Universidade Federal de Santa Catarina

Campus Joinville

Simulação numérica de MCI usando AVL-BOOST

UNIDADE 3 – PROGRAMAS PARA SIMULAÇÃO DE MCI

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Engenharia Automotiva

CTJ - Centro Tecnológico de Joinville

Ementa

- ✓ Introdução
- ✓ Conceitos fundamentais em motores de combustão interna
- ✓ Programas para simulação de MCI
- ✓ Modelagem de MCI usando AVL-BOOST
- ✓ Simulações numéricas usando AVL-BOOST

Conteúdo programático

UNIDADE 3 – Programas para simulação de MCI

3.1 – Programas disponíveis na literatura.

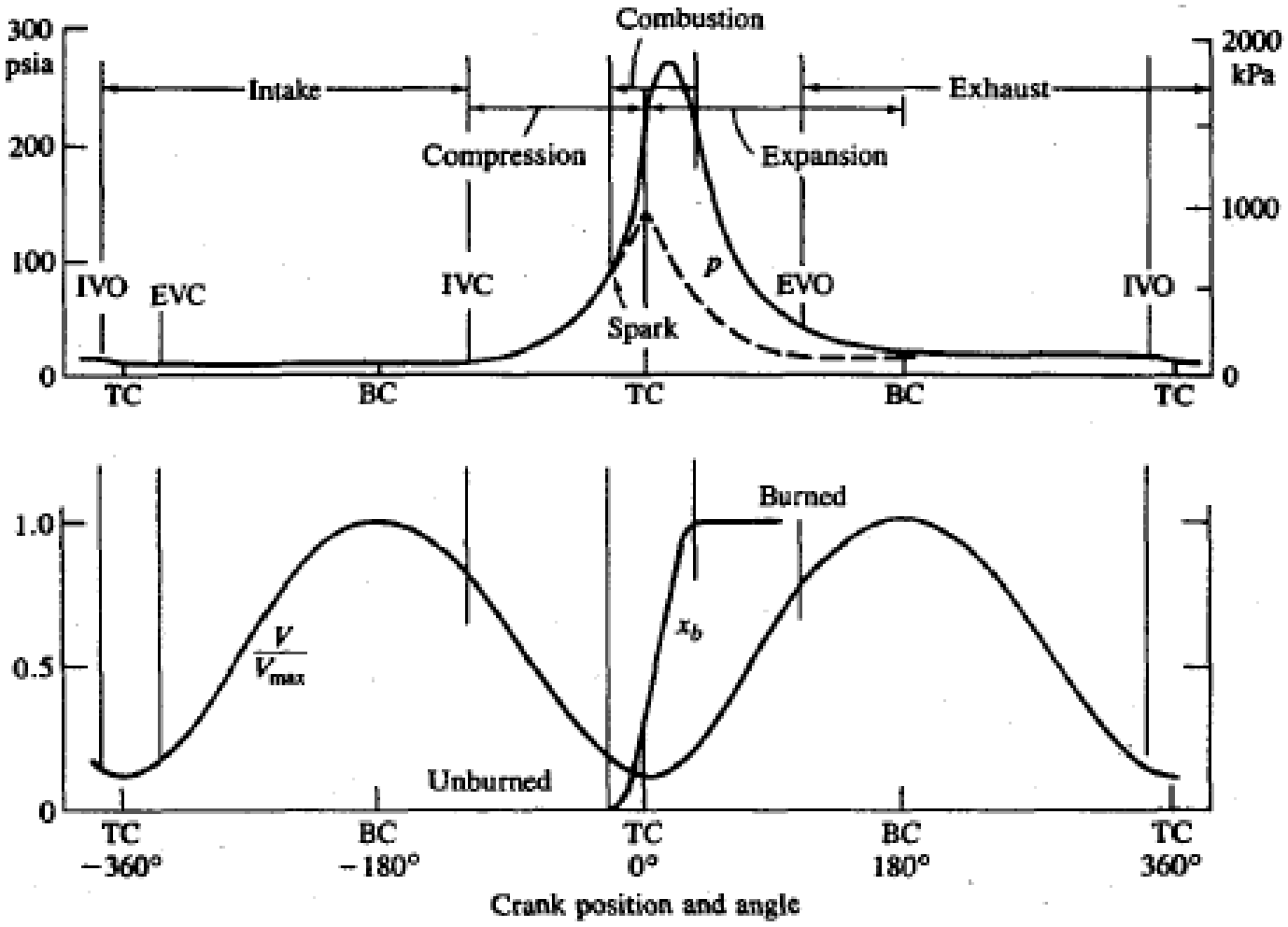
3.2 – O Programa AVL

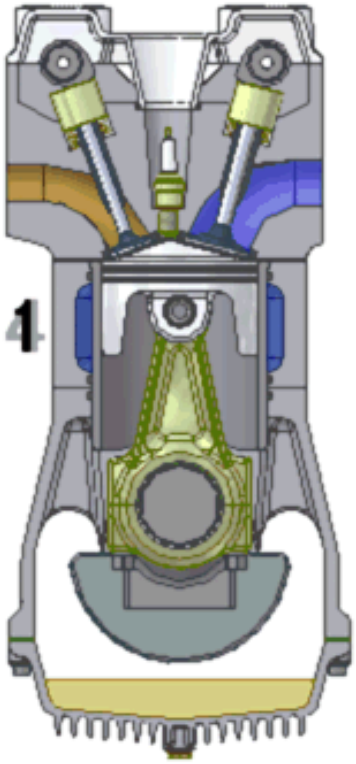
3.3 – AVL-BOOST

Programas para simulação de MCI

- ✓ Siemens PLM Software
- ✓ ANSYS-FORTE
- ✓ ANSYS-FLUENT
- ✓ ANSYS-CHEMKIN
- ✓ GT-Power-Suite
- ✓ CONVERGE-CFD
- ✓ DIESEL-RK
- ✓ ....
- ✓ ....
- ✓ ....
- ✓ ....
- ✓ AVL-Software

