

Ricardo Software

WAVE 2012.2 – New Features

Released Q4/2012



- **WAVE 8.4**
- WAVE 2012.2

WAVE 8.4

- Released November 18th, 2011
 - 8.4p1 released May 4th, 2012
 - WAVE-RT User Functions
 - Allows users to add their own variables and functions to execute in the WAVE-RT model
 - WAVE-RT Model Export Enhancements
 - Turn on/off export of individual sensors/actuators
 - Add extra sensors/actuators, defined by WAVE or WAVE-RT elements
 - Re-order sensors/actuators
 - Add user variables/functions
 - Can be performed via command line using “-wrt” option for WaveBuild
 - Per-cylinder Geometry Inputs
 - Send/Receive Control Elements
 - Multi-component Wiebe Combustion Actuators
 - Move/Rotate CAD Geometry in WB3D
 - Default Data Tables in WavePost
 - Tables can be modified and saved for later use

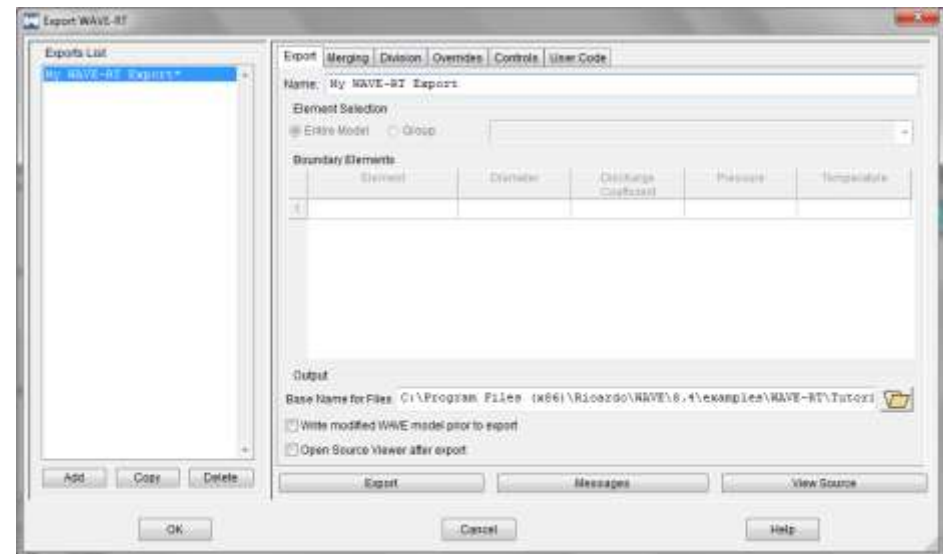
WAVE 8.4 (cont.)

- Improved Component Handling in WaveBuild
 - When a component made using WaveMesher or WaveBuild3D is opened and edited from WaveBuild, then saved to a new file, the user will now be prompted to use the newly-saved component file instead
 - Changes made to the Component Panel allow the user to pick new component models by filename or tag name, without having to delete and drag'n'drop in a new component
- Full 64-bit support for all programs
- New sensors for turbocharger elements
 - Pressure Ratio
 - Efficiency
 - Wastegate/rotor mass flow
- Tube building in WaveBuild3D's Complex Component editor is significantly faster
- New method for calculating duct centreline in WaveMesher
- Improved import of legacy models
- New implicit solver for duct/capacity gas temperature in WAVE-RT
 - Improves performance when temperature has high gradients per time step

