



WHERE INSPIRATION AND INNOVATION COMBINE

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CHASSIS DEMANDS OF THE MODERN CONSUMER

Matthew Taylor - Principal Engineer Vehicle Dynamics

CHASSIS DEMANDS OF THE MODERN CONSUMER

- Vehicle dynamics is not black art, it is physics
 - proper control of force generation (tyres)
 - proper understanding of mass (design)
 - proper understanding of targets
- Targets are changing in the current market place

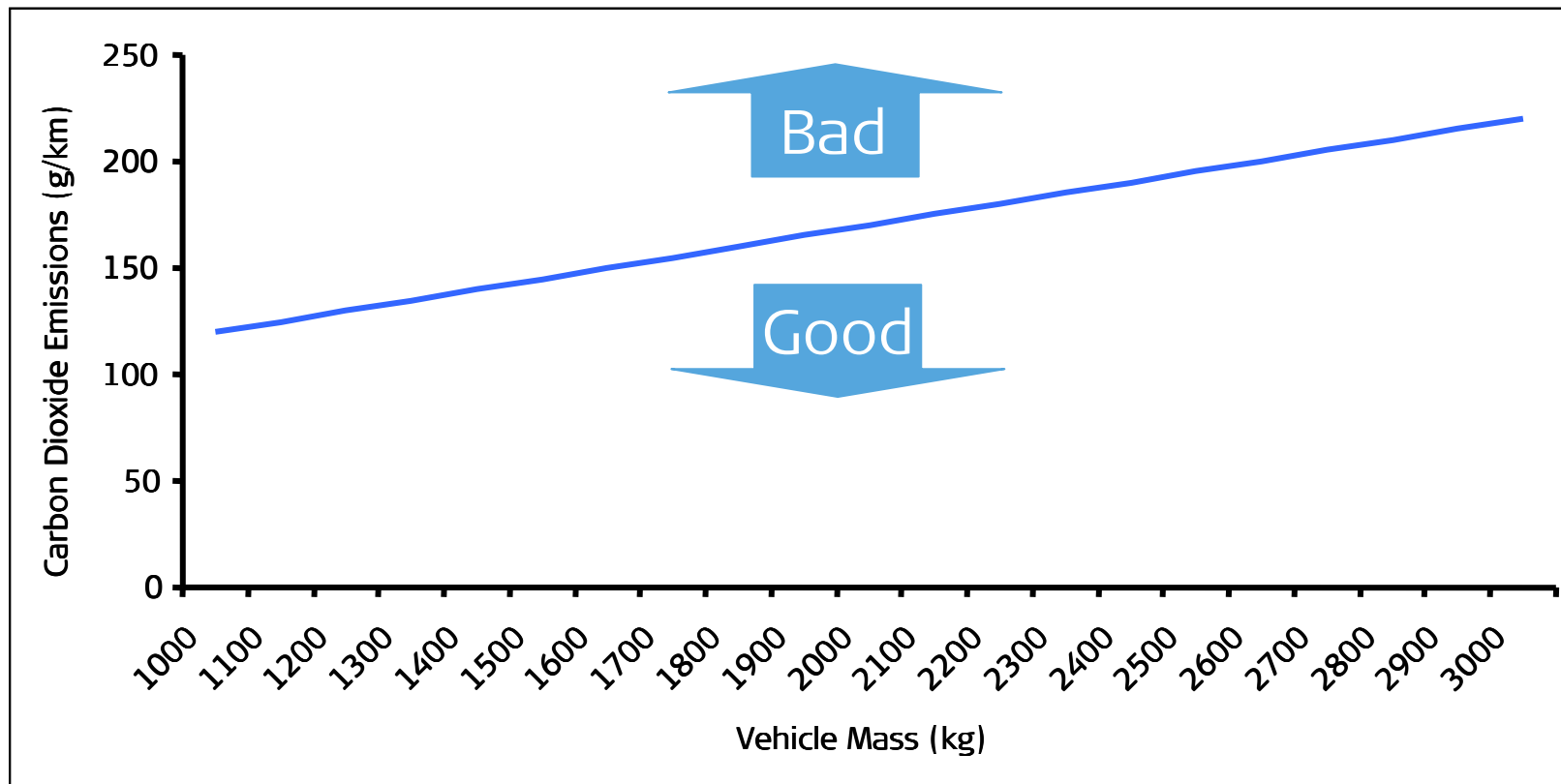


TARGETS

- What are the implications of current fashion on targets?
- What is the real 'performance' that consumers want?
 - Brand identification
 - Daily enjoyment and pleasure of ownership
 - Low cost running
- What is the real 'performance' that manufacturers want?
 - low emissions
 - low cost brand separation
 - exploitable margins