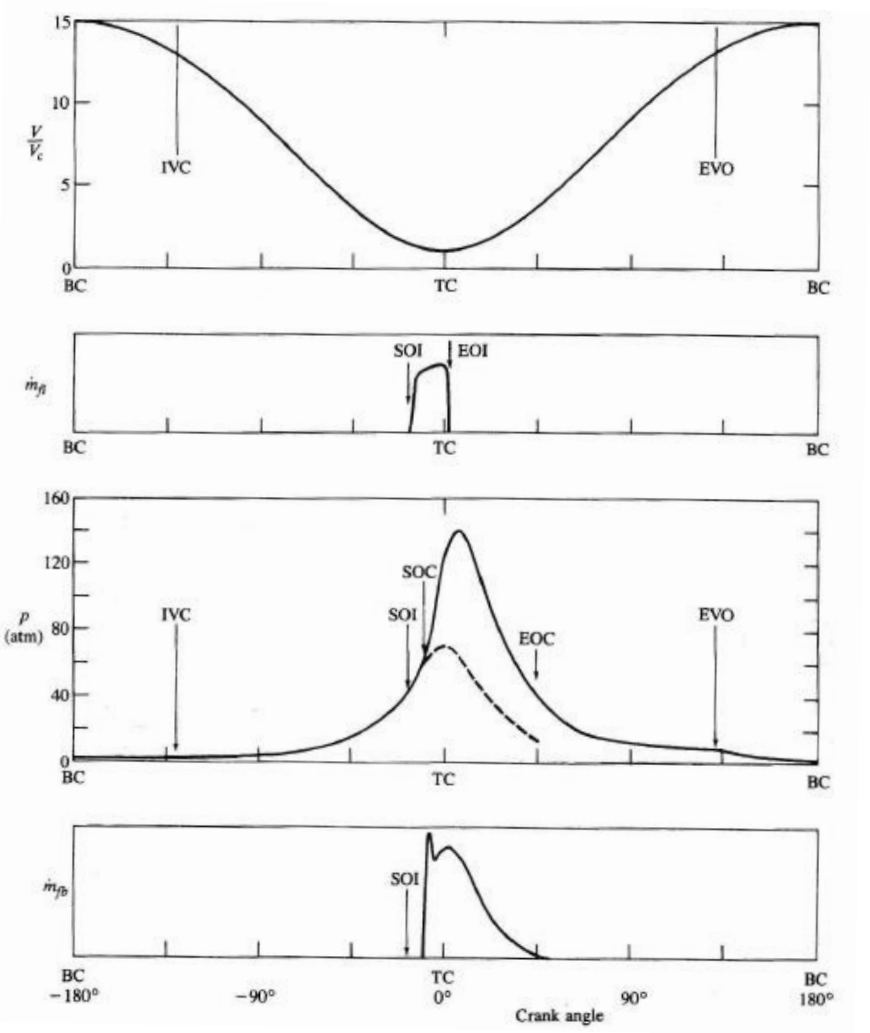
Programas para simulação de MCI

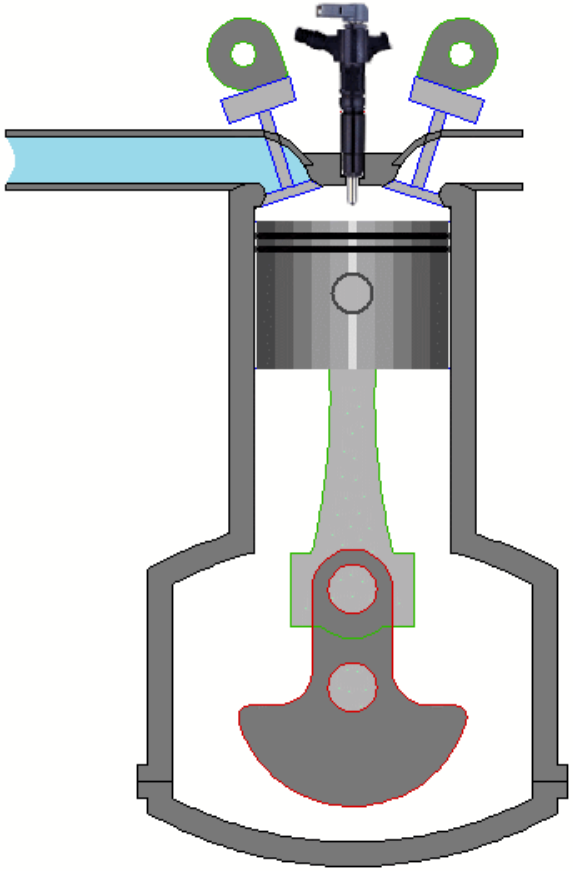




- ✓ AVL-Software

Programas para simulação de MCI





✓ AVL-Software

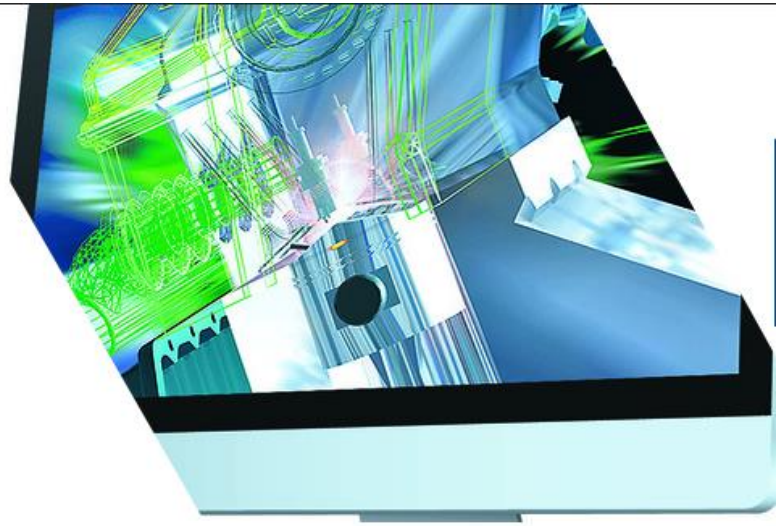
O Programa AVL

https://www.avl.com/simulation-tools1

- Simulation Technologies
  - Simulation Solutions
  - Simulation Tools
    - AVL BOOST™
    - AVL CRUISE™
    - AVL CRUISE™ M
    - AVL EXCITE™
    - AVL FIRE™
    - AVL FIRE™ M
    - AVL TABKIN™
    - FIFTY2 PreonLab
  - Customer Services
  - News and Highlights

A Kaleidoscope of Simulation Possibilities

Simulation Tools



The challenge of reducing time and costs along the product development cycle has created a growing demand to replace physical prototypes with virtual prototypes using frontloading. The vast range of variables in modern powertrain systems and the increasingly considered interaction of all vehicle components are to be mastered in the most efficient manner. Engineers are facing a great number of challenging development and simulation tasks which necessitate more than just 'good software'.

O Programa AVL

https://www.avl.com/simulation-tools1

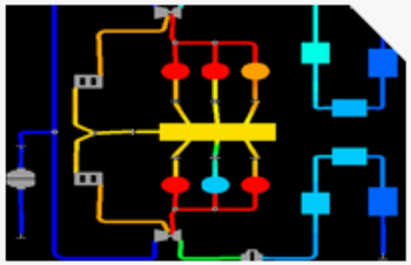
Your Choice if Quality Matters

AVL BOOST™

Virtual Engine Development

AVL BOOST™ is a fully integrated IC engine simulation software. It delivers advanced models enabling accurate prediction of engine performance, tailpipe emissions and acoustics.

Read More



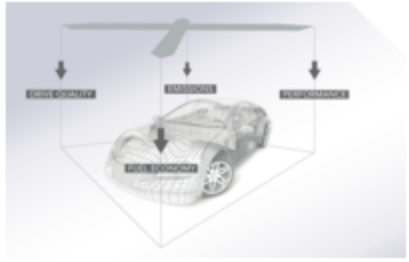
Balance Performance, Fuel Economy and Emissions

AVL CRUISE™

Vehicle Driveline Simulation

AVL CRUISE™ is the industry's most powerful, robust and adaptable simulation tool for vehicle driveline system analysis and optimization. The application field covers fuel efficiency, driving emissions and performance analyses along the vehicle development process with model re-use from concept design through to HiL and testing.

Read More



O Programa AVL

https://www.avl.com/simulation-tools1

SIMULATE ANYWHERE.

AVL CRUISE™ M

Multi-Disciplinary System Simulation

AVL CRUISE™ M is a realtime, multi-disciplinary, vehicle system simulation software used in office environments for the design of powertrains and thermal management systems, in HiL environments for control function development and calibration, and in testbed environments to provide simulation models for component testing.

