**SEOUL NATIONAL UNIVERSITY**
**SCHOOL OF MECHANICAL AND AEROSPACE ENGINEERING**

**SYSTEM ANALYSIS** **Spring 2015**

**HW#5 Suspension Simulation** **Out: April 14, 2015 (Tu)**
**Due: May 7, 2015 (Th)**

Consider a vehicle suspension system shown in the Figure 1 below:

▪ Vehicle speed is 30 km/h.
▪ Suspension parameters

| | | | |
|---|---|---|---|
| unsprung mass | $m_s$ | $=$ | $400\ kg$ |
| sprung mass | $m_u$ | $=$ | $60\ kg$ |
| stiffness of spring | $k_s$ | $=$ | $20,000\ N/m$ |
| stiffness of tire | $k_t$ | $=$ | $200,000\ N/m$ |

▪ A bump road profile $z_r$ is shown in Figure 2 below:
The bump road data will be offered in m-file data form.

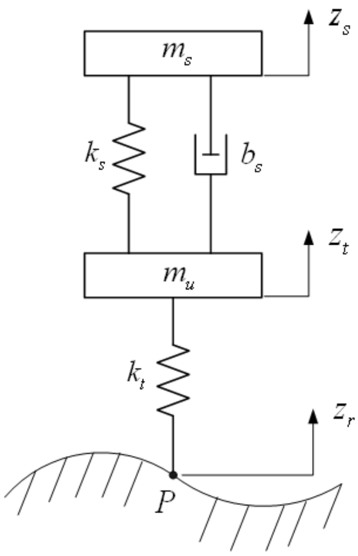


Fig.1 Suspension system

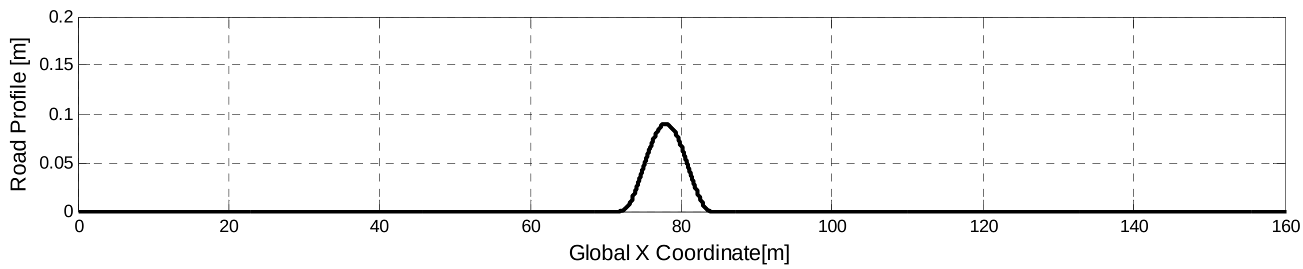


Fig.2 The bump road profile

▪ Figure 3 shows a sprung mass acceleration $\ddot{z}_{s,data}$ response when nonlinear damping coefficient is applied in vehicle suspension system. It also will be offered in m-file data form.

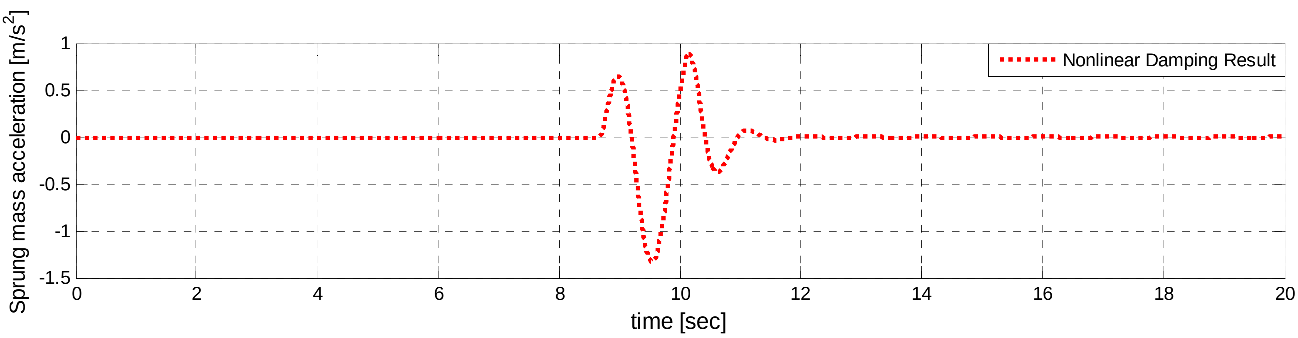


Fig.3 The sprung mass acceleration with nonlinear damper

(1) Get transfer function $G(s)$ about sprung mass acceleration $\frac{\ddot{z}_s(s)}{z_r(s)}$

(2) Find the best linear damping coefficient $b_s$, such that the index defined as following equation is minimized.

$$J = \sum_{t=8}^{t=12} (\ddot{z}_{s,data}(t) - \ddot{z}_{s,sim}(t))^2$$

(3) Plot a sprung mass accelerations for the best damping coefficient obtained in problem (2). Compare your simulation results with the data in Fig.3