

The benchmark of dataset of active suspension system is stored as a MATLAB .mat file called `suspension_dataset.mat`

The input road profile is generated using Equations (A1) to (A3) given below

$$G_q(n) = G_q(n_0) \left(\frac{n}{n_0} \right)^{-w} \quad (\text{A1})$$

where G_q is the PSD at spatial frequency n (in cycles/meter). $G_q(n_0)$ is the reference PSD value at reference spatial frequency n_0 , where $n_0 = 0.1$ is typically used. w is the waviness and typically takes the value of 2 and n is the spatial frequency.

Five classes (i.e., Classes A to E) of road profiles are generated using Eq. (A1), in accordance with ISO 8608, employing multisine signals, where it can be generated as follows:

$$u(x) = \sum_n A_n \cos(2\pi nx + \phi_n) \quad (\text{A2})$$

where n is the spatial frequency, x is the spatial length and ϕ_n is the phase. The amplitude A_n is given by

$$A_n = \sqrt{G_q(n) \Delta n_k} \quad (\text{A3})$$

where $G_q(n)$ is the PSD as defined in Eq. (A1), and $\Delta n_k = \frac{2^k}{L}$ represents the discretised frequency bin width, with $k \in \{3, 7\}$ corresponding to coefficients related to ISO 8608 road roughness classifications from Class A to Class E, in increasing order.

The input signals are given to the Quanser active suspension system and the vehicle and body displacements are recorded.

The input signals are labelled as `hxA`, `hxB`, `hxC`, `hxD` and `hxE` where the alphabet A to E denote the road Classes A to E. The use of `x` indicates that there is no harmonic suppression when generating the input using multisine.

Another set of input signals with multiple harmonics of 2 and 3 suppressed are generated and they are labelled as `hsA`, `hsB`, `hsC`, `hsD` and `hsE`, where `s` indicates suppressed input.

The length of the input signals is 100,000 data point. In measuring the vehicle body and tyre displacements, we concatenate the input signal four times (i.e., four periods of input), resulting in the measured displacements having 400,000 data point.

The displacements are labelled as follows:

- `bodyxsuppressedA` to `bodyxsuppressedE` (body displacements correspond to no harmonic suppressed input Classes A to E)
- `tirexsuppressedA` to `tirexsuppressedE` (tyre displacements correspond to no harmonic suppressed input Classes A to E)

- `bodysuppressedA` to `bodysuppressedE` (body displacements correspond to harmonic suppressed input Classes A to E)
- `tiresuppressedA` to `tiresuppressedE` (tyre displacements correspond to harmonic suppressed input Classes A to E)

Three MATLAB files are also included for the generation of our results.

- `ISO8608_dataplotting.m` - This code is used to plot the ISO 8608 input road profile Classes A to E for both non-suppressed dataset and harmonic-suppressed dataset as well as the associated body and tyre displacements.
- `StateSpace_Subspace.m` - This code is used to perform linear system identification using State Space Subspace approach.
- `Hammerstein_Wiener.m` - This code is used to perform nonlinear system identification using Hammerstein-Wiener model.