Read More

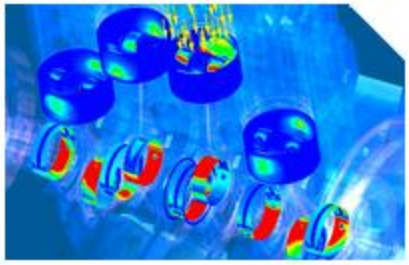
Streamline your Structure Dynamics Simulation

AVL EXCITE™

Multi-Body Dynamics Simulation Software

AVL EXCITE™ is a software for the simulation of rigid and flexible multi-body dynamics of powertrains. It is a specialized tool that calculates the dynamics, strength, vibration and acoustics of combustion engines, transmissions and conventional or electrified powertrains.

Read More



O Programa AVL

https://www.avl.com/simulation-tools1

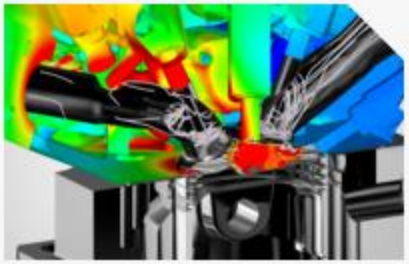
The Leader in Engine CFD

AVL FIRE™

Thermo-Fluid Simulation Software

AVL FIRE™ is the leading CFD simulation tool in the field of combustion analysis. It specializes in the accurate prediction of all IC Engine relevant processes including injection nozzle flow, fuel injection, combustion, emission and exhaust gas aftertreatment. The software also supports the development of electrified powertrains and drivelines.

Read More



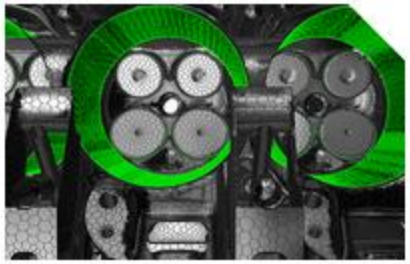
Simulation Challenging Reality

AVL FIRE™ M

CFD Simulation in a Multi-Domain Environment

AVL FIRE™ M is a multi-domain simulation software simultaneously solving non-reacting, single phase fluid flows, heat transfer and solid temperatures in systems without moving boundaries.

Read More



O Programa AVL

https://www.avl.com/simulation-tools1

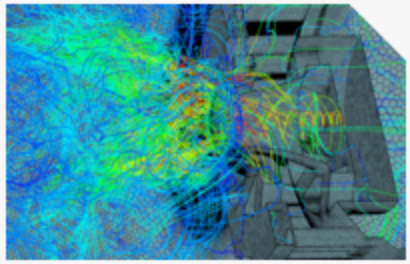
Turbocharge your Combustion CFD

AVL TABKIN™

Chemistry Tabulation

AVL TABKIN™ is a powerful combustion module enhancing CFD simulation results whilst shortening turn-around time. Chemistry tabulation is the most cost-effective way to include detailed chemistry in CFD simulations. AVL TABKIN™ embodies more than a decade of experience with chemistry tabulation for combustion applications.

Read More

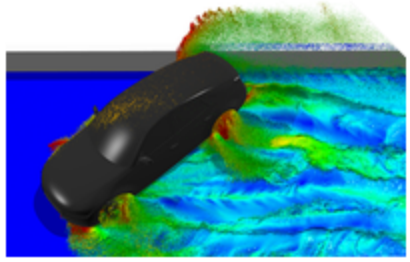


FIFTY2 PreonLab

Meshless Fluid Simulation Software

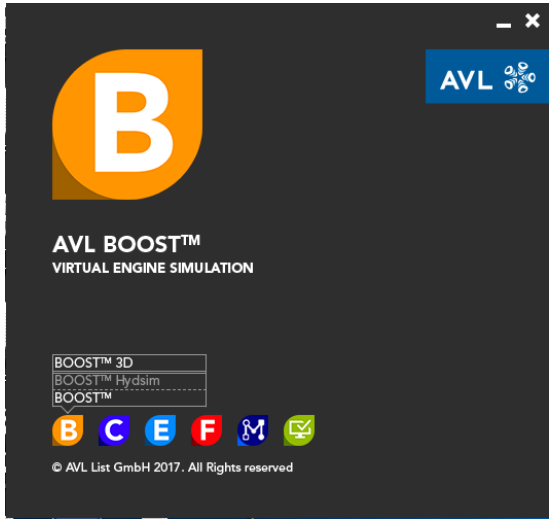
PreonLab is the disruptive innovation for CFD simulation. It focuses on simulating free-surface flow in highly dynamic simulation setups with minimal preprocessing effort. No meshing is required for even complex objects and kinematics. The software enables to accurately predict flow paths of water or oil helping to improve the design of components and integration into the whole vehicle. With PreonLab it is possible to create impressive animations of the simulation results.

