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A discrete element model for investigating the electromechanical characteristics of particulate systems

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The electrical transfer during mechanical actions in particle-to-particle contact is a crucial aspect across many fields [1]. The complexity of particle characteristics leads to challenges in quantitatively assessing the electromechanical behaviour in the experimental studies. In this work, a 3D discrete element model has been developed based on previous work [1–3] to investigate the conductive behaviour during particle-to-surface contact under combined mechanical motions of loading and torsion. The Hertz-Mindlin model has been employed to detect mechanical reactions at each contact point, while Ohm's law and Kirchhoff's law define the electrical characteristics of local contacts and global network. The model has been run through the EDEM™ software package and then validated by comparing it against data from high pressure torsion (HPT) test. The results show a good agreement between the simulation and experimental results. In addition, the results indicate a strong correlation linking particle size, contact area, resistance, and electrical tension. This study has implications for the development and optimisation of materials and electromechanical systems.

Keywords: Discrete element method; Electromechanical coupling behaviour; Resistance measurement; Electrical conductivity.

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