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Prediction of commuting effects of varying hydraulic cylinder movements on soil-plough breast interaction with a HRP

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Hydraulic Cylinder (HC) of Horizontally Reversible Plough (HRP) is commonly used for the commuting tillage of HRP. The mechanics of commuting due to HC movements surely affects the tillage performances, but whether this load has adverse effects on the two essential engaging components of HRP, i.e. ploughshare and moldboard is an underlying question. Based on our previously related work, the objective of this study is to characterize the dynamics behaviors of HRP and thus examine the commuting effects on plough-breast and most especially on plough-shank. Uniform motion was applied for HC. A combined finite element analysis (FEA) and multi-body dynamics analysis (MDA) approach was used to characterize the dynamic behaviors of the plough-breast. Five different HC movement scenarios and two actual HRP tilling conditions were involved, and the maximum operation depth of HRP was kept constant at 0.36 m. The five HC movement scenarios were specified from 15 to 25mm/s in 2.5 mm increments, and the two actual HRP tilling conditions were HRP commuting either between left and right or between left and middle continuously and alternatively. The loading data due to the HC movements were obtained from an MDA and applied to load a finite element modal of the plough-breast. Results show that the HC movements do result in the maximum stress and strain at the plough-shank, however, has no adverse effects on the service life of the plough-breast. The current HC absolutely favors the actual HRP tillage.

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