- WAVE 8.4
- **WAVE 2012.2**

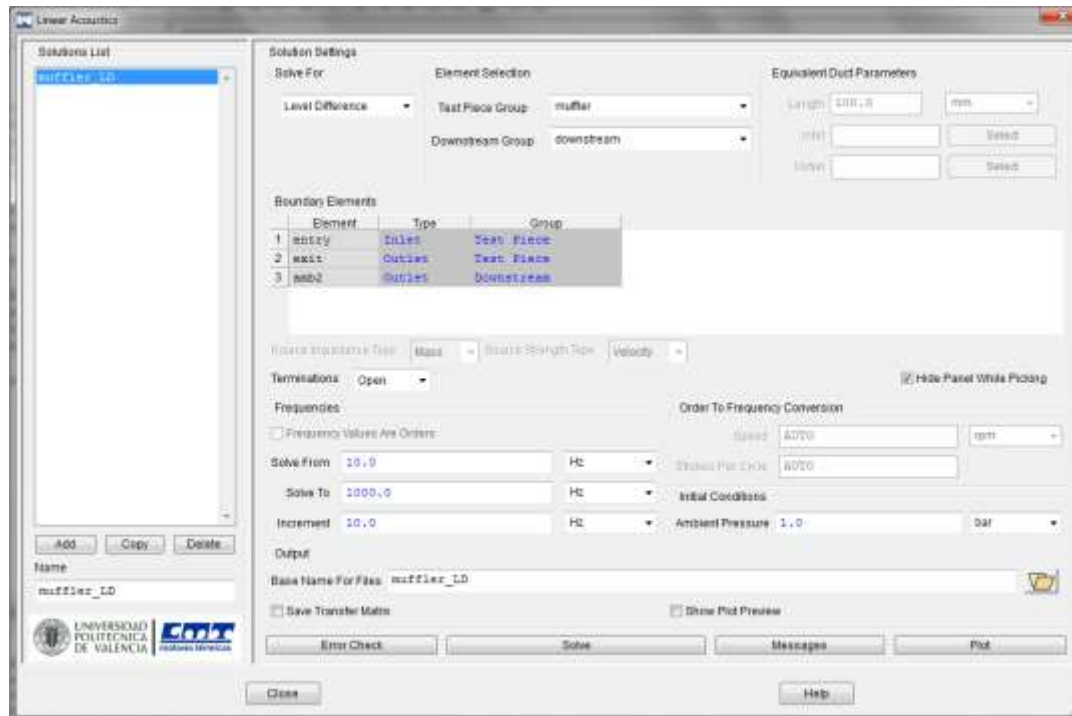
WAVE-RT Model Export Enhancements

- The process to export a WAVE-RT model from WaveBuild is significantly revised:
 - Multiple export sets can be defined within a single model
 - Command line option allows you to specify which to export
 - Within each export set, the user can
 - Export the entire model or a specific group
 - Merge ducts to simplify the exported model
 - Divide ducts to add fidelity where required
 - Override values in the WAVE model
 - Order/define sensors/actuators
 - Define user functions
 - Create a copy of the WAVE model representing the modifications made for validating the WAVE-RT model