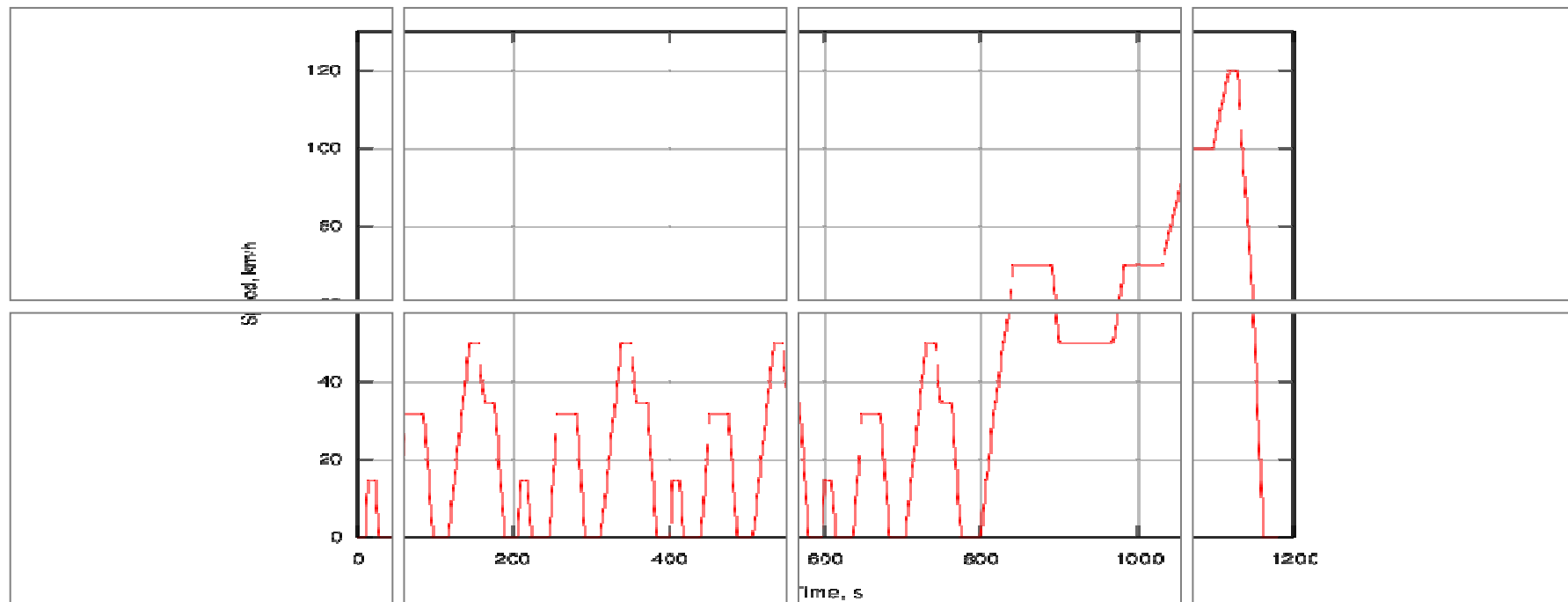
UNDERSTANDING THE TARGET – THE GOVERNMENT

- Government has draft legislation to control carbon dioxide emissions
- The charge is based on payment per vehicle over fleet average
 - A premium of €20 per vehicle per g/km has been proposed for 2012



