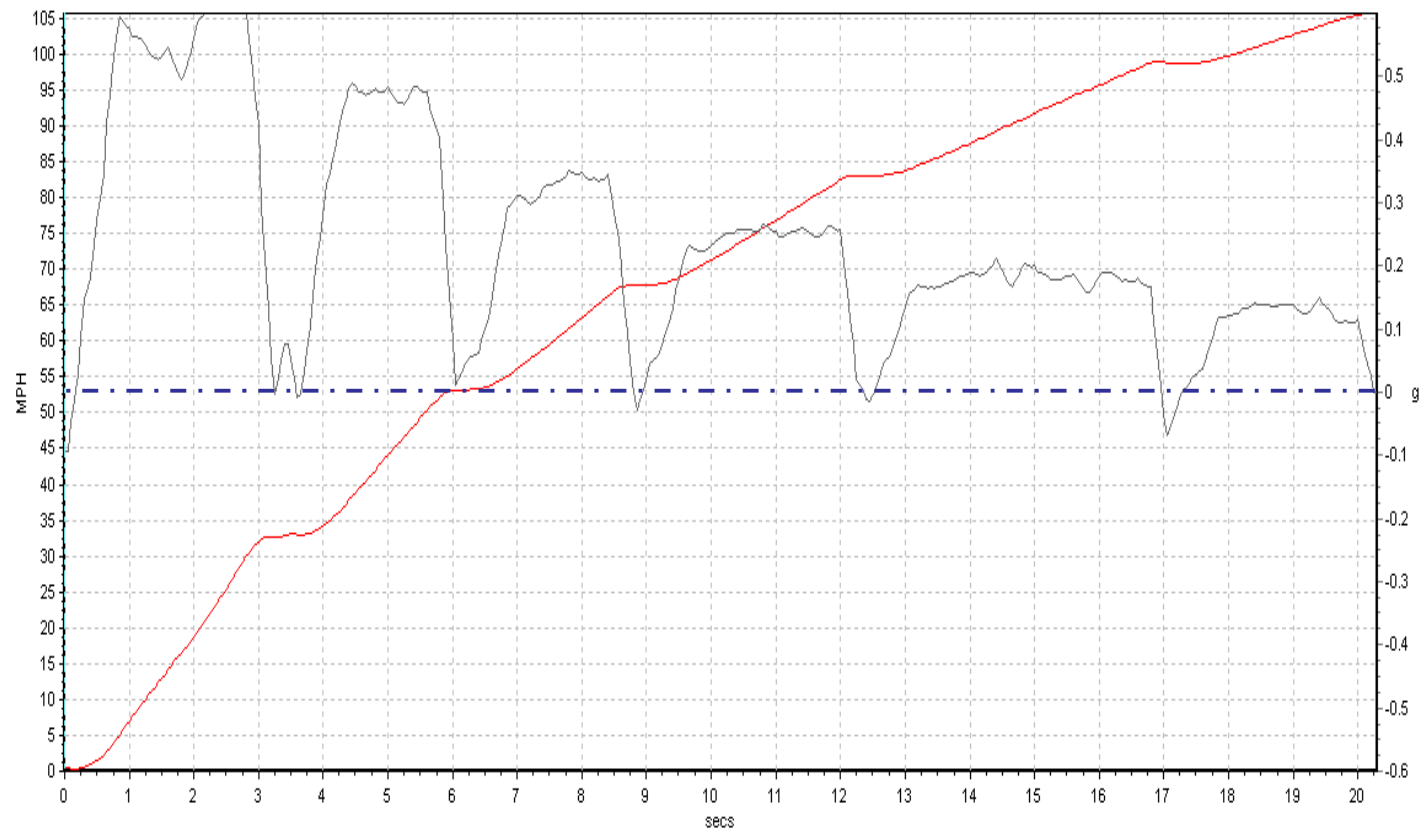
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DATA COLLECTION AND ANALYSIS

