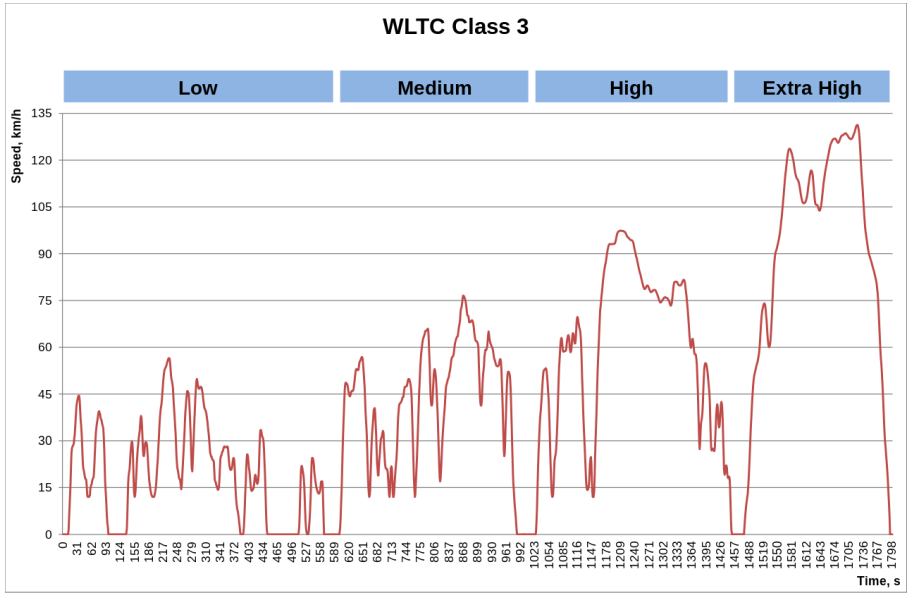
Virtual Internship Batch 1

Engine Performance & Emissions

Drive Cycle Behavior

- Drive cycles demand velocity changes
- Velocity changes requires acceleration and deceleration
- Acceleration and deceleration needs torque
- Higher torque equals higher pressures inside cylinder
- Higher pressures usually accompanied by higher emissions
- Higher pressures achieved by calibration properties
  - Optimum spark advances
  - Richer air fuel mixture



Drive Cycle Modelling

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Engine Control Strategy

Air

Fuel @ const AFR

Chem Energy

Higher Pressures

More Torque

Engine Control Strategy

- Throttle request is translated into “Torque Request”
- Engine now has to supply the requested torque
- If user is not happy with acceleration, he presses more on the throttle pedal and requests for more torque
- EMS in charge of satisfying torque request
- Torque Request satisfied by
  - Changing Calibration Parameters
  - Changing Operating Parameters (in turn calibration)

Engine Control Strategy

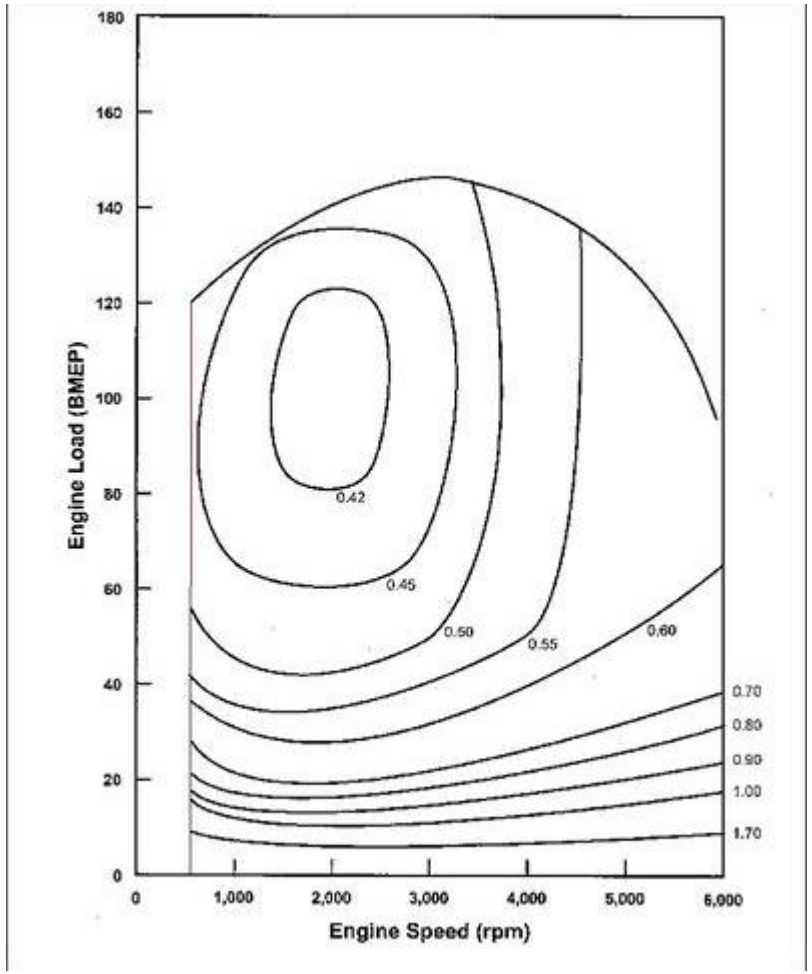
- An engine at the same RPM and throttle can produce varying amounts of torque. True or False?
- What happens when the engine produces varying amount of torque?
- Emissions vary!
- Emissions vary as a function of amount of torque and RPM at which torque is expected
- This is the basis for Torque Based Calibration

Torque Based Control Strategy

1. Based on throttle input, torque request is generated, sent to ECU
2. Torque Demand has to be supplied by the engine, The ECU has to make sure of this
3. ECU ensures torque delivery by changing calibration parameters
4. Calibration parameters chosen based on look up tables
5. Look up tables populated by Calibration Engineer
6. What is the logic followed?

Torque Based Control Strategy

1. Plot efficiency islands
2. Contour Plot generation
3. Similar plots can be had for Torque vs RPM with NOX, BMEP, HC, CO plots
4. For every nm torque delivered there is an associated HC, CO, NOX emission



Torque Based Control Strategy

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Model Based Development

1. Generate / collect data
2. Figure out what is the maximum torque you can generate for each RPM
3. Calculate the amount of emissions – Engine out emissions
4. Based on tail out emissions, decide % of emissions reduction
5. Select / Design emissions control devices based on this

Activity

Activity 1

- Select a vehicle of your choice, it can be a two / three or four wheeler
- Figure out what the classification of your vehicle is
- Find out the relevant drive cycle for your target vehicle
- Find out the emissions performance of the vehicle (if possible)

Torque and Emissions

Reference Books

- Internal Combustion Engine Fundamentals – John Heywood