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Brake Specific Fuel Consumption (BSFC) in Gasoline Powered Cars

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Brake Specific Fuel Consumption in Gasoline Powered Cars

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Abstract

In this experiment, I measured the effects of Brake Specific Fuel Consumption on fuel efficiency. My research investigates the question of how to maximize fuel economy. We used a method of collecting driving data using the ScanGaugell, a commercially available device that plugs into a car's onboard computer (OBD). I wrote a Java program that uses the data to perform calculations for BSFC and fuel efficiency. I determined that fuel efficiency does not depend on the distance travelled, but rather the engine speed (RPM) and load of the engine (torque). My research also found that it is more efficient to accelerate at a moderate rate for the best fuel economy.

Program

- Contains data in arrays
- Takes user input for
 - Initial speed
 - Final speed
 - Acceleration type (slow, moderate, quick)
- All data is indexed relative to speed
- Finite Sum Approximation to definite time integrals using *WHILE* loops

```
deltaV = (((rpm*torque) - (Wc*Tc))*deltaT)/(1060045*(currentV *  
.000277778))) *1.404;  
dist = dist + ((currentV * .000277778) * deltaT;  
deltaMass = ((bsfc/360000) * torque * rpm * dist) / currentV;  
massUsed = massUsed + deltaMass;  
currentV = currentV + deltaV;
```

Future Expansion

- Currently only have data for one vehicle
- Implementation of database
 - Would allow for multiple data sets
 - Expand program capabilities
 - Quicker queries
- More cohesive data
- Accelerate & Coast vs. cruise control?

Background Information

- Brake Specific Fuel Consumption (BSFC) is fuel consumption per unit power
- BSFC does not actually refer to car brakes
- Lower BSFC corresponds to a higher fuel efficiency
- It is tough to stay in the low BSFC zones
- How will we maximize the amount of driving time spent within the low BSFC zones?
- Is it more efficient to accelerate slowly, moderately, or quickly?

Methods

- Record data for engine speed (RPM), engine load, vehicle speed, and fuel efficiency [3]
- Write Java program to calculate definite time integrals to approximate distance travelled, mass of fuel consumed, volume of fuel consumed, and change in velocity [4]

$$\Delta v = \frac{(\omega * \tau) - (\omega_{cruise} * \tau_{cruise}) \Delta t}{m_{vehicle} * v_{current}}$$