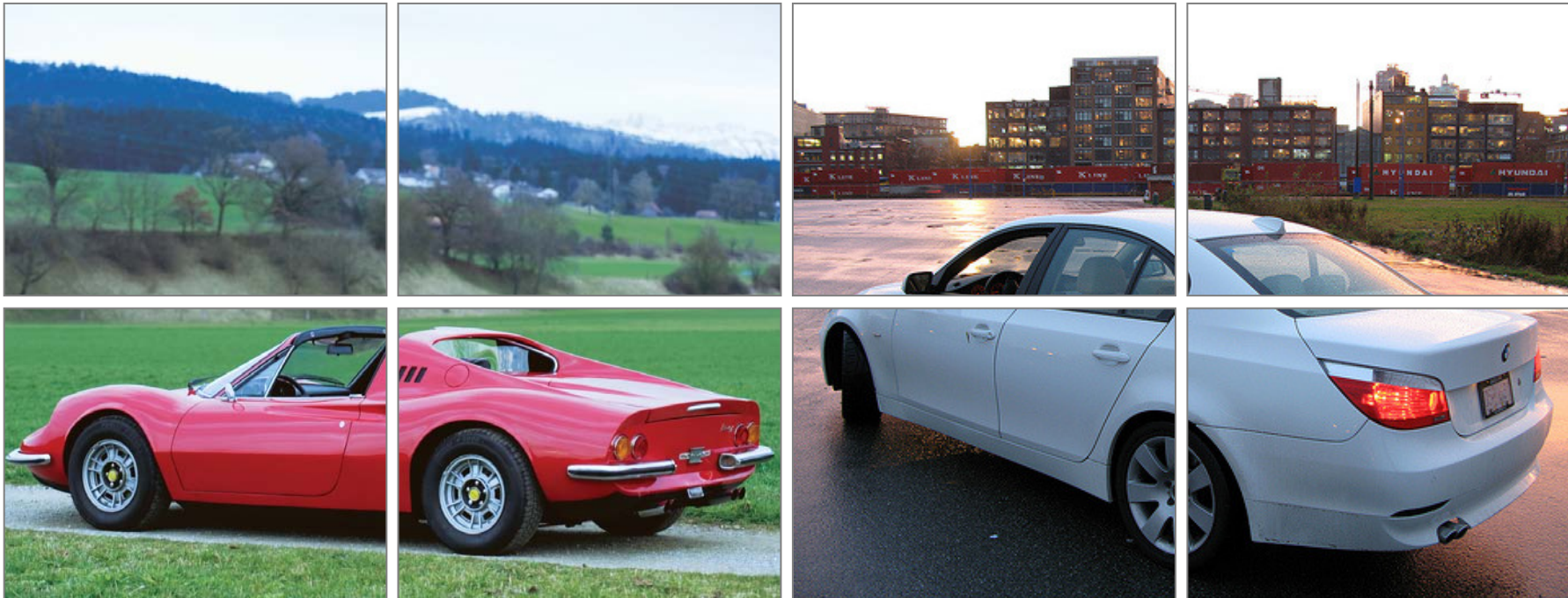
UNDERSTANDING THE TARGET – THE GOVERNMENT

- Engine engineers' primary focus is clear
- Chassis engineers' challenge is less obvious
 - mass benefits are skewed by tier system
- Chassis requirements are to focus the efforts on saleable attributes
 - reduced rolling resistance
 - improved contribution of installed devices