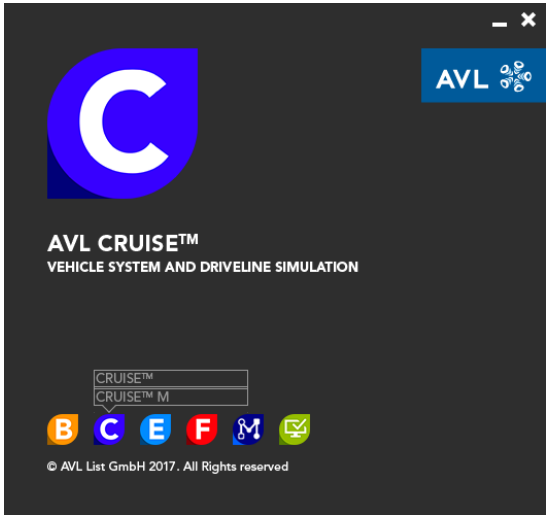
Read More



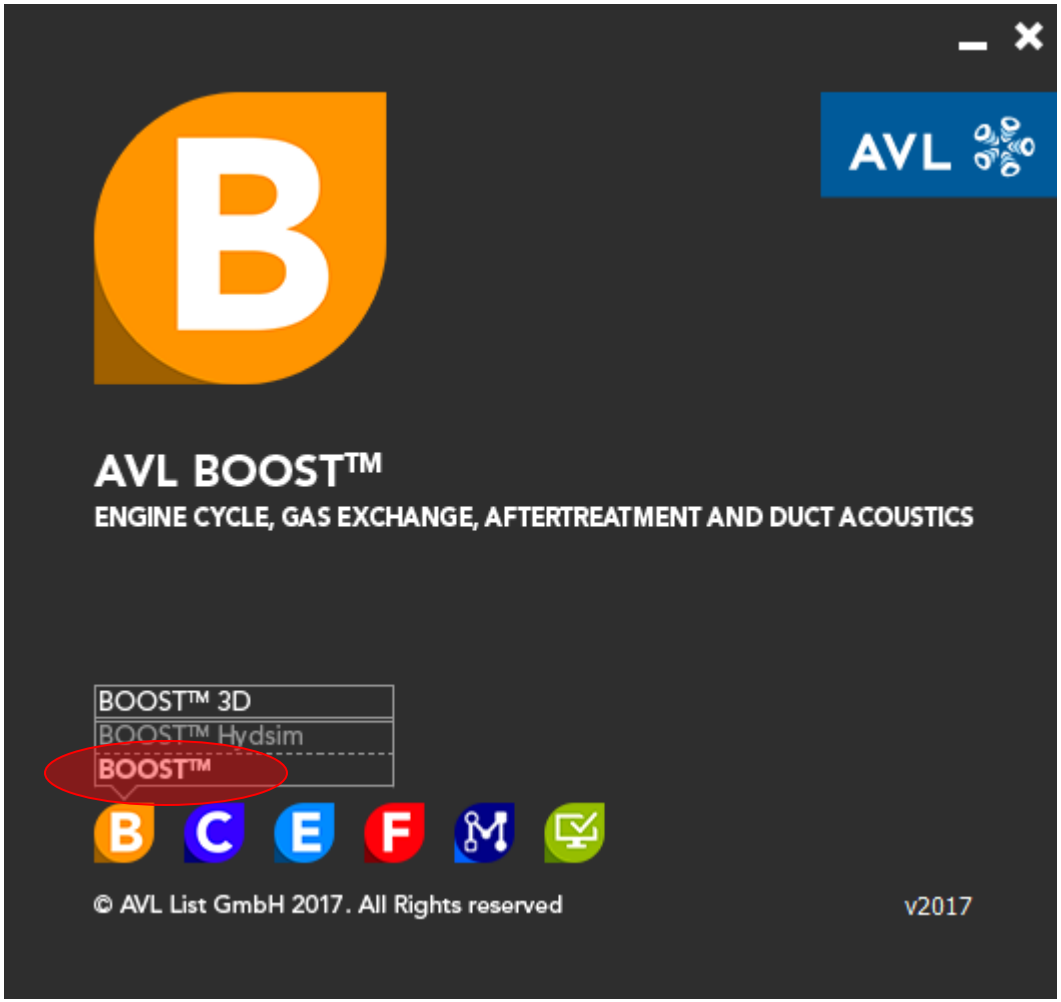
O Programa AVL

O Programa AVL





AVL-BOOST


AVL
AVL BOOST™
ENGINE CYCLE, GAS EXCHANGE, AFTERTREATMENT AND DUCT ACOUSTICS
BOOST™ 3D
BOOST™ Hydsim
BOOST™
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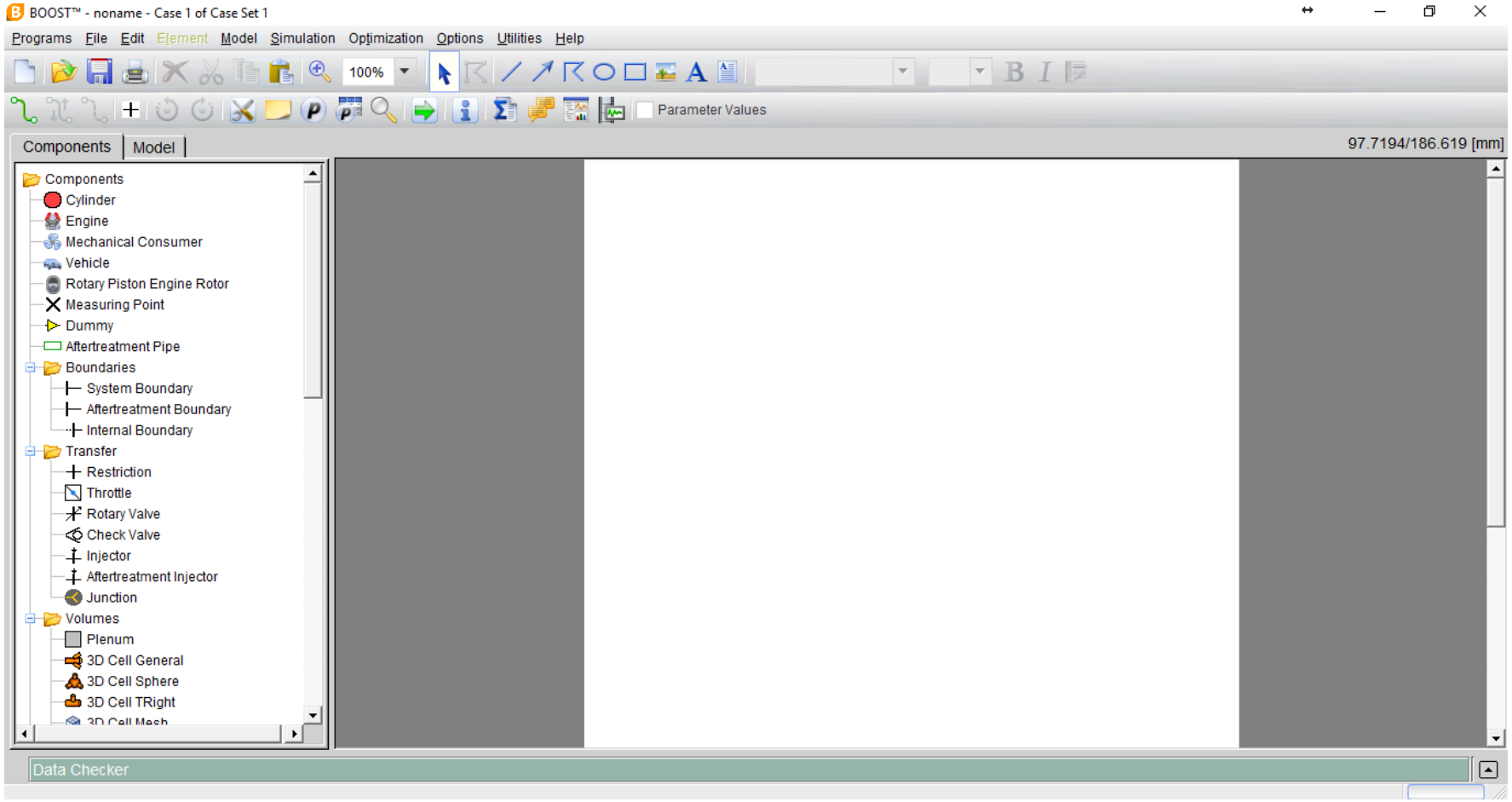
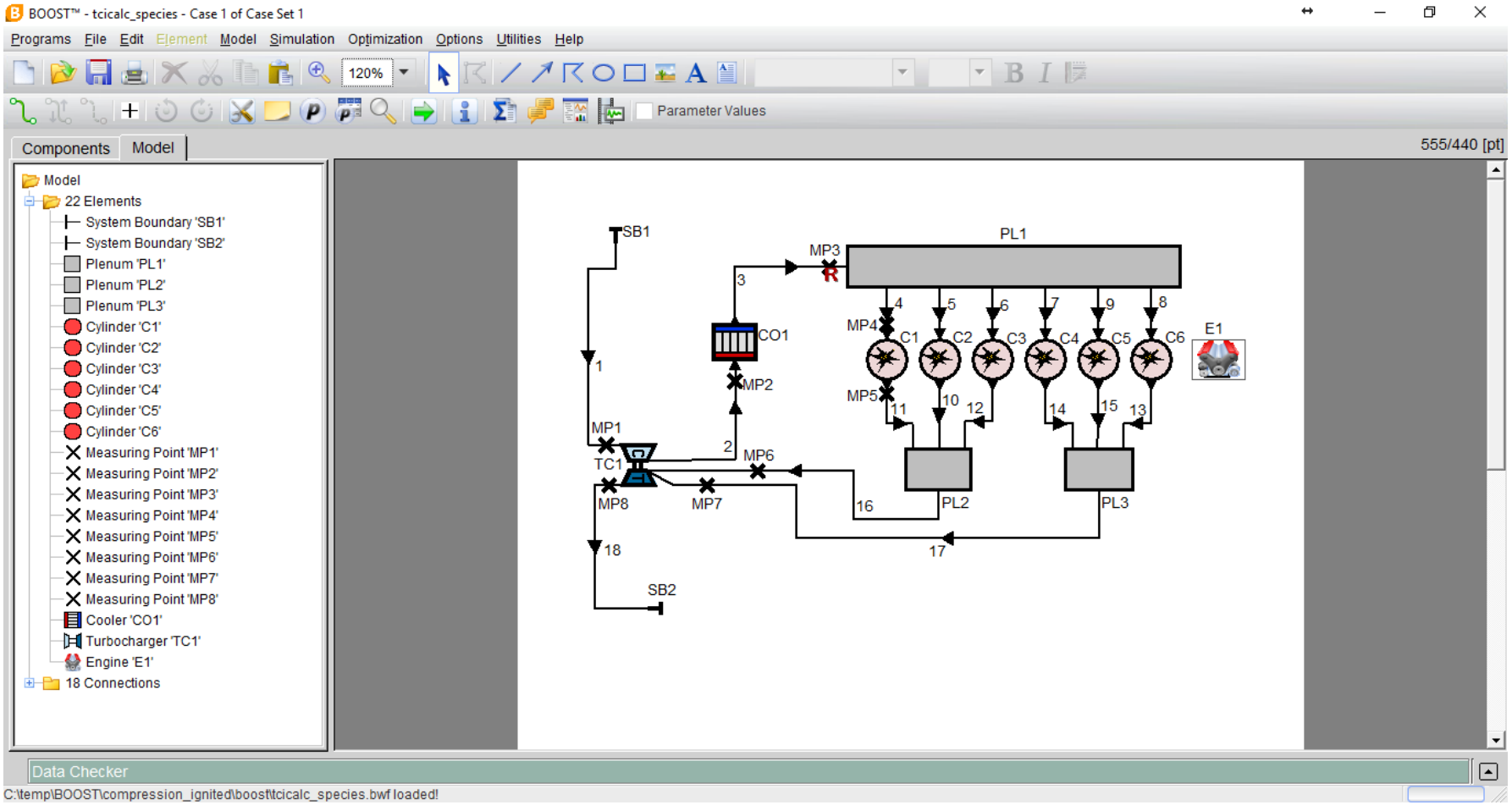
v2017