Ferrari 360 – Challenge Stradale



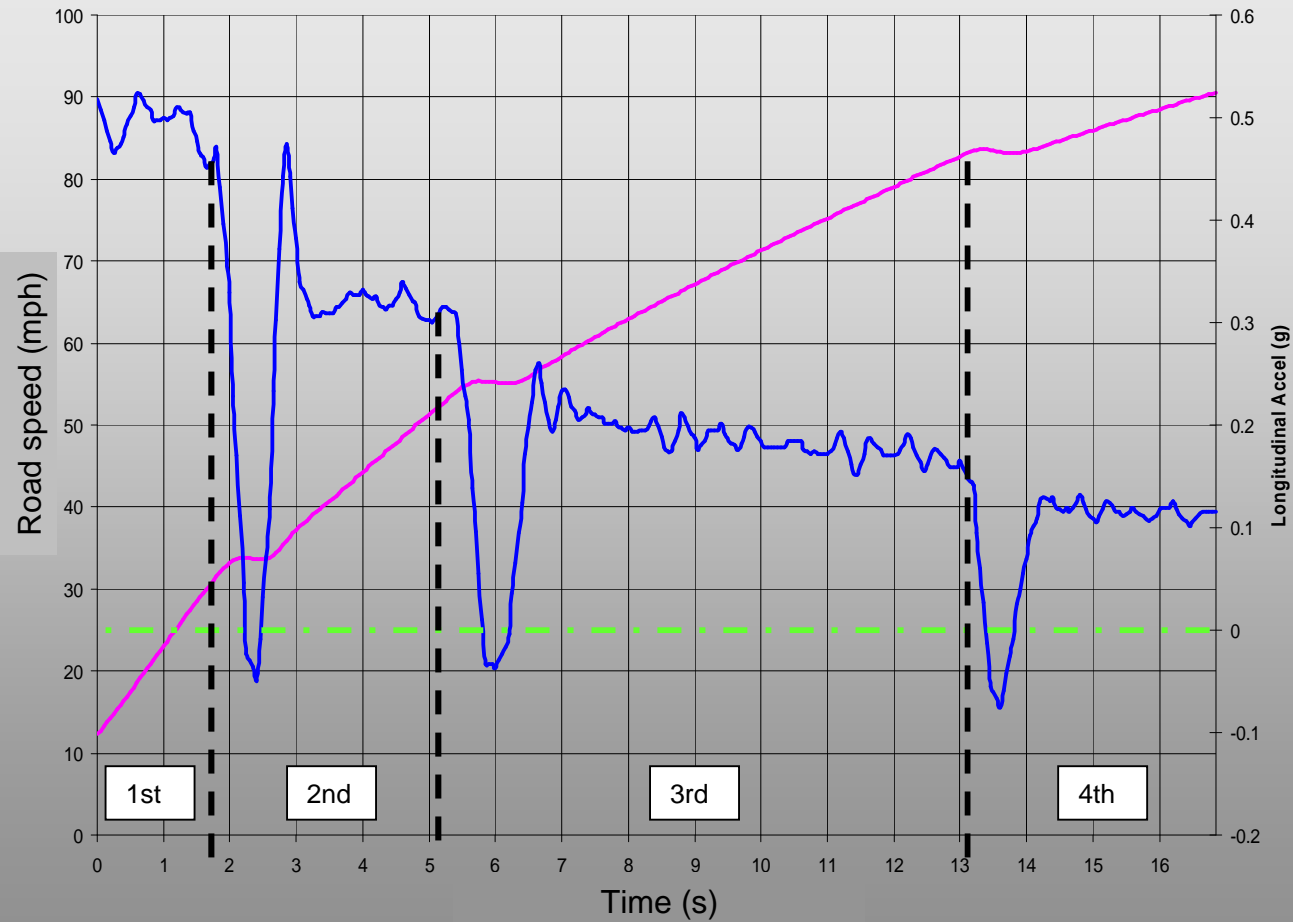
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DATA COLLECTION AND ANALYSIS

