Numerical modelling of railway ballast behaviour using the Discrete Element Method (DEM) and spherical particles

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ABSTRACT

In the last two decades there has been a great development of high-speed train lines. This advance has led to more demanding loads in railway infrastructures and to the appearance of new problems, such as the so-called *ballast flight*: the aerodynamic load induced by the train generates the ejection of some of the ballast particles, which may hit the train underbody and its elements. This has raised interest for the development of numerical tools for the analysis of the ballast superstructure under different load conditions, as it will enable design optimization.

The DEM is considered an effective and powerful method for solving engineering problems involving granular and discontinuous materials, such as railroad ballast [1]. However, the computational cost of contact calculation between irregular particles is high and limits the calculation capability.

From the point of view of micro-scale analysis, it is essential to represent the exact geometry of the particle. By contrast, if the interest lies in the behavior of the granular material as a whole, the geometry is not a determining factor. Moreover, setting up a simulation of granular material taking into account the exact geometry of each particle would not be efficient.

Current work presents the methodology followed to achieve accurate results in the calculation of railway ballast behaviour using DEM and spherical particles. The use of spherical particles reduces the computational cost and makes the simulation set up efficient.

The results presented include the calculation of a) the lateral resistance force of the ballast bed in front of a moving sleeper, and b) the effect of particle impact against a ballast bed.

REFERENCES

[1] E. Tutumluera, Y. Qiana, Y.M.A. Hashasha, J. Ghaboussia and & D.D. Davisb, *Discrete element modelling of ballasted track deformation behaviour*, International Journal of Rail Transportation, Volume 1, Issue 1-2, 2013.