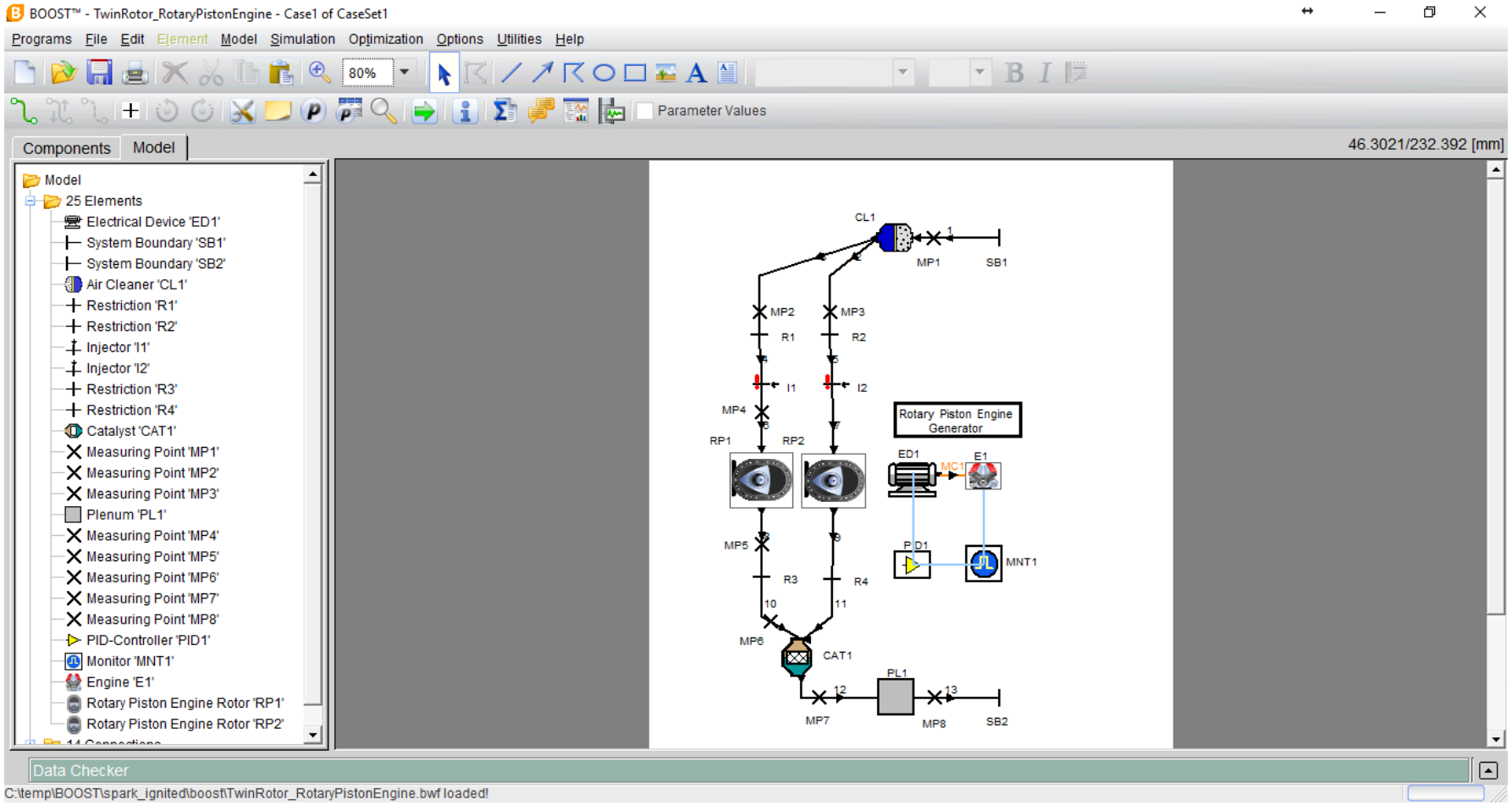
AVL-BOOST


BOOST™ - noname - Case 1 of Case Set 1
Programs File Edit Element Model Simulation Optimization Options Utilities Help
100%
Parameter Values
Components
Model
97.7194/186.619 [mm]
Components
Cylinder
Engine
Mechanical Consumer
Vehicle
Rotary Piston Engine Rotor
Measuring Point
Dummy
Aftertreatment Pipe
Boundaries
System Boundary
Aftertreatment Boundary
Internal Boundary
Transfer
Restriction
Throttle
Rotary Valve
Check Valve
Injector
Aftertreatment Injector
Junction
Volumes
Plenum
3D Cell General
3D Cell Sphere
3D Cell TRight
Data Checker