Standard Manual Ford Mustang



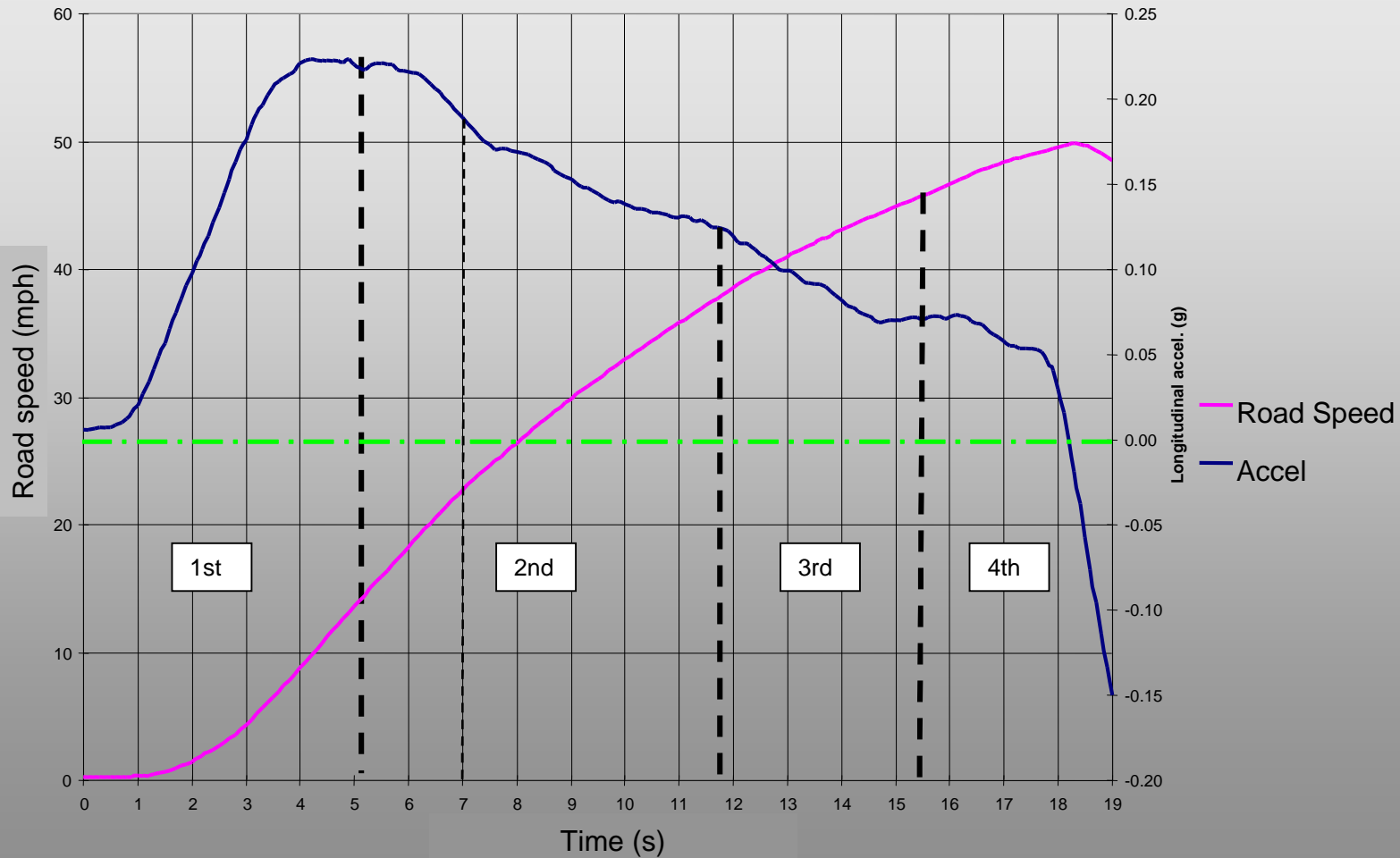
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DATA COLLECTION AND ANALYSIS