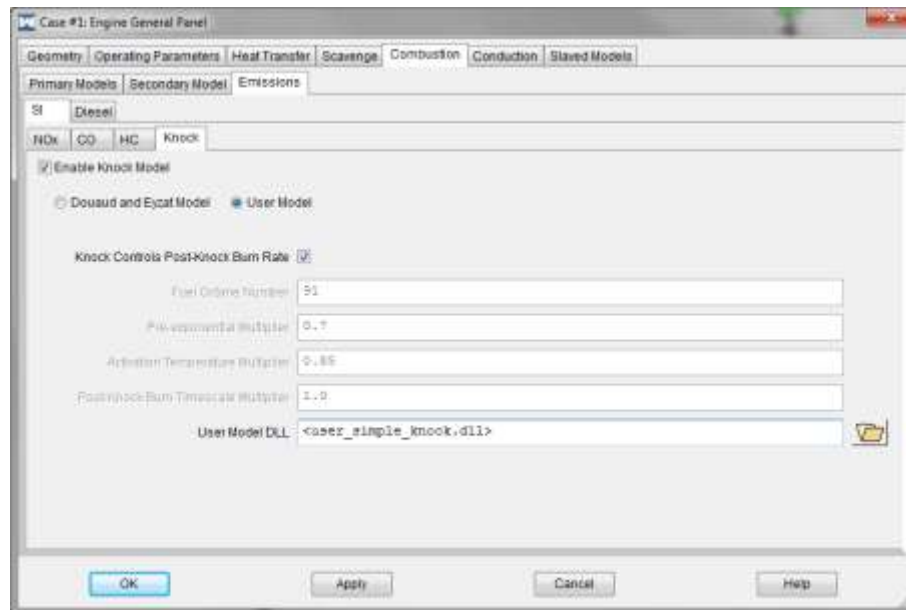
New Linear Acoustics Solutions

- The Linear Acoustics solver has two new solution types:
 1. Insertion Loss
 2. Level Difference
- Additionally, if summary quantities for the current model exist from a time-domain solution, they will be automatically applied as initial conditions to the linear solution, enabling better setting of temperature/flow conditions



User Knock Sub-model

- The Knock sub-model for WAVE can now be replaced with a user-coded model
 - WAVE passes a list of data to the user knock sub-model at each time step
 - The user code passes back a logical flag of whether or not knock has occurred and what the post-knock fuel burn rate is
- User code can be in Fortran or C
- Sample models provided (in each language) in “Examples” sub-directory of installation



User Combustion Sub-model

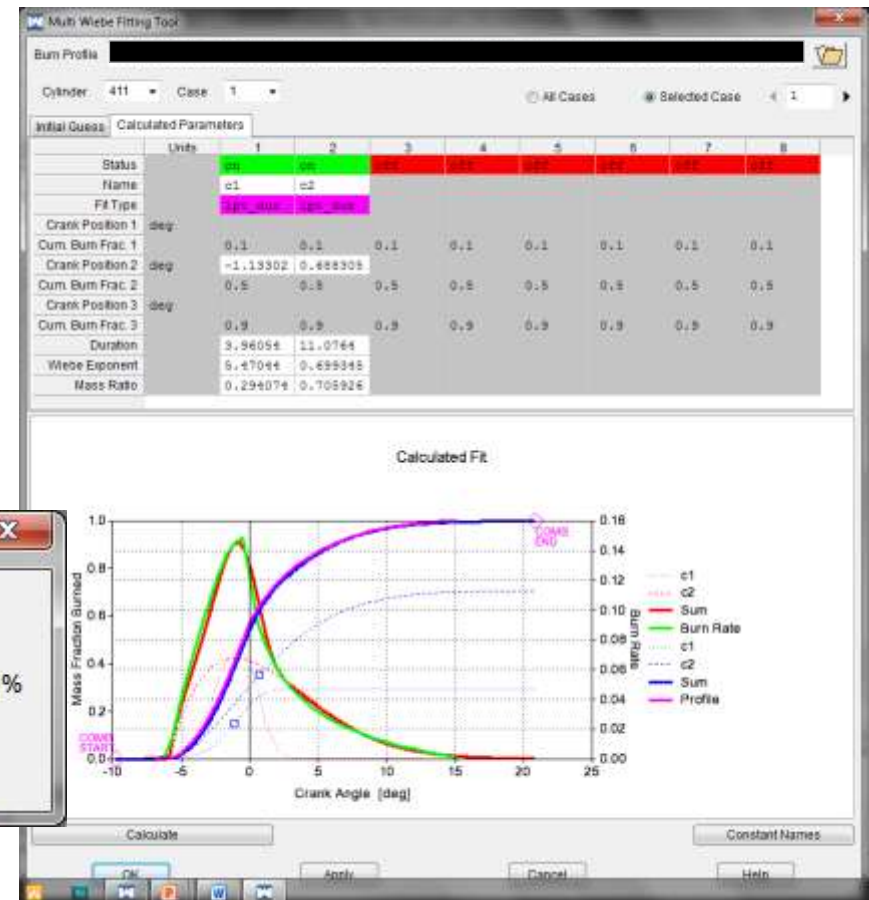
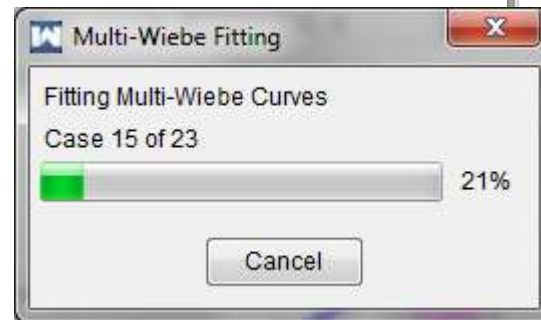
- Updates to the user combustion sub-model to be consistent with user knock sub-model
 - More sub-routines for setup and clean up of the user model
 - More data passed across the `wave_to_user()` array
 - Updated sample models (in each language) provided in the examples sub-directory of the installation
 - The length of the combustion profile is now user-specified, rather than fixed at 1001 points, making it much easier to code
 - A new option is added to let the user specify the time during the engine cycle at which the user combustion sub-model is called
 - Previously, if you only wanted to call it once per cycle, it had to be at SOI, which wouldn't work on a port-injected cylinder!