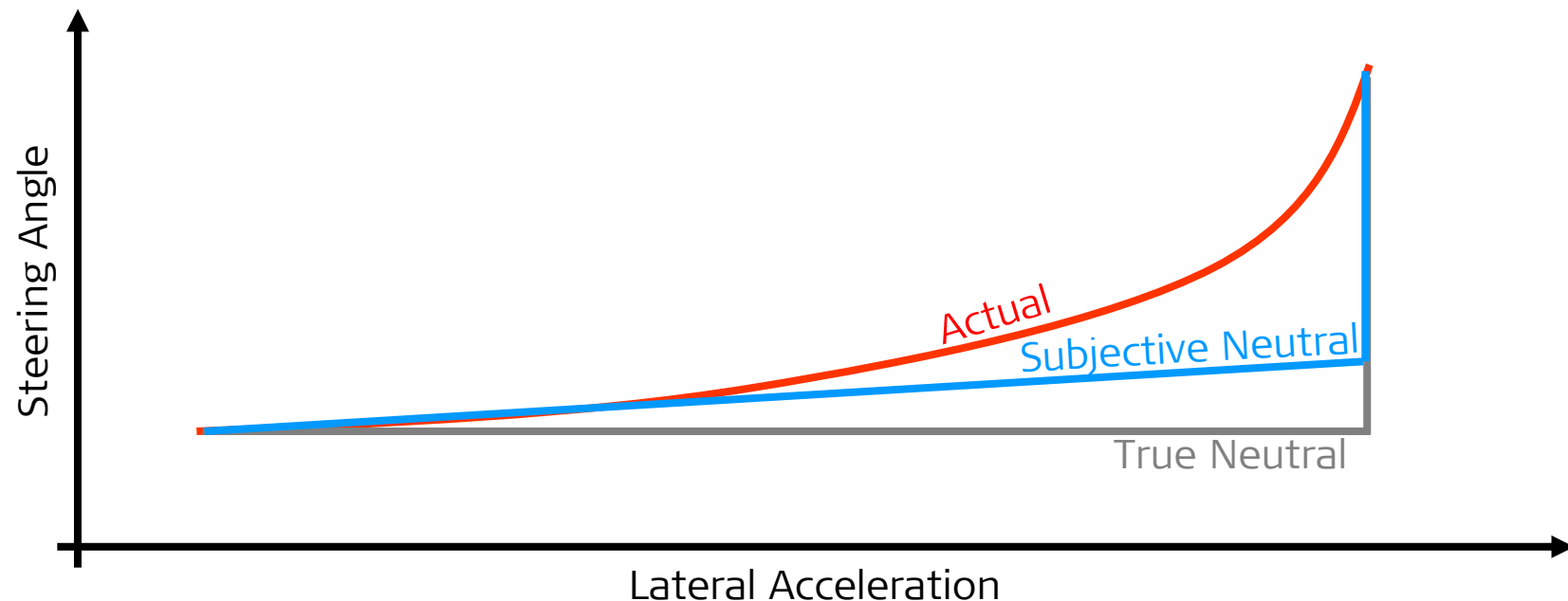
UNDERSTANDING THE TARGET - CONSUMERS

- Unending improvement in vehicles over the last century
- Broadly consistent driver capability in the same period
- 2007 BMW 530i outperforms 1972 Ferrari Dino in arguably every way
 - which car do most people consider to be the sports car?
 - why?



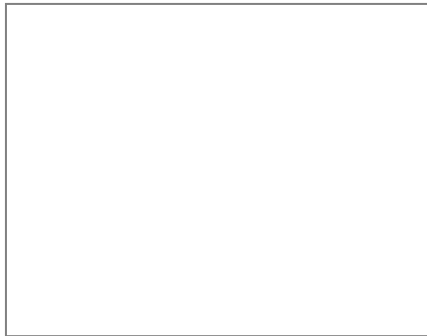
UNDERSTANDING THE TARGET - CONSUMERS

- Perception is more influential to the driver than reality
 - focus should be on bringing driver experience at 'usable' levels
 - genuine improvements to a vehicle are expensive and of limited reward
- 'Linear' map based on behaviour of the car at low demand and extrapolated
 - Fixed radius, increasing speed understeer gradient



THE CONTRIBUTION OF 'REAL' PERFORMANCE

- Brand support and placement (M5, S6, S-TypeR ...)
 - Performance figures are important to show what a brand can achieve
 - Brand can sell product but cannot support itself
 - High margin but low volume
 - Not a new concept



THE BENEFIT OF PERCEIVED PERFORMANCE

- Strong brand benefits all range but there are further opportunities for the image conscious customer
 - ‘Sport’ sector of market is strong and complementary to performance sector
 - customers look for ‘personality’ and ‘feel’ in pursuit of ‘sportiness’
 - ‘Sport’ models deliver important attributes with much smaller engineering costs



MEETING THE MANUFACTURERS' NEEDS - COST

- Focus arguably introduced strong change to C-class market in the late 1990s
 - established itself as C-class hatch dynamics benchmark
 - effect on market position was considerable
- Competitors have migrated to similar suspension investment
 - cost is excessive for sector volume (600,000 units p.a. for Focus) and margin



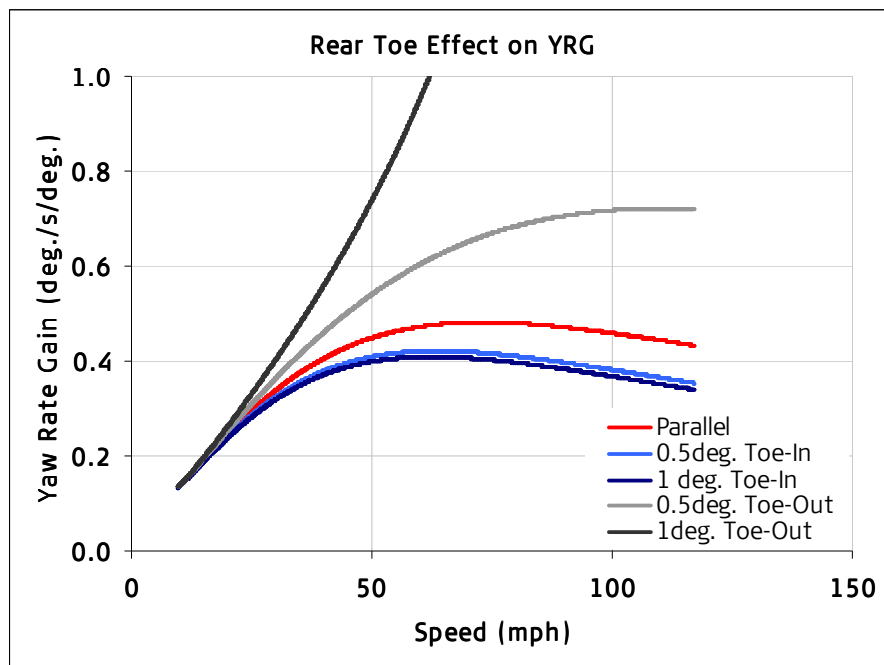
MEETING THE MANUFACTURERS' NEEDS - COST

- Approximate on-cost of €120 per vehicle
- Equivalent to 6g/km (5%) over 'legislation'
- Similar contribution to significant engine technology investment
- Weight reduction adds additional contribution