Zeroshift Ford Mustang



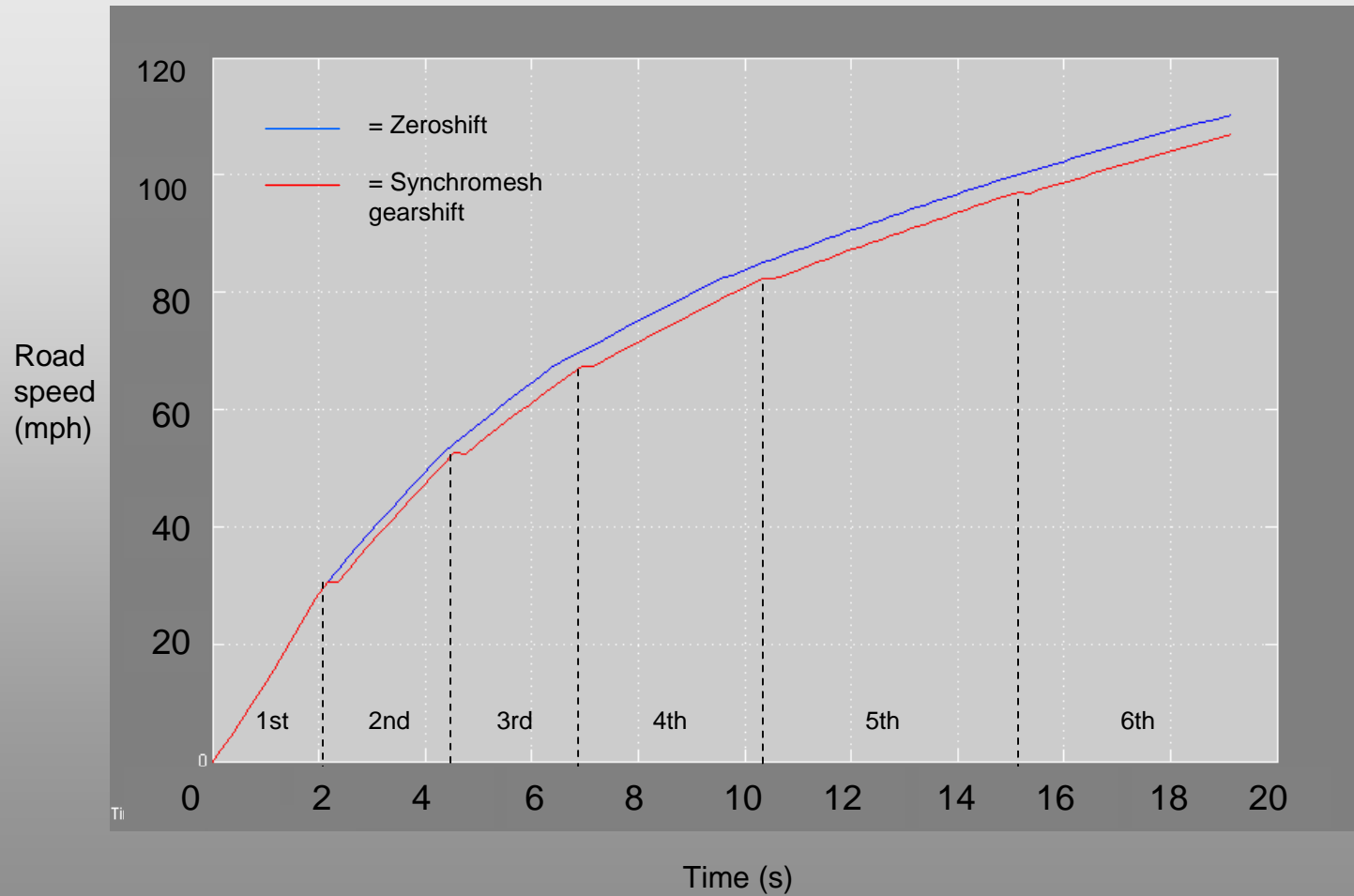
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DATA COLLECTION AND ANALYSIS