General Features for User Sub-models

- The general user sub-models public interface has been dramatically improved with some public functions and features which make it much easier to use and more functional
- The `getconst()` function has been supplemented with additional versions to get WAVE constants as specific data types:
 - float/real
 - int
 - char
- A new `get_summary_value()` function has been added to retrieve the last cycle's value of summary quantities
- The user can now set their own summary quantities to be output in the `.sum` file by WAVE

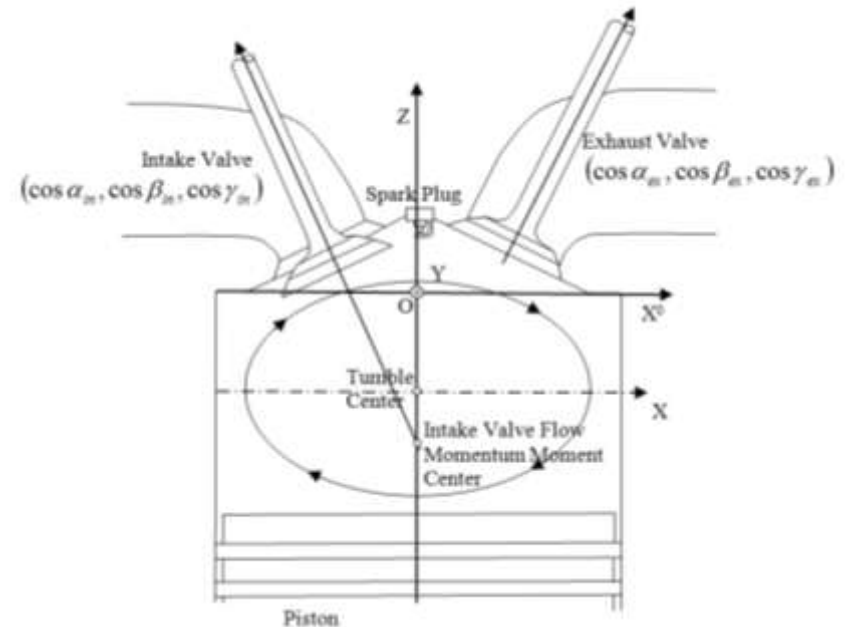
Multi-Component Wiebe Fitting Tool

- Tool launched from the Multi-Component Wiebe panel to create the combustion sub-model inputs from a generic profile
 - Can read in results from a WAVE simulation when combustion profiles data is recorded
 - Can read in raw text data (same format for input into WAVE)
 - Enables a development process from concept (predictive combustion models) to production (use a fast-executing combustion model) to real time (multi-component combustion is supported in WAVE-RT)