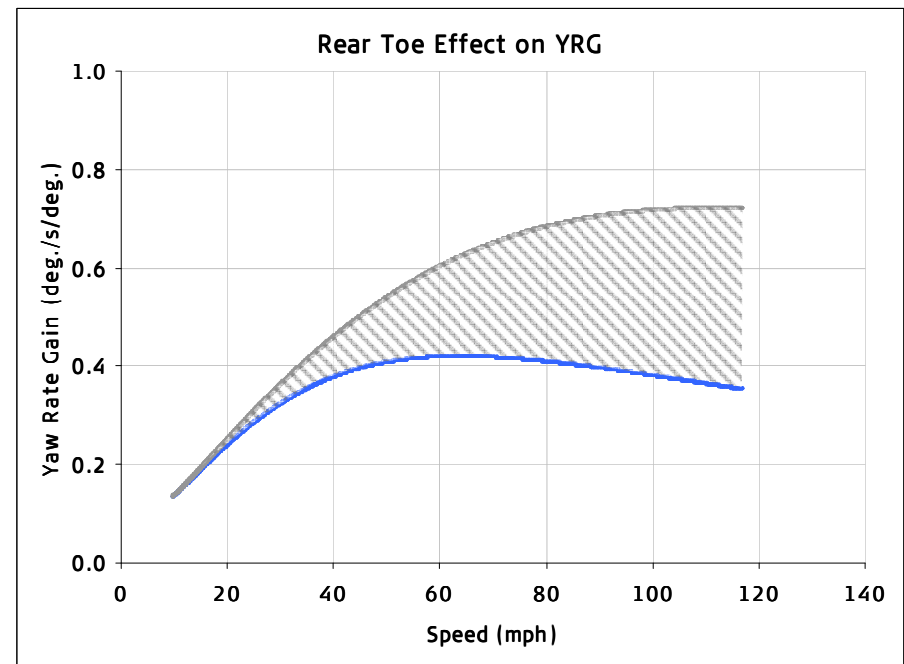
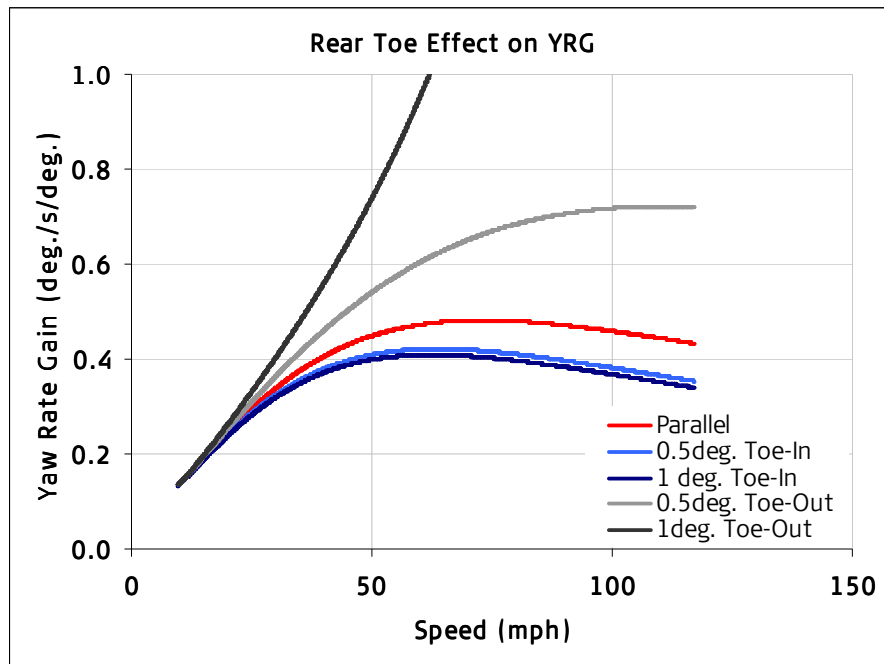
A MODERN PHILOSOPHY - E.G. ACTIVE TOE

- Low cost, low bandwidth application addresses several targets
 - cost benefit
 - perceptible performance change
 - reduced rolling resistance – real world and drive cycle
- Modification of fundamental vehicle characteristic