Simulated Ferrari 360 AMT vs Zeroshift Ferrari 360



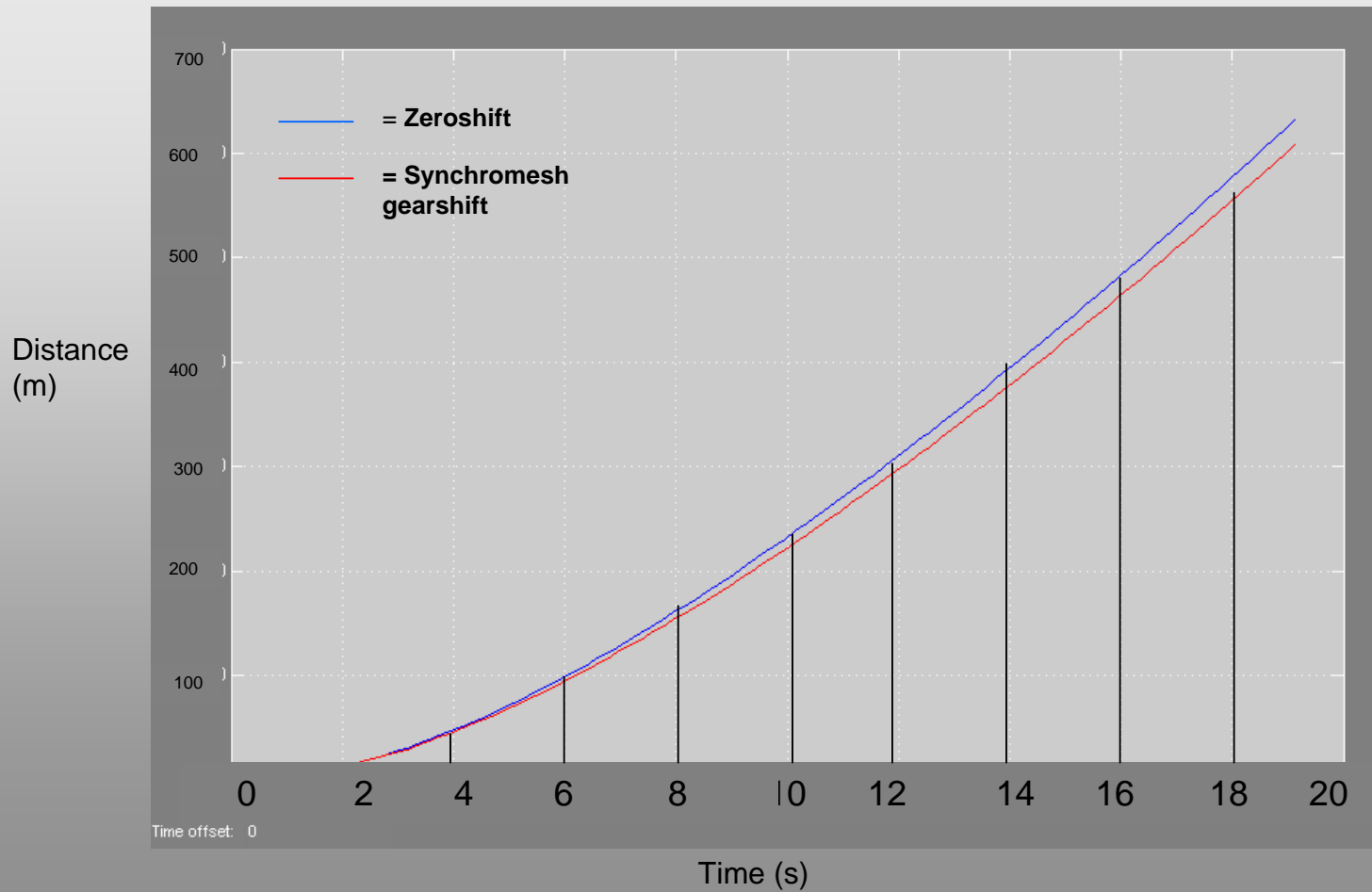
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DATA COLLECTION AND ANALYSIS