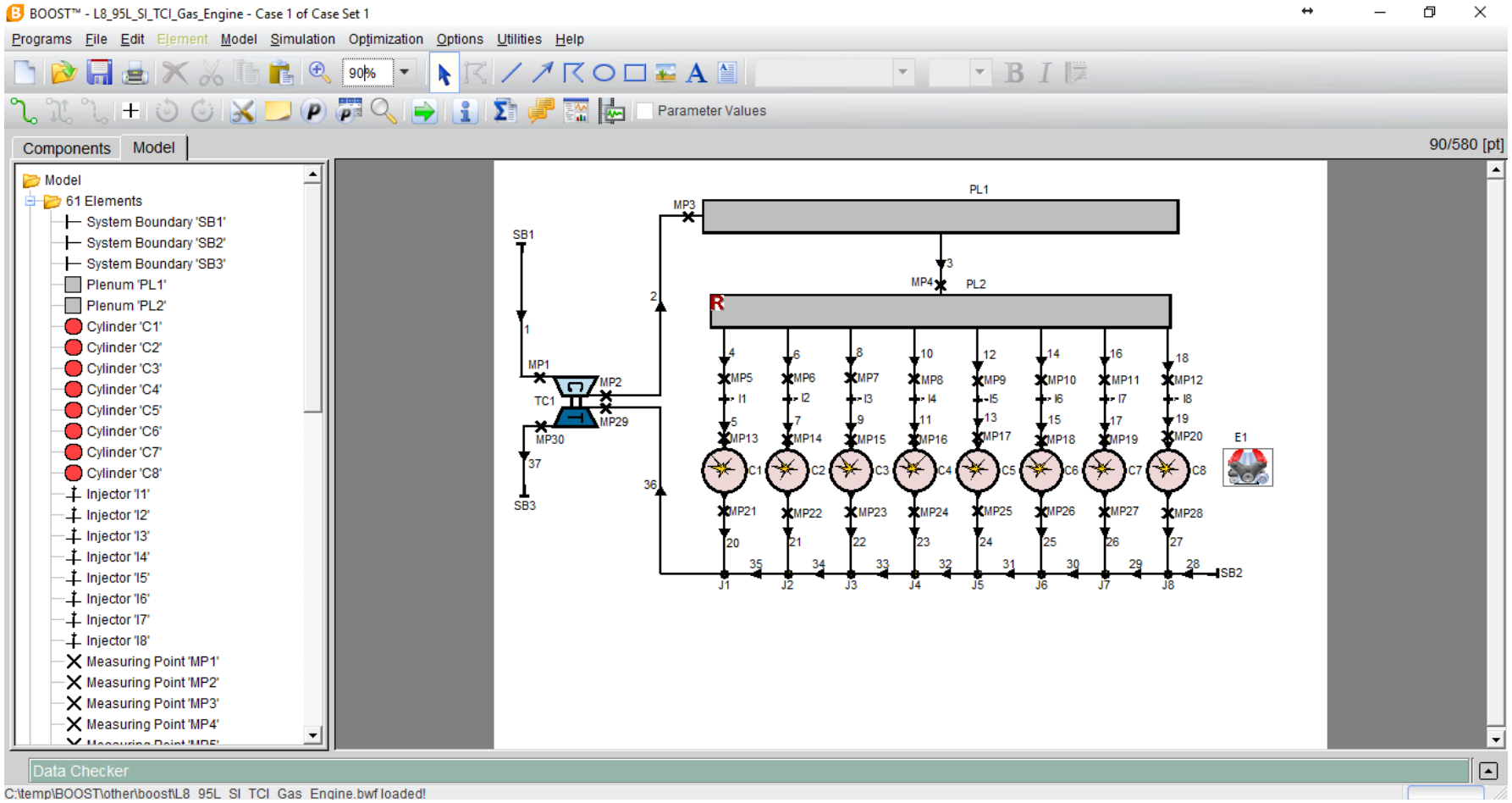
AVL-BOOST


BOOST™ - tcicalc_species - Case 1 of Case Set 1
Programs File Edit Element Model Simulation Optimization Options Utilities Help
120%
Parameter Values
Components Model
555/440 [pt]
Model
22 Elements
System Boundary 'SB1'
System Boundary 'SB2'
Plenum 'PL1'
Plenum 'PL2'
Plenum 'PL3'
Cylinder 'C1'
Cylinder 'C2'
Cylinder 'C3'
Cylinder 'C4'
Cylinder 'C5'
Cylinder 'C6'
Measuring Point 'MP1'
Measuring Point 'MP2'
Measuring Point 'MP3'
Measuring Point 'MP4'
Measuring Point 'MP5'
Measuring Point 'MP6'
Measuring Point 'MP7'
Measuring Point 'MP8'
Cooler 'CO1'
Turbocharger 'TC1'
Engine 'E1'
18 Connections
SB1
PL1
MP3
CO1
MP4
C1
C2
C3
C4
C5
C6
E1
MP2
MP5
MP1
TC1
MP6
MP8
MP7
PL2
PL3
SB2
Data Checker
C:\temp\BOOST\compression_ignited\boost\tcicalc_species.bwf loaded!

