Performance Evaluation of a Computational Design Tool for Three-Point Hitch Geometry Optimization

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**Abstract.** During tillage operations or implement maneuvering, the efficiency, comfort, safety, and operational performance of agricultural tractors are directly affected by the distribution of the dynamic loads resulting from the interaction between the implement and the soil and transmitted to the tractor chassis through the three point-hitch (TPH) attachment system. The correct design of the hitching system allows to increase tractor-implement performance during agricultural field operations. In this context, a computational design tool for TPH geometry optimization (the Optimizer) was recently developed by Avello Fernandez et al. [1]. The tool is based on a constrained minimization algorithm which allows to search for optimal TPH geometries that respect all the design constraints established by the ISO-730 Standard functional requirements and other design requirements while reducing the weight transfer effects on the front axle of agricultural wheeled tractors.

Based on the aforementioned research [1], the present study is focused on testing the robustness and potentialities of the Optimizer as well as its feasibility for practical applications. In order to do that, a set of four different commercially available TPH geometries were used as starting points for the Optimizer. Results show that even though starting from different TPH configurations, the tool converges to similar optimized geometries that reduce the weight transfer effects at the tractor front axle by about 15% for each configuration. It was demonstrated that the resulting geometries respect the established linear and non-linear design constraints since the algorithm converges to a feasible geometry solution in a low number of function evaluations within the defined constraint tolerance. The computational processing time was about thirty minutes for each configuration, considered an adequate convergence time for the numerical algorithm running in a quad-core Intel Xeon CPU at a 3,30 GHz of working frequency. Simulation results suggested that the Optimizer is an effective and efficient tool able to simplify the exploration of the design parameters conforming a three-point hitch geometry and thus demonstrating that it could be applied in practical applications, improving the efficiency of the engineering design process and consequently the overall dynamic performance of the agricultural tractors.

1. Avello Fernandez, L.; Maraldi, M.; Mattetti, M.; Varani, M. Computational Tool for Three-Point Hitch Geometry Optimisation. *Agriculture* **2022**, *submited*.