

1999 GT-Suite Users Conference

Mean-Value Cylinder Model

MEAN VALUE CYLINDER

- Fast-executing cylinder representation
- Replaces detailed cylinder in GT-Power model
- Allows GT-Power to be shared by design engineers (detailed cylinder) and control system engineers (mean value cylinder)
- Air system can be further simplified for speed increase

VOLUMETRIC EFFICIENCY

- Volumetric efficiency map
 - Nominal map is a function of speed and pressure ratio across engine
 - May also include default pressure ratio correction per Heywood
 - Map may be extended to be a function of any sensed GT-Power quantity
 - Maps can be populated either by detailed
 GT-Power results or experimental results

FUEL ENERGY DISTRIBUTION

- Fuel energy distribution maps
 - Fuel energy to crankshaft torque
 - Fuel energy to exhaust energy
 - Nominal maps are functions of speed and air/fuel ratio or intake pressure
 - Maps may be extended to be functions of any sensed GT-Power quantity

CYLINDER PRESSURE



- Cyclic pressure variation is normally not produced by mean-value models MVM
- In GT-Power MVM, crank angle-varying pressure is (optionally) calculated through use of idealized P-V relation:
 - User controls peak pressure and shape of pressure curve after TDC to match detailed P-V curve
 - Iterative process ensures that IMEP matches the value obtained from the fuel energy map

TORQUE PRODUCTION



- EngCylMeanV connects to the cranktrain in same way as detailed cylinders
- If cylinder pressure is calculated, phasing between cylinders (and cylinder-to-cylinder changes) are accounted for and torque is calculated from the pressure
- If cylinder pressure is not calculated, cranktrain calculates only mean brake torque

INCREASED CALC. SPEED



- EngCylMeanV may be substituted directly for a detailed cylinder part - moderate change in run time
- Intake and exhaust piping may be simplified to a lumped-volume system with filling-andemptying - substantial change in run time
- Multiple cylinders can be represented by one EngCylMeanV part - further run speed up



MEAN VALUE CYLINDER EXAMPLE

- Convert detailed model of turbocharged 6cylinder diesel engine to mean value model
- Different levels of detail possible for different analysis needs

1: DETAILED MODEL

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4: CYLINDERS COMBINED

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CLOSURE



- Offers suitable level of detail for control system development efforts
- True sharing of models between development engineers and control engineers