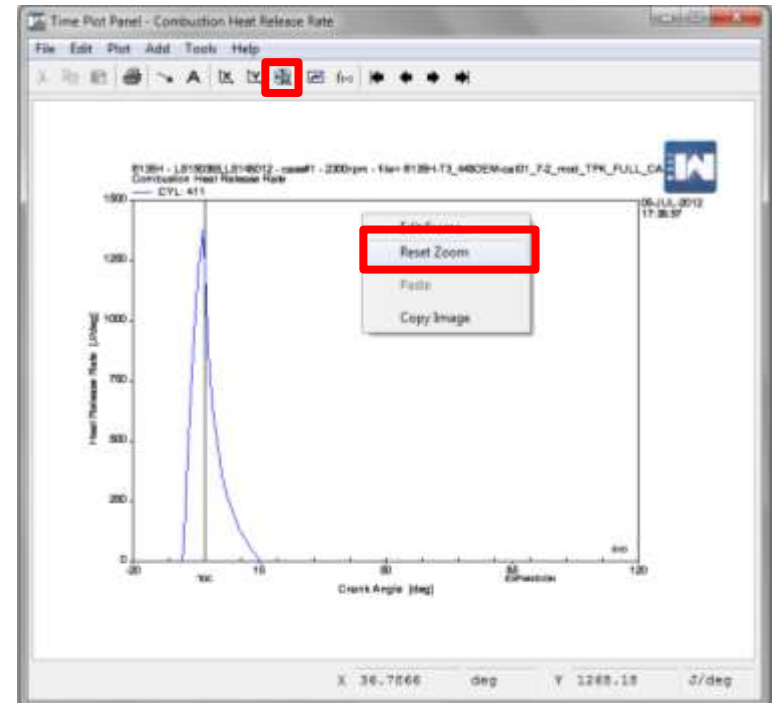
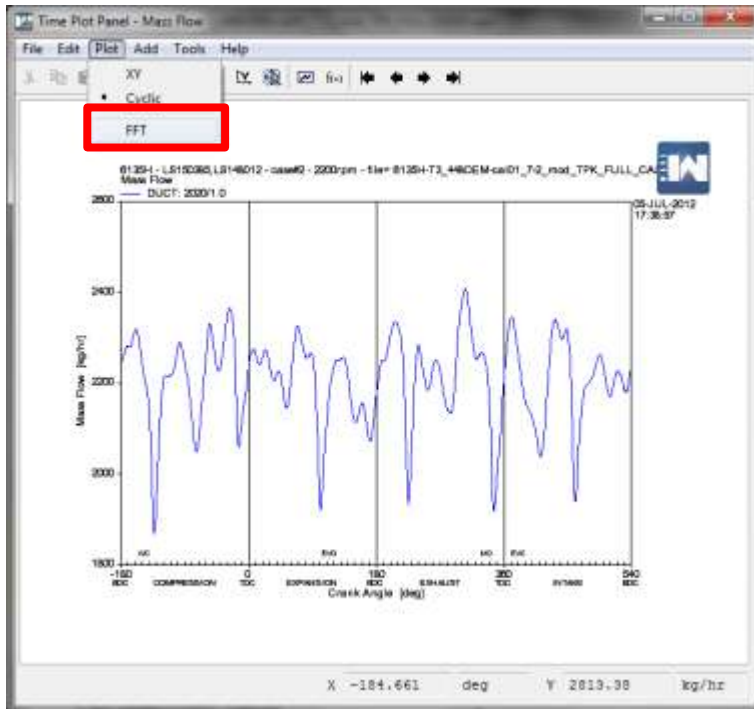
New SI Turbulent Flame Combustion Sub-Model

- Predictive combustion sub-model for SI engines
 - Uses 3D true geometry
 - Imported to WaveMesher, surfaces are identified, combustion maps are generated
 - Various levels of in-cylinder turbulence/flow models
 - Simple correlation of turbulence
 - Direct input of turbulence (from CFD)
 - Predictive models for bulk flow/turbulence using valve curtain flow profile (from CFD)
 - 3 Options for flame growth model
 - Turbulent Flame
 - Strain-rate Turbulent Flame
 - Fractal Turbulent Flame



