

NISSAN'S NEW HIGH PERFORMANCE DRIVING SIMULATOR FOR VEHICLE DYNAMICS PERFORMANCE & MAN-MACHINE INTERFACE STUDIES

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1. Motivation

For vehicle dynamics performance development, Driving Simulator (DS) will be a strong solution in addition to HILS. Since it enables to evaluate performance by actual driver with complete reproducible condition, without any safety concern, in short time than physical test.

Nissan already has DS for Man Machine Interface(MMI, Fig.1). However, the requirements to vehicle dynamics evaluation are quite different, we've decided to introduce brand-new facility within few years.



Fig.1 Current DS for MMI (Since 2002)

2. Feature

2.1. Motion System

In case of DS for MMI, evaluation was mainly focused on driver's first reaction against some distraction. Therefore we took first priority to reproduce visual sensation by large screen.

On the other hand, motion system is enhanced (Fig.2) for vehicle dynamics, since we will evaluate up to critical maneuver and physical limit such as emergent lane change & twisty cornering.

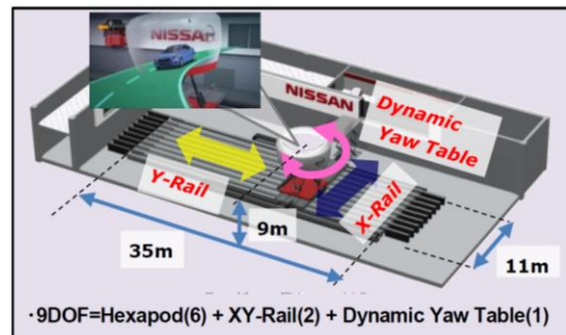


Fig.2 New DS for Vehicle Dynamics

This enhanced system will include XY-Rail & Dynamic Yaw Table. XY-Rail is driven by linear motor for getting the best response. Rail length will be decided considering evaluation scene and cueing methodology. Dynamic Yaw table can be used for evaluation such as intersection, runabout driving scene which are important for future autonomous driving. In addition, the table is used for changing direction of X-Y according to evaluation scenario.

As total DOF of the system will add up to 9, we can use 3 redundancies to optimize motion system control including cueing. XY-Rail & Dynamic Yaw table are used for large horizontal behavior which enables hexapod to focus on reproducing 3 motion(roll, pitch, & heave).

2.2. System Configuration(Fig.3)

Besides Motion system & cueing, followings are the key technologies for our New DS.

2.2.1. Graphic

In a critical situation, driver's viewpoint becomes closer than normal. For the driver to judge precisely in such situation, clear, smooth and less latency visualization is mandatory.

➔ **4K & 120fps Graphic, etc.**

2.2.2. Acoustic

A driver recognizes vehicle speed, tire grip margin, etc. through sound information to reflect his /her maneuver. Therefore realistic sound plays important part.

➔ **Tire Squeal, Eng., Wind Noise with sound image localization**

2.2.3. Reaction force

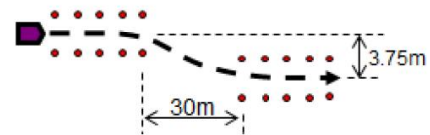
One of the dominant factors for a driver to decide steering maneuver

➔ **Precise Steering mechanism, EPS & Tire character Modeling.**

- VDC (ESC) ON

Installed Technologies :

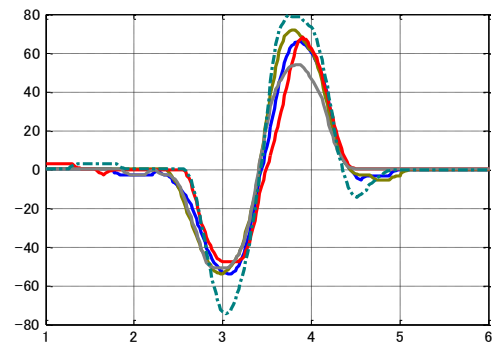
- Minimized Graphic Latency
- Steer & EPS detail model
- Sound Generation technology
- VDC (ESC) Model



Similarity check between Fixed base DS & Track Test.

➔ **Both Steering angle amplitude & frequency are similar** (Installed 4 items contributed)

On Track Test :



On Fixed Base DS :

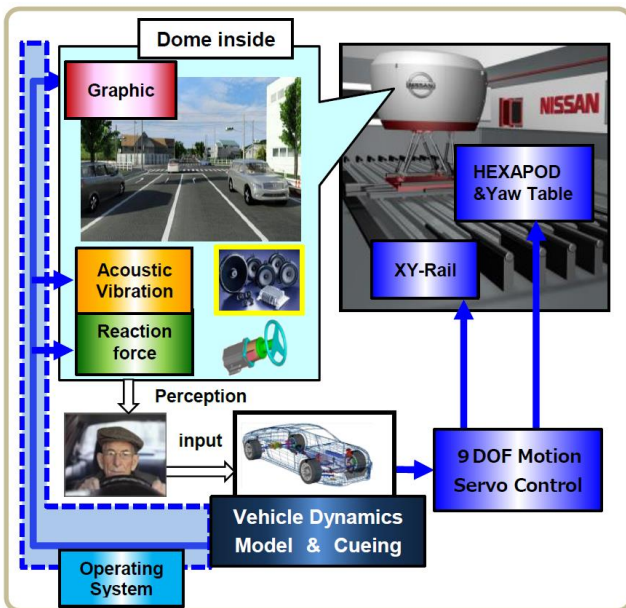
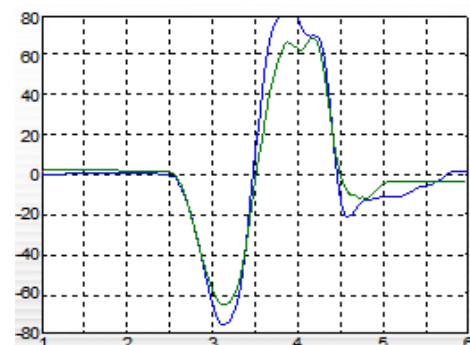


Fig3 New DS System Configuration

3. New Driving Simulator Feasibility Study

- Task : Emergent lane change
- Velocity: 100 km/h constant
- Maneuver: STRG only