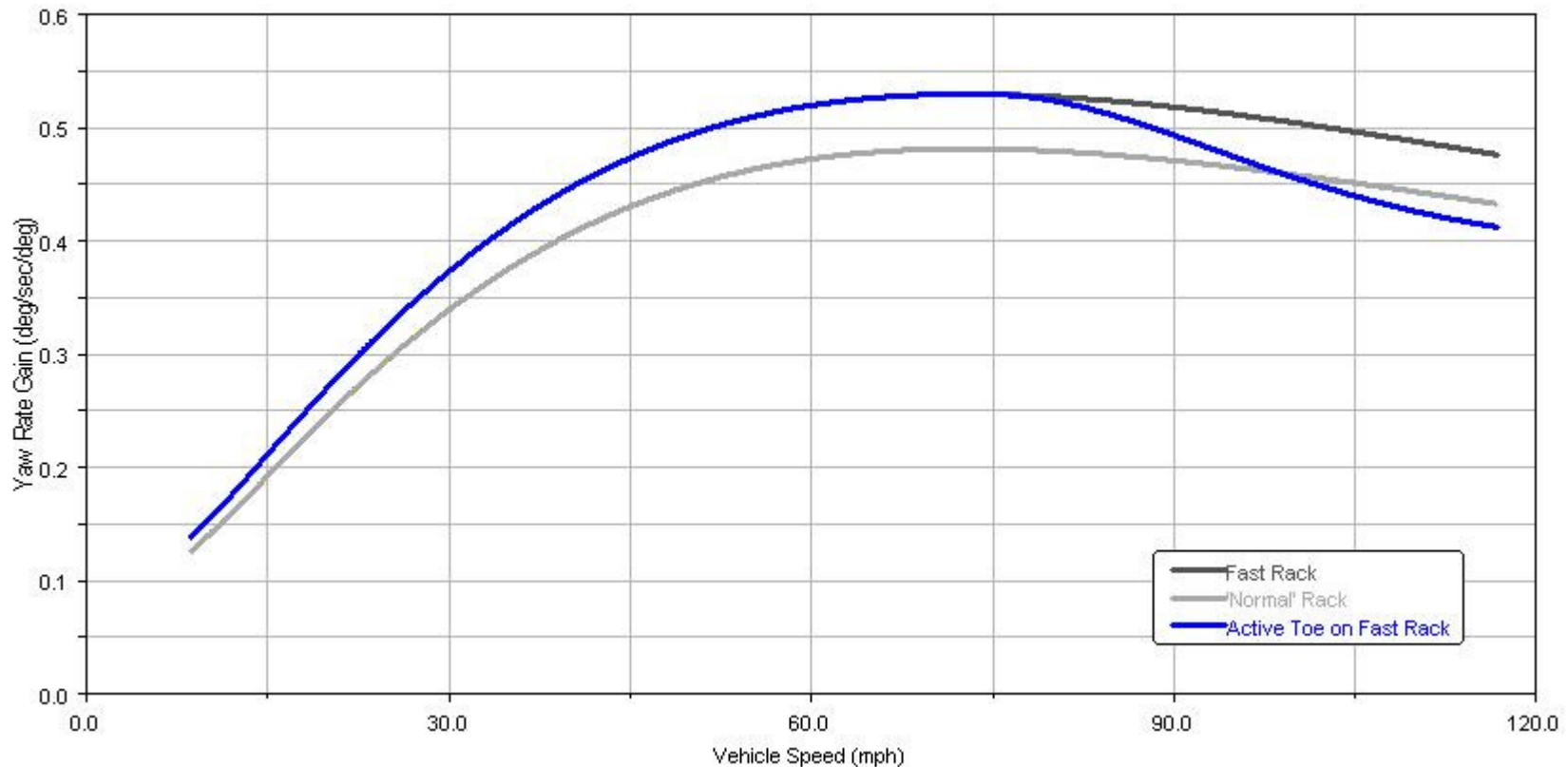
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A MODERN PHILOSOPHY - E.G. ACTIVE TOE

- In practice (simulation) basic strategies produce convincing results
 - vehicle benefits from 'fast rack' at low speed
 - characteristic returns to 'normal' at higher speeds



