

Optimization of a Sweep Geometry and Working Parameters Using Discrete Element Method and Genetic Algorithm

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Oral presentation

Sub-topics:

Equipment, Artificial intelligence

Abstract Summary :

Cultivation is an essential part of soil tillage techniques. This operation is highly energy-intensive and covers vast areas, so even small increases in efficiency can result in significant energy savings. For these reasons, the soil-sweep tool interaction is intensively researched. Researchers use physical measurements and numerical simulations to determine the optimal geometry for specific soil tillage tasks and tillage parameters. One commonly used numerical method for modeling soil-sweep tool interaction is the discrete element method (DEM). Increasingly accurate DEM soil models can simulate the draught force acting on the tool simultaneously with the movement of the soil. This model enables more reliable optimization of tillage tool geometries and tillage parameters. There is limited literature on how DEM can be more effectively applied in the design practice of soil tillage tools. Therefore, the aim of this research is to develop a method for the automatic optimization of a sweep tool geometry and cultivation parameters using DEM and a genetic algorithm (GA). The optimization aim is to achieve the soil cultivation objective with minimal energy input, considering the movement and interaction of soil and crop residues. The research results demonstrate that by employing a properly calibrated DEM soil model, the genetic algorithm can provide suggestions for tool geometries and corresponding cultivation depths that meet the specified objective functions at a given tool speed.

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