



# Seismic Performance and Vulnerability of Transportation Networks Subjected to Strong Earthquakes Considering Traffic Loading

D3 Su Danna Nonlinear seismic analysis for vehicle-bridge interactive system

## 【Background】

Earthquakes have caused damage to transportation networks. Also, the inertial effect caused by live load due to earthquakes during traffic jam could not be negligible. However, design procedures do not consider the simultaneous presence of live load and earthquakes to be considered. For this reason, in urban areas where traffic congestion is a frequent occurrence, the adequacy of bridges to sustain strong earthquakes considering traffic loading has been under investigation. Few studies consider strong earthquakes and nonlinear behavior on vehicle-bridge interaction system.

## 【Objective】

This research aims to clarify dynamic responses of vehicle-bridge interaction (VBI) system during strong earthquakes by means of a developed platform to simulate various situations. This study also intends to provide information concerning how the effects should be included in the seismic design of bridges

## 【Approach】

A partition integrated method was developed to simulate the dynamic interaction between the bridge and moving vehicles, incorporating the effect of nonlinear behavior, earthquake and road surface roughness. Bridge and vehicles were modelled in different software suite. The finite element (FE) bridge model was established in ABAQUS and moving vehicle model was established in MATLAB. The above two partitions were integrated and a recursive analysis scheme were controlled by a MATLAB algorithm.

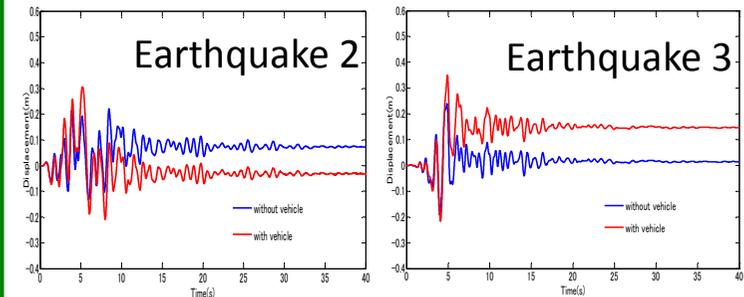
## 【Publication】

Sudanna Borjigin, Chul-Woo Kim, Kai-Chun Chang, Kunitomo Sugiura. Non-linear seismic response analysis of vehicle-bridge interactive systems. *Steel Construction*, Vol. 8, No. 1 (2015) 2-8.

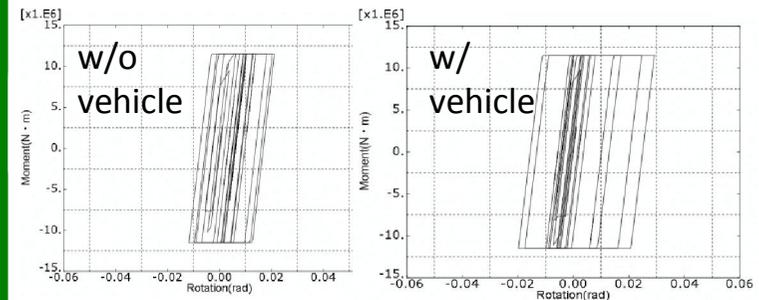
K.C.Chang, C.W.Kim and Sudanna Borjigin. Variability in bridge frequency induced by a parked vehicle. *Smart Structures and Systems*, Vol.13, No.5 (2014) 755-773.

## 【Results】

Consideration of the moving vehicles resulted in increase or decrease of the transverse displacements of the bridge, due to different ground motions as shown in following simulation results.



The maximum rotation in the hysteresis loop of the bridge with vehicle is larger than those without vehicle, indicating the bridge suffered from a more severe plastic behavior.



Results emphasize the need and importance of considering effect of vehicle and different ground motions in seismic design of bridge.