Virtual Proving ground using Hardware -in-loop.

TECHNICAL SPECIFICATIONS

I. Software

1. Proposed system shall have commercially available real-time Dynamic Simulation Software AND a Hardware-In-Loop (HIL) System for both Passenger Cars and Heavy Commercial Road Vehicles (Trucks up to Three Axles).

2. Shall simulate both Cars and Trucks in the same environmental PC and in the real-time hardware.

3. Shall have an open integration platform to connect at least one 'third party software' and have interface to 'one program language'.

4. Shall be equally used for Software in Loop (SIL) and HIL applications (two separate licenses) and perfectly meet various simulation requirements of both Cars & Trucks viz., concept design and testing, simulation on ECU and network HIL systems; virtual test driving on dynamic test rigs etc.

5. Shall test and develop chassis control systems, driver assistance systems etc. and interact further with other subsystems viz., steering, drive train; electrical systems etc.

6. Shall have different inbuilt 3D roads.

7. Shall configure road tracks with different coefficient of friction values, slopes, bends, side winds, obstacles, inclination, traffic barrier, traffic signs, traffic lights, CRG sections, environmental 3D models; digitized roads etc.

8. Shall simulate and program driver behaviour viz., soft driving, normal and rash driving, uphill or downhill driving etc.; and also different vehicle manoevures viz., steering, braking, lane changing etc.

9. Shall behave as intelligent 'Driver'; it should be able to follow its independent path in case of traffic or any emergency situation, apart from test cycle or path already configured for its movement.

10. Shall be capable of interfacing user-developed models for basic and advanced power train system, steering system, brake system {both hydraulic & pneumatic including Battery Electric Vehicles (BEVs), Hybrid vehicles etc.}, tyres, suspensions, aerodynamics and other vehicle features.

11. Shall have standard database library of different types of vehicles with all the sub-systems.

12. Generic models built using the software's standard library shall correspond to certain class of standard / existing vehicles which shall be helpful for analyzing their overall performance.

13. Shall have different sensor modules like lateral and longitudinal accelerations, sideslip, yaw angle, individual wheel speed etc. to simulate and control of various vehicle manoeuvres.

14. Shall import real world road conditions from Google Maps / GPS.

15. Shall have the capacity to introduce potholes and other details of the road in this real world road conditions.

16. Shall support manoeuvers based testing method for virtual test driving as in the real world conditions such as system intervention and driver activities in both open and closed loop environments.

17. Shall have good animation facility to visualize vehicle movement.

18. Shall have kinematics module to model the vehicle sub-systems.

19. Shall monitor inputs and outputs in a user friendly GUI.

20. Shall access the parameters through online.

21. Shall export data / generate reports in terms of text / excel files.

I.1 Simulation and Modelling {Car & Truck Models}

1. Shall be modelled as multi-body systems that are fully non-linear and extendable. Shall be manageably arranged in terms of the individual sub-assemblies and also can be modified or exchanged with in-house models with Simulink and / or on a C code level. The parameterization can be done via a GUI.

2. Shall validate the parameters of single subsystems using numerical sensors in the assembled vehicle.

3. Shall configure axles with single or twin tyres.

4. Shall have provision to include hitch systems,

5. Shall configure fixed and movable load conditions, parameterizations of all special suspension types : rigid, steerable and driven axles.

6. Shall have provision to include Trailers as future expansion.

I.2 Integration capability

1. Shall integrate data directly from other models like Adams/Car, suspension K&C files, Pfeffer steering models, tyre models (MF Tyre, MF Swift, Pacejka Models, Tame Tyre etc.) in their modelling environment and shall have provision to modify different parameters as per the requirement.

2. Shall allow MIL, SIL and HIL simulations. Same model shall be used in all of these without any change in the model and shall ensure the same accuracy of the results and consistency.

3. Shall integrate chassis control systems, driver assistance systems and integrated control systems combining chassis, drivetrain, driver assistance etc.

4. Shall automatically generate and parameterize the real-time model from the complete model.

5. Shall integrate with the MATLAB environment. Shall import and export models / data from / to MATLAB environment.

6. Shall integrate different Simulink models built in different MATLAB versions (built for different sub-systems) in a single test.

II. Hardware

Real-time hardware shall be modular so that it offers extremely high performance and very strong real-time capacity for efficient HIL testing.

Shall support real-time simulations by a high-performing and flexibly configurable version of the simulation models and the associated Input / Output connections.

Shall integrate wide range of simulation models from various environments (test-rig configurations) into the hardware platform in parallel.

Shall incorporate any number of real-time applications in a real-time environment.

Shall facilitate all the virtual test drive applications in conjunction with the software - together making the HIL system}.

1. Complete set of hardware with the necessary modules for integration with the real equipment and with a minimum of :

    a. Differential analog inputs, 16 Bits – 8 nos.

b. Analog output channels, 16 Bits – 16 nos.
c. Binary input channels, common ground is preferable – 16 nos.
d. Relay output channels – 8 nos.
e. CAN or CAN FD channels with high and low speed (preferable)

2. Provision to

    a. Monitor inputs and outputs of the models through user friendly GUI.
    b. Online access of the parameters.
    c. Export data / generate reports in terms of text / excel files.

3. Provision to

    a. Change inputs when a plant model simulation is executed.
    b. Change and view different parameters of the model when it is integrated / run with a real time HIL system

III. Virtual Driving Simulator

1. Automotive Steering Hardware shall fulfill the following :

    - Shall be capable for high end simulator models
    - Shall interface via Hi-speed CAN easily
    - Physical effects and end stops shall be realistic
    - Spring stiffness, friction, damping and steering torque shall be programmable
    - Shall possess multi-turn mechanical end stops, table top rack, CAN-USB interface
    - Rated torque shall not exceed 7.5 Nm; maximum torque shall be 16 Nm (ensures truck compatibility)
    - Steering wheel angle resolution shall be a minimum of 0.009 degrees (ensures truck compatibility)
    - Torque resolution shall be a minimum of 0.03 Nm (ensures truck compatibility)

2. Shall have a car cabin that can be interfaced with accelerator, brake, clutch and gearbox. The complete setup shall perform as a driving simulator.

3. Shall interface with “programmable 3D virtual reality Occulus Rift glasses.

4. Shall connect with multiple monitors to have the combined view of virtual 3D roads on three sides (left, right and center views) as identical to the real world.

5. As an optional item : The accelerator, brake or clutch pedal, equipped with the latest force-feedback technology.

General :

1. Warranty for one year.
2. Please quote for annual maintenance contract for another four years.