*The 2024 World Congress on*
***The 2024 Structures Congress (Structures24)***
*19-22, August, 2024, The K hotel, Seoul, Korea*

# Explicit dynamic interaction analysis between an ultra-high-speed maglev vehicle and the guideway shell structure

*Seunghwan Park[1)], Seung-Min Baek[2)], Hyung-Jo Jung[3)], Phill-Seung Lee[4)], and Man-Cheol Kim[5)]

[1), 4)] *Department of Mechanical Engineering, KAIST, Korea*
[2), 3)] *Department of Civil & Environmental Engineering, KAIST, Korea*
[5)] *Korea Railroad Research Institute, KRRI, Korea*
[1)] *qkrtmd387@kaist.ac.kr*
[2)] *tmdals@kaist.ac.kr*
[3)] *hjung@kaist.ac.kr*
[4)] *phillseung@kaist.edu*
[5)] *kimmc@krri.re.kr*

## ABSTRACT

In this paper, we propose an explicit dynamic interaction analysis algorithm for an ultra-high-speed maglev vehicle and the guideway shell structure. The maglev vehicle uses superconductive electromagnets to achieve magnetic levitation through induction and repulsion with the guideway coils, drastically reducing friction and enabling ultra-high-speed travel. The maglev vehicle and the guideway shell structure experience dynamic loads from each other due to their interaction. These dynamic interactions significantly apply design and safety of the vehicle. Thus, we numerically analyze the interaction dynamic behaviors of both the vehicle and the guideway shell structure. We perform the 3D dynamic analysis from the well-known Central Difference Method (CDM) of explicit dynamic analysis. Nonlinear interaction stiffness between the vehicle and guideway is applied for realistic and accurate analysis. We also consider guideway irregularities referred to Federal Rail Administration (FRA). Our results help understand the running dynamic characteristics of the vehicle and the vibration tendency of the guideway, providing essential data for the initial design of advanced maglev vehicle transportation systems.

---

[1)] Graduate Student
[2)] Graduate Student
[3)] Professor
[4)] Professor
[5)] Researcher

## REFERENCES

Choi, C.K., Song, M.K., & Yang, S.C. (2000), "A Model for Simplified 3-dimensional Analysis of High-speed Train Vehicle (TGV)-Bridge Interactions", *J. Comput. Struct. Eng. Inst. Korea*, **13**(2), 165-178.

Kim, M.C. (2003), "Development of a Quasi-Three Dimensional Train/Track/Bridge Interaction Analysis Program for Evaluating Dynamic Characteristics of High Speed Railway Bridges", *J. Comput. Struct. Eng. Inst. Korea*, **16**(2), 141-152.

Lee, J.H., Yoo, W.H., Lee, J., & Lee, C.Y. (2023), "Study on The guideway Tolerance and Allowable Load in Capsule Train Test Track through Running Dynamic Characteristic Analysis", *J. Korean Soc. Railway*, **26**(7), 489-497.

Abdelrahman, A. S., Sayeed, J., & Youssef, M. Z. (2017), "Hyperloop transportation system: analysis, design, control, and implementation", *IEEE Transactions on Industrial Electronics*, **65**(9), 7427-7436.

Janzen, R. (2017), "TransPod ultra-high-speed tube transportation: dynamics of vehicles and infrastructure", *Procedia engineering*, 199, 8-17.

Wu, J. J., Whittaker, A. R., & Cartmell, M. P. (2000), "The use of finite element techniques for calculating the dynamic response of structures to moving loads" *Computers & Structures*, 78(6), 789-799.

Yang, Y. B., Yau, J. D., Yao, Z., & Wu, Y. S. (2004), "Vehicle-bridge interaction dynamics: with applications to high-speed railways" *World Scientific*.

Ohashi, S., Ohsaki, H., & Masada, E. (1998), "Equivalent model of the side wall electrodynamic suspension system" *Electrical engineering in Japan*, **124**(2), 63-73.

## ACKNOWLEDGNETS

This work was supported by the Korea Railroad Research Institute (KRRI) (N06240024)