

# Investigation of particle properties on the holding force in a granular gripper

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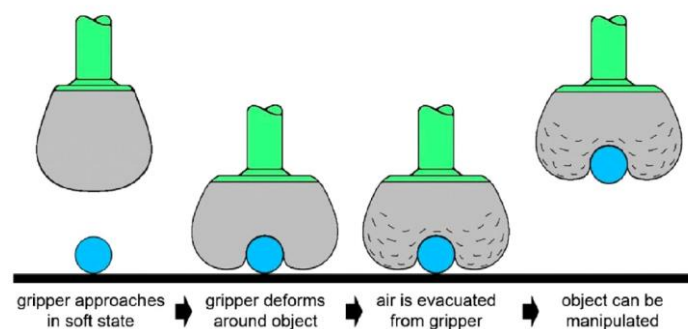
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## ABSTRACT

The granular gripper is an innovative device designed to grasp objects using the jamming properties of granular materials. However, the granular properties that influence its performance are poorly understood. Moreover, to date, there is no numerical model for the granular gripper. In this paper, we combine numerical and experimental approaches to examine the effects of the mechanical properties of the grains on the grip force, with the goal to gain better insight on the influence of these properties and to improve the performance of the granular gripper.

On the numerical side, a model based on Discrete Elements Method (DEM) is developed to predict the effect of the granular properties, such as the roughness, on the holding force. Two different ways of modelling the gripper system are presented and compared. The DEM model is tested for different pressures around the jamming pressure. On the experiment side, a granular gripper apparatus is mounted and used to find the relationship between the grains properties and the holding force. The experimental apparatus is also used to validate the DEM model.

We found that grains with higher surface roughness result in a higher holding force on a cubical aluminium object. We also found agreements between the results of the experiments and the DEM models. Lastly, advice is given about approximating the holding force for a given gripper system and about further optimizing this system in terms of holding force, pressure and particle roughness.



Functioning of the granular gripper [1].

## REFERENCES

[1] E. Brown, N. Rodenberg, J. Amend, et al. Jaeger, Universal robotic gripper based on the jamming of granular material, Proceedings of the National Academy of Sciences, (2010),107(44):18809–18814.