Simulated Ferrari 360 AMT vs Zeroshift Ferrari 360



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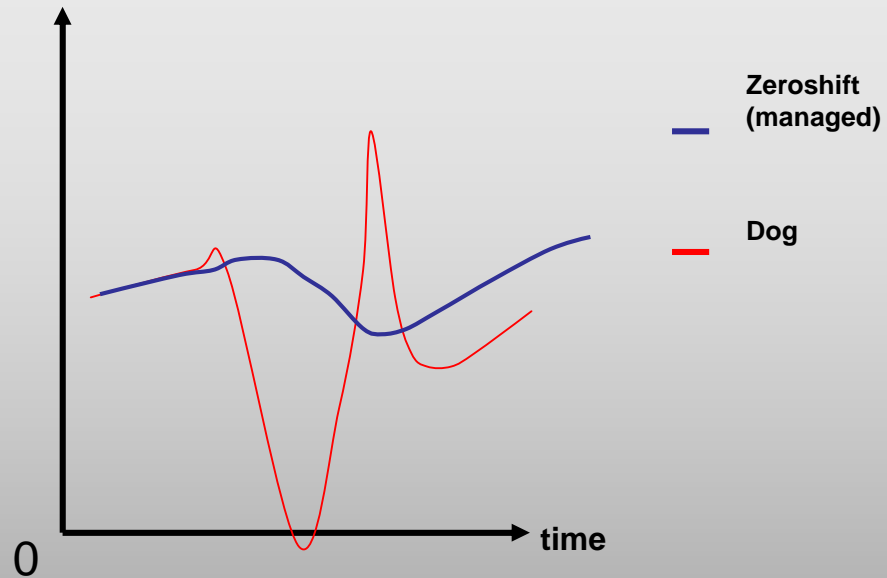
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BENEFITS

- Drivetrain dynamics



- Engine performance
 - Reduced disruption to fluid dynamics
 - Turbo lag/stall reduced

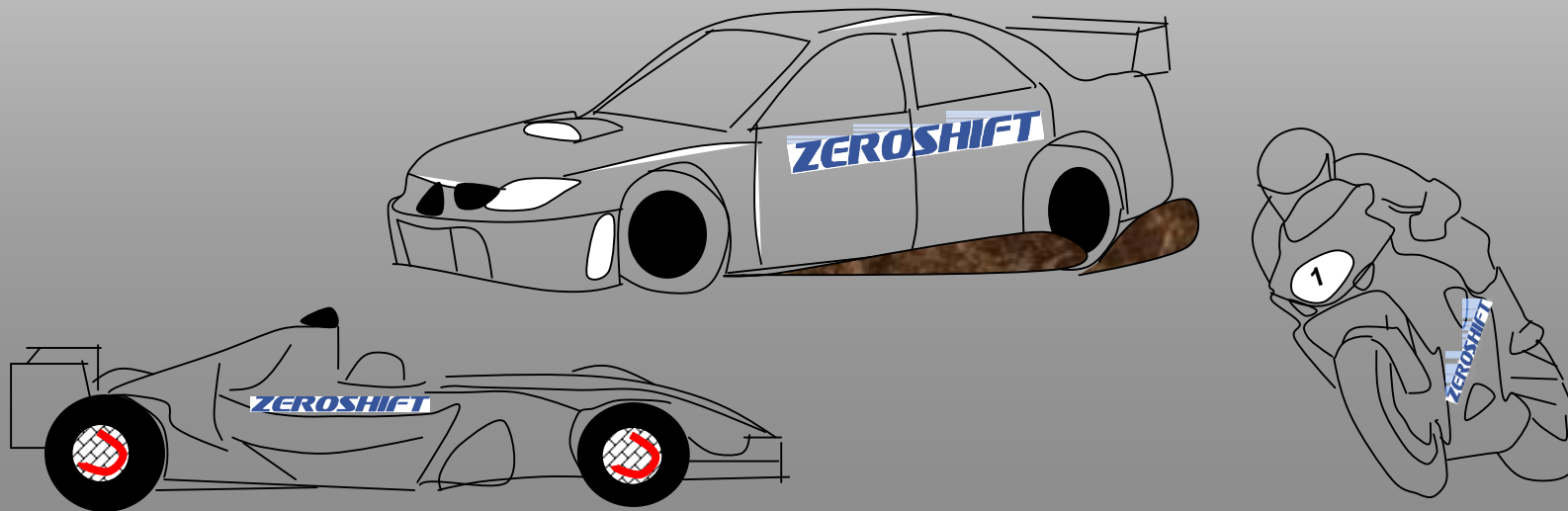
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BENEFITS

- Performance and acceleration
- Shift quality
- Fuel economy/Improved range
- Vehicle dynamics — Change gear where your competitors daren't



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QUESTIONS

- Questions ?

www.zeroshift.com

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