$$m = \int \frac{BSFC * \tau * \omega}{v} dx$$

- Fuel efficiency does *not* depend on distance travelled

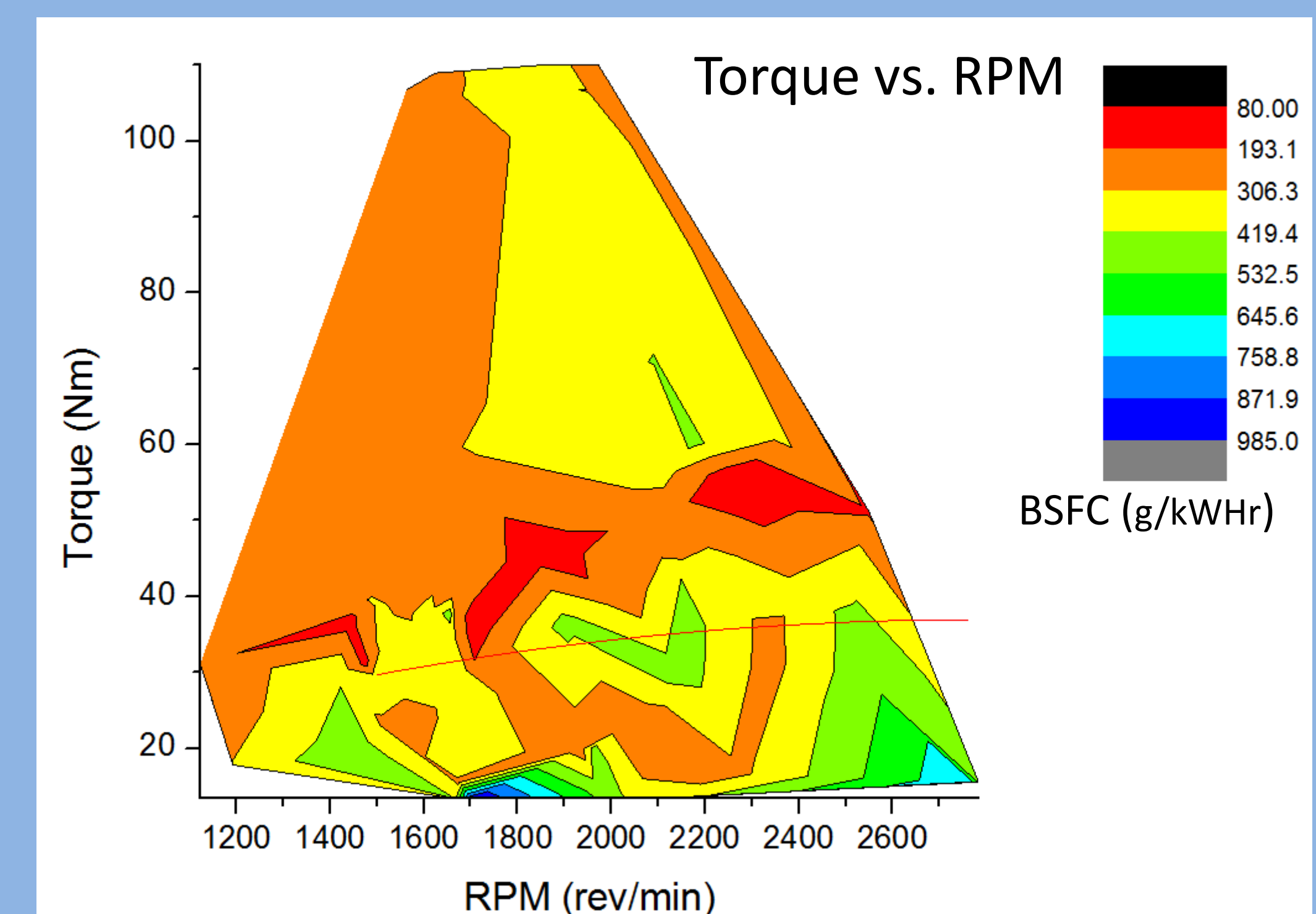


Figure 1. BSFC contour map. The red line represents the cruising speed curve. [1]

- Red zones represent low BSFC
- Low BSFC values correspond to high fuel efficiency [2]
- Want to spend as much driving time as possible in the red zones
- Red curve is constant speed line
- Cruising line doesn't stay in the low BSFC zones
- Can conclude that setting cruise control is not most efficient

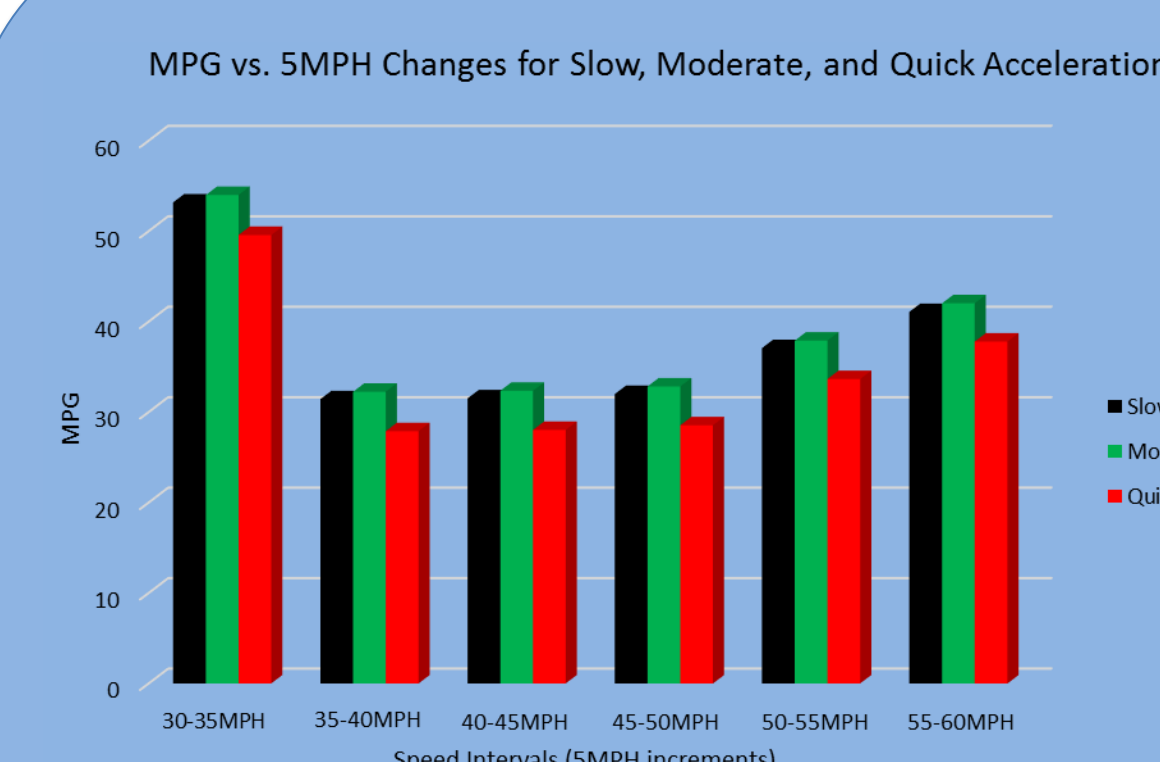


Figure 2. Visual representation of MPG for different acceleration styles.

- Moderate acceleration gives best overall miles per gallon

- MPG computed for different accelerations over a constant distance
- Visual for the optimization of MPG

Conclusions

- Fuel efficiency does not depend on distance travelled
- Accelerating at a moderate rate yields the best miles per gallon
- More efficient to drive at low speed with high throttle
- More efficient to keep engine speed nearest the best BSFC rpm and torque

References

- [1] "Understanding BSFC Maps." Online Posting. 23 April 2014. Engineering Forums. 15 June 2016. <<http://www.eng-tips.com/viewthread.cfm?qid=363722>>.
- [2] "Fuel Economy in Automobiles." *World Heritage Encyclopedia*. 22 June 2016. <http://www.ebooklibrary.org/articles/eng/Fuel_economy_in_automobiles>.
- [3] Gladwin, Ross. "VW TDI_1.9L_ALH_BSFC Map". Email to Ross Gladwin. 29 June 2016.
- [4] *Used 2013 Chevrolet Spark Features & Specs*. Edmunds. 5 January 2017. <www.Edmunds.com/Chevrolet/spark/2013/features-specs>.