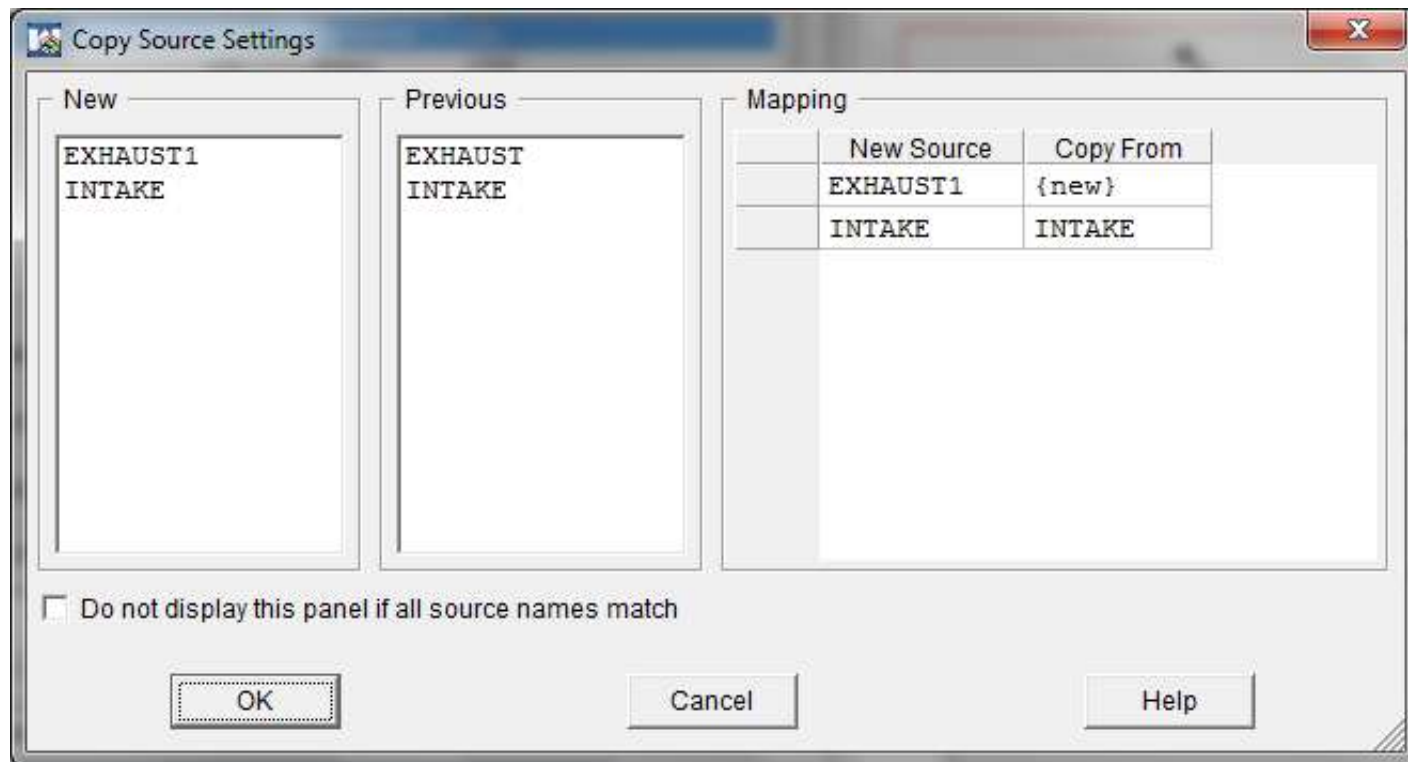
WavePost Enhancements

- Alignment of plots in the Reporting Tool
- Ability to define location from which velocity is extracted for flow noise contribution in acoustic acquisitions
- Time plots can now have their type set to “FFT” when the X axis is either time or crank angle
- Plots that are zoomed can now have their scales reset to “auto” with a right-click menu item or toolbar button



WavePost Enhancements (continued)

- Source settings for acoustic acquisitions are now remembered when a new .wvd file is selected for an existing acquisition:
 - This step can be skipped (as a user-controlled option) when switching between .wvd files with identically-named ambient elements by checking “Do not display this panel if all source names match”



Miscellaneous Enhancements

- Turbo speed can now be limited to a maximum value using the turbo shaft element
- Moment of Inertia actuator for turbo shaft element
 - Useful for allowing start up of a model without over speeding the turbocharger
- Output of GMEP per cylinder in the .sum file