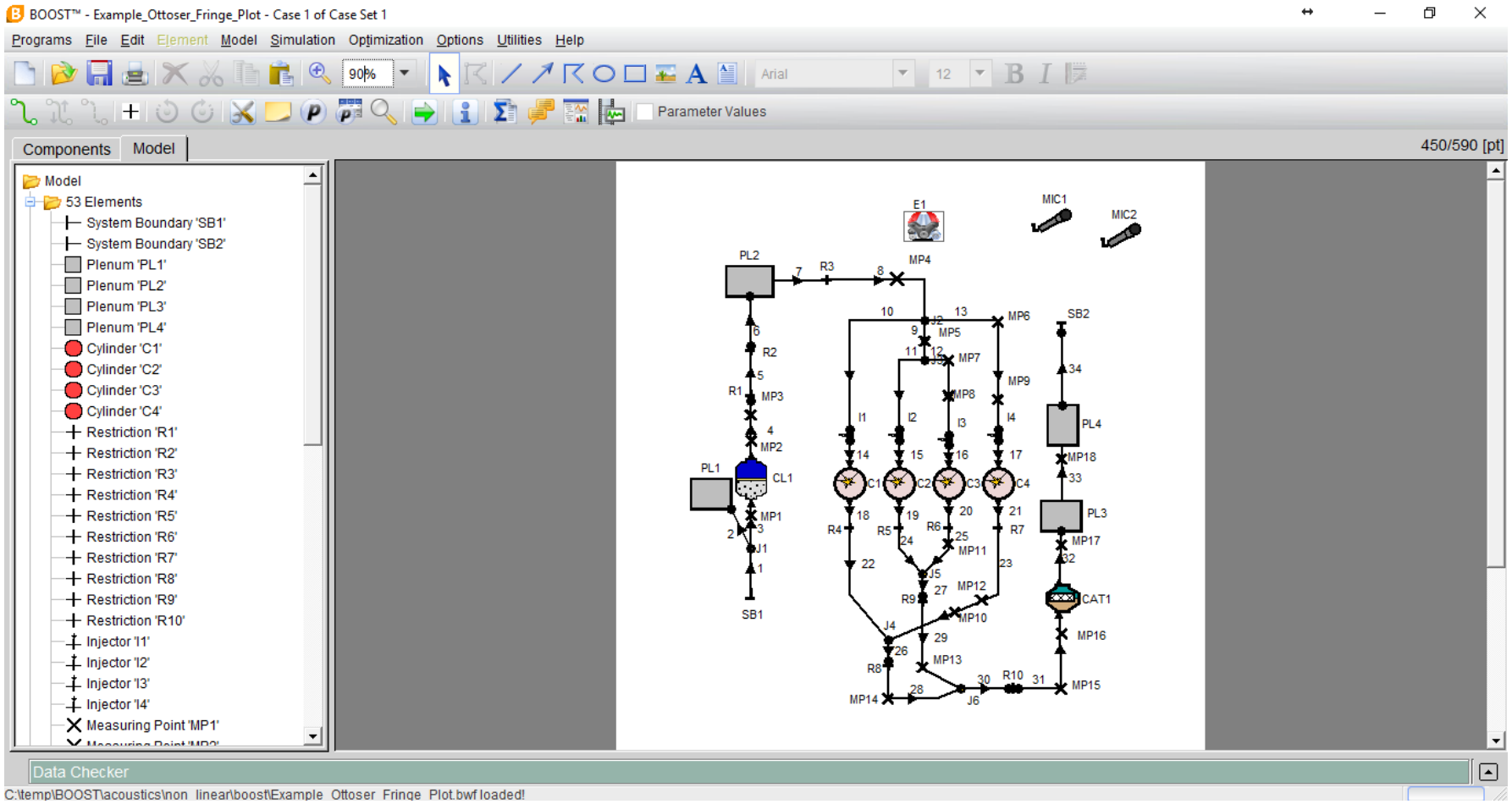
AVL-BOOST


BOOST™ - TwinRotor_RotaryPistonEngine - Case1 of CaseSet1
Programs File Edit Element Model Simulation Optimization Options Utilities Help
80%
Parameter Values
Components
Model
46.3021/232.392 [mm]
Model
25 Elements
Electrical Device 'ED1'
System Boundary 'SB1'
System Boundary 'SB2'
Air Cleaner 'CL1'
Restriction 'R1'
Restriction 'R2'
Injector 'I1'
Injector 'I2'
Restriction 'R3'
Restriction 'R4'
Catalyst 'CAT1'
Measuring Point 'MP1'
Measuring Point 'MP2'
Measuring Point 'MP3'
Plenum 'PL1'
Measuring Point 'MP4'
Measuring Point 'MP5'
Measuring Point 'MP6'
Measuring Point 'MP7'
Measuring Point 'MP8'
PID-Controller 'PID1'
Monitor 'MNT1'
Engine 'E1'
Rotary Piston Engine Rotor 'RP1'
Rotary Piston Engine Rotor 'RP2'
CL1
MP1
SB1
MP2
MP3
R1
R2
I1
I2
MP4
RP1
RP2
Rotary Piston Engine Generator
ED1
E1
MC1
PID1
MNT1
MP5
R3
R4
MP6
CAT1
PL1
MP7
MP8
SB2
Data Checker
C:\temp\BOOST\spark_ignited\boost\TwinRotor_RotaryPistonEngine.bwf loaded!

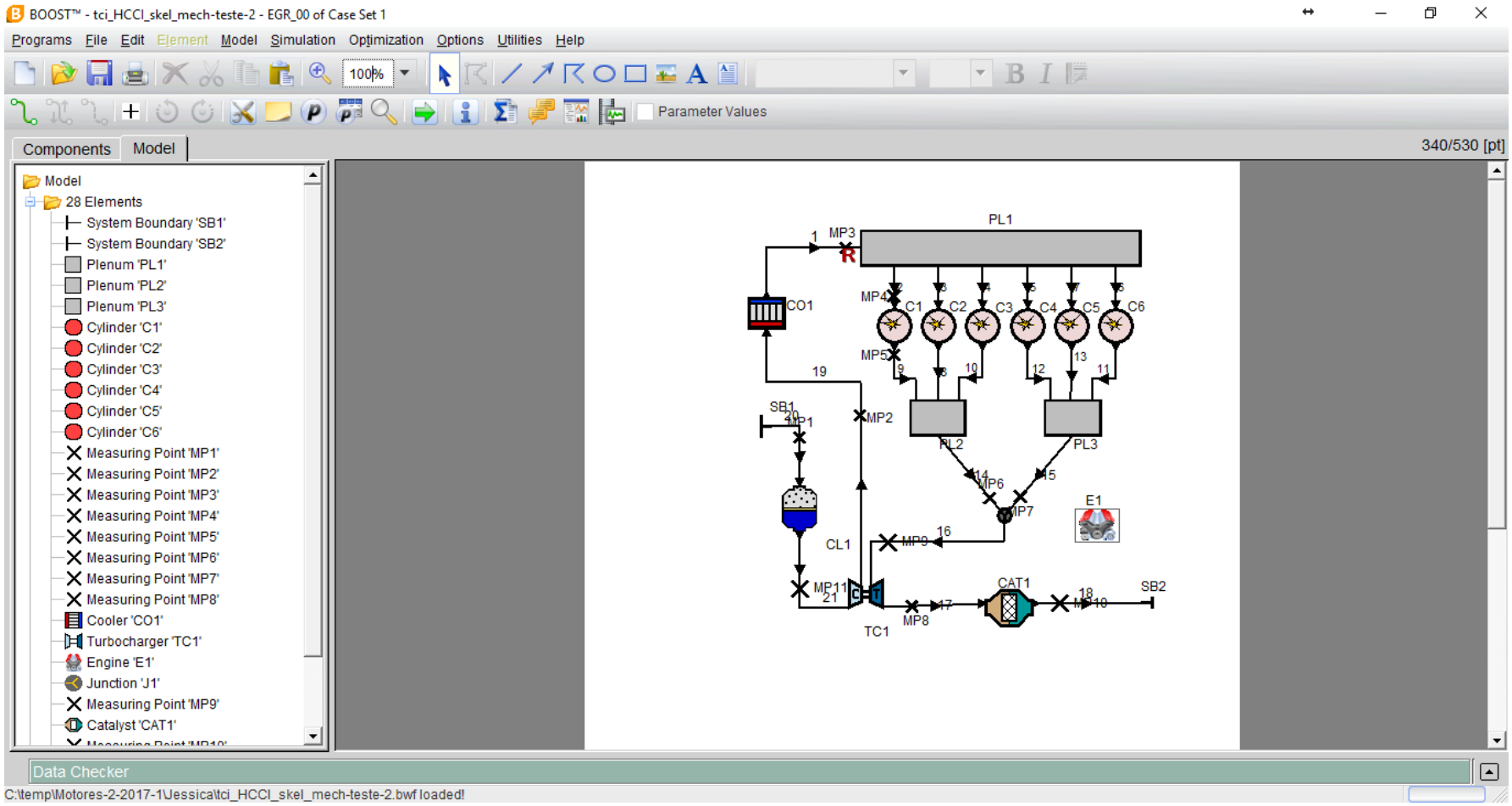
AVL-BOOST


BOOST™ - L8_95L_SI_TCI_Gas_Engine - Case 1 of Case Set 1
Programs File Edit Element Model Simulation Optimization Options Utilities Help
Parameter Values
Components Model
90/580 [pt]
Model
61 Elements
System Boundary 'SB1'
System Boundary 'SB2'
System Boundary 'SB3'
Plenum 'PL1'
Plenum 'PL2'
Cylinder 'C1'
Cylinder 'C2'
Cylinder 'C3'
Cylinder 'C4'
Cylinder 'C5'
Cylinder 'C6'
Cylinder 'C7'
Cylinder 'C8'
Injector 'I1'
Injector 'I2'
Injector 'I3'
Injector 'I4'
Injector 'I5'
Injector 'I6'
Injector 'I7'
Injector 'I8'
Measuring Point 'MP1'
Measuring Point 'MP2'
Measuring Point 'MP3'
Measuring Point 'MP4'
PL1
PL2
SB1
SB2
SB3
TC1
E1
C1
C2
C3
C4
C5
C6
C7
C8
Data Checker
C:\temp\BOOST\other\boost\L8_95L_SI_TCI_Gas_Engine.bwf loaded!

