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Mathematical Time Prediction Models of Loader HSM 904 Using Multiple Linear Regressions (MLR) and Adaptive Neuro Fuzzy Inference System (ANFIS)

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Loading operation is the bottleneck of forest harvesting operation. A precise prediction of loading time can result in high quality harvesting and more economic advantages for forest management. There is a clear need to model the performance of harvesting machinery given the undeniable role they play in forest management. The main objective of this research was to compare the capability of a linear method with a non-linear approach in prediction of loading time by loader HSM 904. The Adaptive Neuro Fuzzy Inference System (ANFIS) and three Multiple Linear Regression (MLR) methods were employed to generate the models. The time of 35 loading cycles were investigated and used as the modeling data. To investigate the influence of change in Membership Functions (MF) and Inference System (IS) on the performance and generalization power of the model, four types of MF and two types of IS were adopted. The Stepwise, Forward, and Backward techniques were applied to develop MLR models. Comparing the modeling approaches indicated that the generated ANFIS with constant IS, Back Propagation training algorithm, and Gaussian membership function had a greater generalization power ($R^2 = 0.84$) and higher performance than all adopted MLR models in prediction of the loading time. The results showed that adopting the ANFIS could efficiently help forest engineers to model and monitor the performance of the machinery in forest operation.