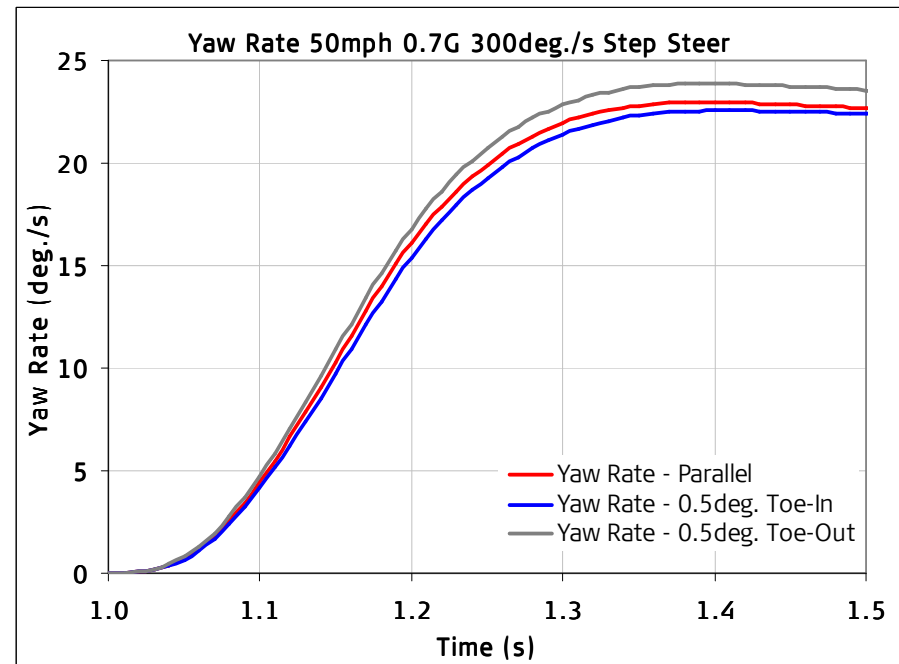
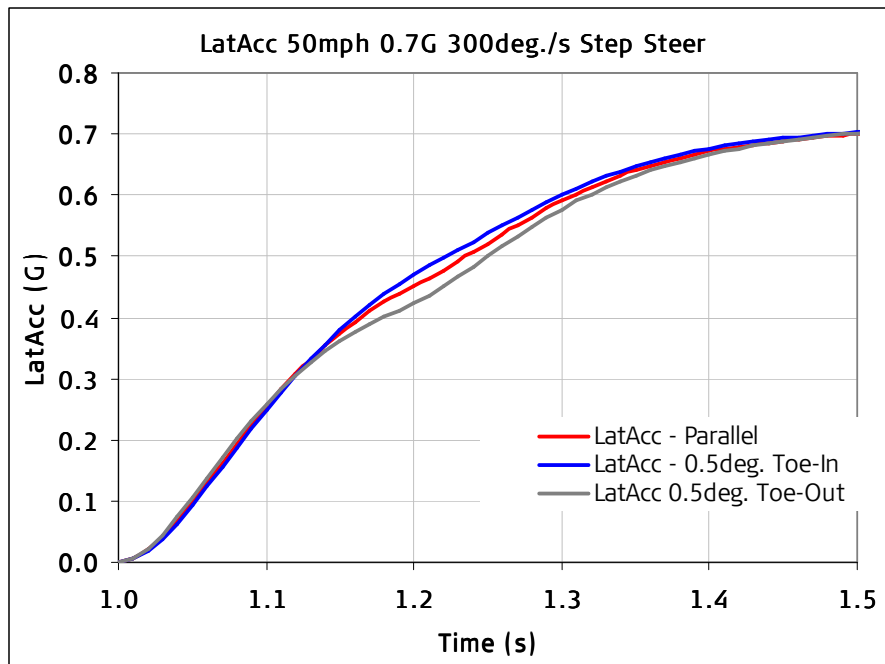
A MODERN PHILOSOPHY - E.G. ACTIVE TOE

- Often customer interpretation and preferences vary
 - many customers interpret yaw lead as agile
 - many customers interpret tight yaw / lat acc phasing as accurate
- Clear difference between customer preference of turn-in character
 - Renault Clio – strong yaw lead
 - BMW 3 Series – tight yaw / latacc phasing



