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Enquiry no.: ME/ERL/2018-19/March/02

Enquiry date: March 26th, 2018

Last Date: April 20th, 2018

Extended Last Date: April 27th, 2018

Inquiry for Supply of One dimensional (1D) Simulation Software for Engine and Vehicle Simulation platform for Concept and System detailed design Analysis

There are many 1D simulation softwares, which are used by every major engine and vehicle manufacturer for the design and development of their engines and vehicles. But the best out of them has a comprehensive set of validated 0D/1D/3D multi-physics component libraries, which can simulate the physics of fluid flow, thermal, mechanical, multi-body, structural, electrical, magnetic, chemistry, and controls. Utilizing combinations of these libraries, accurate models can be built of practically any rail system, such as train diesel-electric propulsion, train air brakes and many more. It should be applicable to all sizes and types of engines. Software should have system level locomotive modelling tool capable of simulating all sub-systems (Driveline-Engine, Generator, Traction Motor; hydraulics, suspension, breaking system, Air Conditioning, Ventilation) in different detail level. It must contain the industry's most comprehensive and advanced set of models for engine performance analysis, providing the breadth of features required to allow the engineer to analyze a number of engine configurations and performance characteristics, including:

- Torque and power curves, airflow, vol. efficiency, fuel consumption, emissions
- Steady state or full transient analysis, under any driving scenario
- Turbocharged, supercharged, turbo-compound, e-boost, pneumatic assist
- SI, DI, HCCI and multi-mode combustion, multi-fuel, and multi-pulse injection
- Valve-train/Camshaft kinematics and dynamics with Infinitely variable valve timing and lift (VVT and VVL), Crank-train kinematics and dynamics (incl. balancing and bearings)
- Acoustic analysis of intake and exhaust systems
- Manifold and cylinder component thermal analysis, with included FE solver
- Controls system modeling, via built-in controls library or Simulink coupling
- Exhaust aftertreatment
- SIL, HIL and Real-Time simulation
- Vehicle thermal & energy management
- Under-hood cooling module analysis (3-D with Pre-processing Tool)
- Single objective and multi-objective optimization with in-build direct optimizer and DOE tools

The tool should able to be used in integration with full vehicle modelling with improved license types where solvers are robust and highly capable of Handling large scale models with even 10,000 or more components easily and accurately.

General Features of the software:

Operating System:
- The software should be able to run on Windows, Linux architecture
- It should be able to support network license / floating license.

Pre-processor:
- The software should be able to import CAD data in a simple file format which is compatible with all CAD software
- Software should have in-built CAD data clean-up or building solid geometry for simulation
- It must have the capability to repair the surface for errors such as holes, non-manifold edges, and intersections.
- It must have the capability to extract the inner/fluid core (negative) of a solid model
- The software should be capable of converting 3D geometry to respective 1D model so that the user efforts are reduced.
- Discretization of the element should be specified during 3D to 1D conversion.
- Software should have 3-D model building and automatic export of underhood cooling module models.
- Software should have graphical pre-processing tool for valve train and cam design.
- In-built examples/templates for different types of engines and other vehicle modelling
- All physical models except major parts should be fully defined from the pre-processor, and it should have a facility to check the settings for any errors

Solver:
The solver should have all the following capabilities:
- It should include Explicit, Implicit and Quasi-steady solvers which are robust and should work in both steady state and transient cases

- Multi-physics modelling capabilities for various physical domains: Flow (Navier -stokes solution), 1D/2D/3D Multi-body dynamics, Thermal modelling, Chemical Kinetics (Aftertreatment), Electromagnetic, Electrical etc
- Model the valve opening & closing events, optimize valve overlap for checking performance predictions
- It must have ability to model emissions using one of the above models (preferably detailed chemistry) such as NOx, CO, HC, and Soot
- In addition, it should be integrated with after-treatment model which includes all type of catalyst and filter modelling with Advance adaptive solver
- Solver should have an in-built optimization tools based on the various algorithms such as 'Genetic Algorithm'. This module should be able to optimize based on various input conditions, and also geometry that is defined parametrically from respective CAD Model
- Capable to couple with 3-D CFD software for 1D-3D co-simulation (Like Converge, STAR-CCM+ etc)

- Quasi-3D Navier-Stokes based approach for underhood cooling modules handles non-uniform flow and temperature distribution
- Option to impose CFD flow and temperature distribution at inlet to underhood cooling module
- Liquid flow solution includes thermal effects and is robust, and stable, during zero flow conditions
- It should have its own controller's library and Capable to couple with other controls software in SiL environment

- Capable of coupling through HiL environment

Post Processing:
- Design of Optimization, Distributed computing, Post-processing capabilities. The software should predict optimized value at the same time targeted performance with independent parameters
- The Software should output data in simple text files, excel files, contours showing various quantities (for e.g. Pressure, Temp, Turbulence, Species etc) during the simulation. This data should able to be plotted in graphs, and the software should have 2-D plotting capability. The software should have 3D flow contours plotting and animation capability
- The software should provide 2D/3D animations for mechanical applications and should be able to export data into various formats to be post processed with third party software

Other applications and advanced features:
The software should:
- Have ability to do engine acoustics and after-treatment modelling (for e.g. SCR, DPF DOC, AOC, TWC) with no extra cost. It should model all catalyst and filters available in the market and has ability to optimize the loading and pressure drops through the catalyst
- Have ability to model multi-layer coats, soot and ash loading and regeneration strategies for DPFs
- Have ability to inject Urea into the SCR system for NOx optimization
- Have ability to model multiple sprays with different fuel properties in engine and its effect on the engine performance analysis
- ability of doing multi-cylinder inline and V-engine modelling with single stage and multistage turbocharging
- model all types of gaseous and liquid fuels including blending options
- Predict all emissions from the engine in predictive approach
- Simulate conventional and various locomotive propulsion system
- Simulate engine and battery thermal management in Locomotive

Terms & Conditions:
1. The supplier must validate his software by solving one problem comprehensively, as suggested by ERL.
2. The quote should include **two weeks in-house training** for ERL staff members and students at ERL, IIT Kanpur.
3. Provide "Authorization certificate" from the manufacturer, in case the quotation is submitted by an Indian Agent.
4. Prices should be FOB/ CIF up to Delhi.
5. Validity of quotation should be at least for 90 days.
6. The license should be for Three Years from the date of Installation of hand-over to ERL. Anything missing in the tender document to prove/ validate the software is also the responsibility of the supplier.
7. Training and installation and proving out on an engine setup at ERL, IIT Kanpur is the responsibility of the supplier. Suitable accommodation for the staff and food will be provided by ERL.

Kindly send your best Technical and Commercial offer (Separately for two bid-system) so as to reach us on or before April 20th, 2018 to the following address:

The undersigned reserves the right to accept the offer in part or full or reject completely without assigning any reasons.

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In case of any queries/clarification related to this tender, you may contact Mr. Nikhil Sharma) (+91 9455504117)