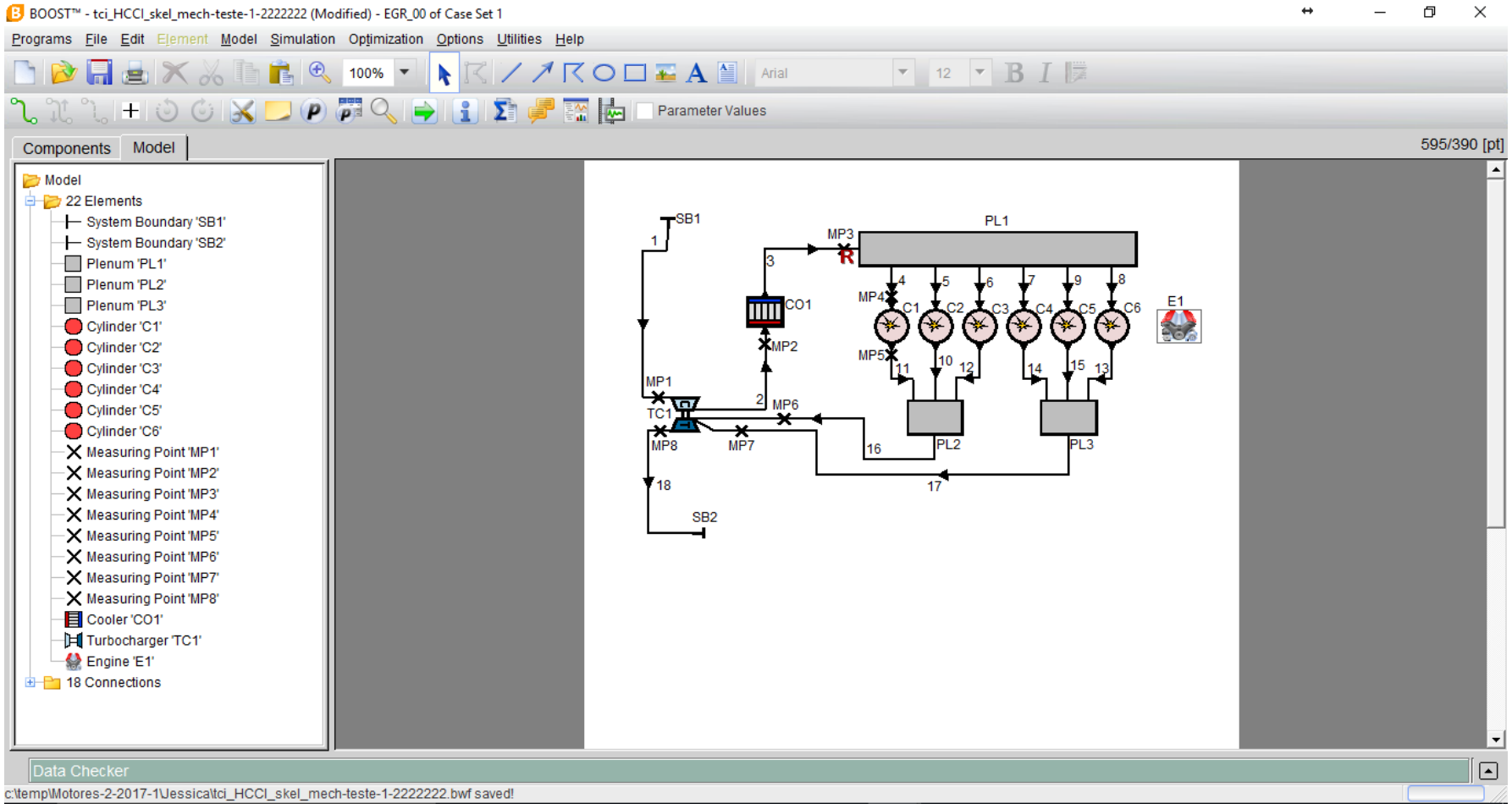
AVL-BOOST


BOOST™ - Example_Ottoser_Fringe_Plot - Case 1 of Case Set 1
Programs File Edit Element Model Simulation Optimization Options Utilities Help
Parameter Values
Components Model
450/590 [pt]
Model
53 Elements
System Boundary 'SB1'
System Boundary 'SB2'
Plenum 'PL1'
Plenum 'PL2'
Plenum 'PL3'
Plenum 'PL4'
Cylinder 'C1'
Cylinder 'C2'
Cylinder 'C3'
Cylinder 'C4'
Restriction 'R1'
Restriction 'R2'
Restriction 'R3'
Restriction 'R4'
Restriction 'R5'
Restriction 'R6'
Restriction 'R7'
Restriction 'R8'
Restriction 'R9'
Restriction 'R10'
Injector 'I1'
Injector 'I2'
Injector 'I3'
Injector 'I4'
Measuring Point 'MP1'
E1
MIC1
MIC2
PL2
R3
MP4
MP5
MP6
MP7
MP8
MP9
SB2
R2
R1
MP3
MP2
PL1
CL1
MP1
J1
SB1
I1
I2
I3
I4
C1
C2
C3
C4
R4
R5
R6
R7
MP11
J5
MP12
R9
MP10
J4
R8
MP13
MP14
R10
J6
MP15
MP16
CAT1
MP17
PL3
MP18
PL4
Data Checker
C:\temp\BOOST\acoustics\non_linear\boost\Example_Ottoser_Fringe_Plot.bwf loaded!

AVL-BOOST


BOOST™ - tci_HCCI_skel_mech-teste-2 - EGR_00 of Case Set 1
Programs File Edit Element Model Simulation Optimization Options Utilities Help
Parameter Values
Components Model
340/530 [pt]
Model
28 Elements
System Boundary 'SB1'
System Boundary 'SB2'
Plenum 'PL1'
Plenum 'PL2'
Plenum 'PL3'
Cylinder 'C1'
Cylinder 'C2'
Cylinder 'C3'
Cylinder 'C4'
Cylinder 'C5'
Cylinder 'C6'
Measuring Point 'MP1'
Measuring Point 'MP2'
Measuring Point 'MP3'
Measuring Point 'MP4'
Measuring Point 'MP5'
Measuring Point 'MP6'
Measuring Point 'MP7'
Measuring Point 'MP8'
Cooler 'CO1'
Turbocharger 'TC1'
Engine 'E1'
Junction 'J1'
Measuring Point 'MP9'
Catalyst 'CAT1'
PL1
MP3
CO1
MP4
C1
C2
C3
C4
C5
C6
MP5
PL2
PL3
SB1
MP1
MP2
MP6
MP7
E1
CL1
MP9
MP11
CAT1
SB2
MP8
TC1
Data Checker
C:\temp\Motores-2-2017-1\Jessica\tci_HCCI_skel_mech-teste-2.bwf loaded!

AVL-BOOST


BOOST™ - tci_HCCI_skel_mech-teste-1-2222222 (Modified) - EGR_00 of Case Set 1
Programs File Edit Element Model Simulation Optimization Options Utilities Help
Parameter Values
Components Model
595/390 [pt]
Model
22 Elements
System Boundary 'SB1'
System Boundary 'SB2'
Plenum 'PL1'
Plenum 'PL2'
Plenum 'PL3'
Cylinder 'C1'
Cylinder 'C2'
Cylinder 'C3'
Cylinder 'C4'
Cylinder 'C5'
Cylinder 'C6'
Measuring Point 'MP1'
Measuring Point 'MP2'
Measuring Point 'MP3'
Measuring Point 'MP4'
Measuring Point 'MP5'
Measuring Point 'MP6'
Measuring Point 'MP7'
Measuring Point 'MP8'
Cooler 'CO1'
Turbocharger 'TC1'
Engine 'E1'
18 Connections
SB1
PL1
MP3
CO1
MP4
C1
C2
C3
C4
C5
C6
E1
MP2
MP5
MP1
TC1
MP6
MP8
MP7
PL2
PL3
SB2
Data Checker
c:\temp\Motores-2-2017-1\Jessica\tci_HCCI_skel_mech-teste-1-2222222.bwf saved!

IMPRESS™ - Chart