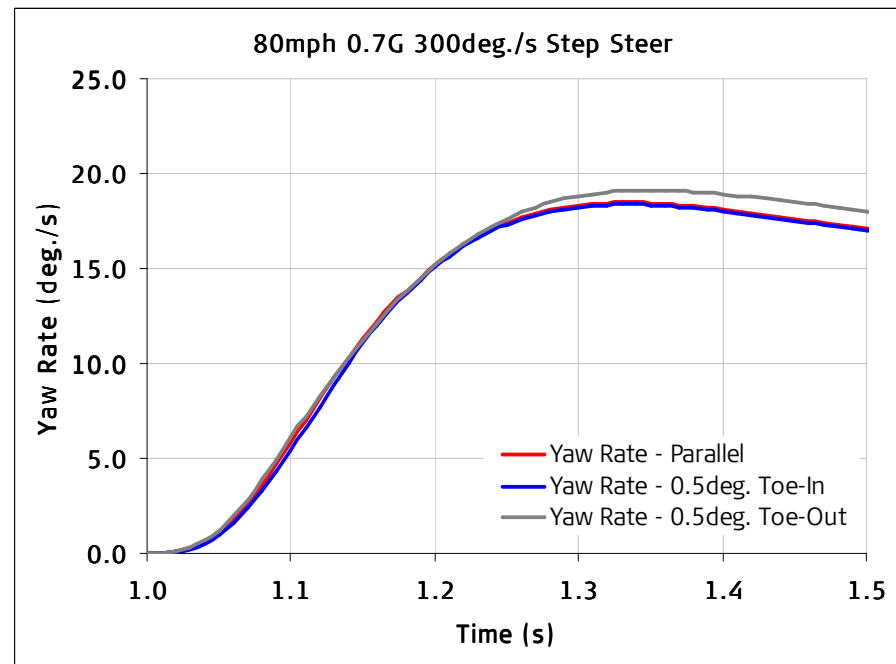
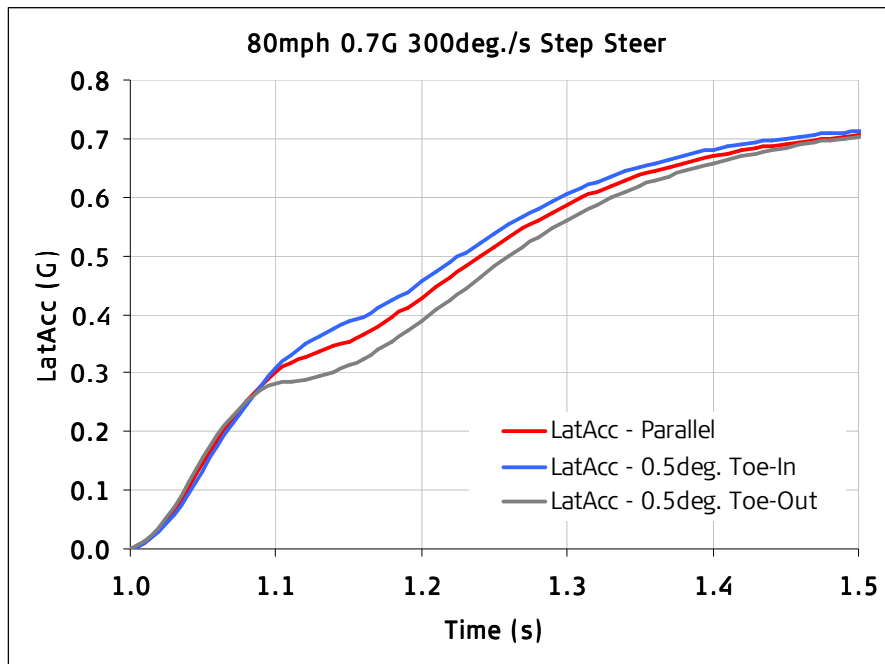
A MODERN PHILOSOPHY - E.G. ACTIVE TOE

- Rear toe has a strong influence on phasing between yaw and latacc
 - at lower speeds, toe-out increases yaw acceleration and reduces latacc rate
- Different phase relationships at lower speeds offers brand differentiation
 - improved volumes
 - for Brand-by-Wire™



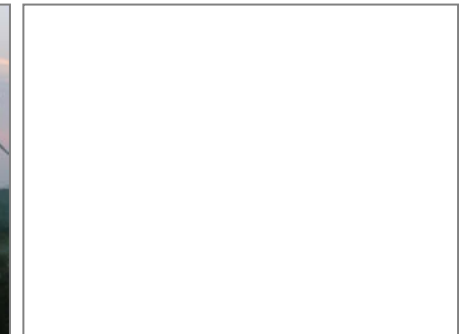
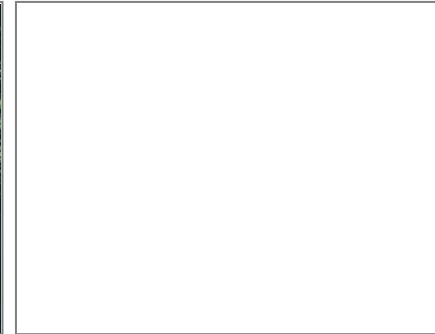
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- Different phase relationships at lower speeds offers brand differentiation
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 - for Brand-by-Wire™
- At higher speeds yaw lead promotes feel of instability



A MODERN PHILOSOPHY

- Exploit opportunity to address more than one need
- Active toe concept for example
 - better brand separation for OEM
 - better brand identification for consumer
 - cost reduction compared to elaborate rear suspensions
 - potential for reduced rolling friction



CHASSIS DEMANDS OF THE MODERN CONSUMER

- Vehicles are dynamically more capable than consumers require
 - consumers are looking for characteristics with which they can identify
 - consumers enjoy characteristics they can personally experience
- Expected legislative pressure must dominate the OEM requirements
 - expenditure is focussed on emissions control
- Cars are in a curious position within the public arena
 - essential, desirable
 - 'evil'
- The chassis demands are addressing such complex targets



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