Modelling of a conveyor-belt grain dryer utilizing a sigmoid network

ABSTRACT

Post-harvest techniques play an important role in modern agricultural industry. One of these essential post-harvest techniques is the grain drying process. However, this process is characterized by its high complexity and nonlinearity due to the effects of several drying parameters. Therefore, conventional modelling approaches cannot produce accurate modelling results to describe the dynamics of this challenging process. This paper presents a nonlinear modelling technique to develop a highly accurate model for a laboratory-scale conveyor-belt grain drying system. In particular, this modelling technique is based on utilizing the sigmoid network as a nonlinearity estimator in a nonlinear autoregressive with exogenous input (NARX) model. As the training samples, a set of experimental input-output data was used in the model development process. This data set was collected from the conveyor-belt grain dryer during a real-time experiment to dry paddy (rough rice) grains. Compared to other previously reported modelling techniques which were applied for the same drying process, the proposed sigmoid-based NARX model has achieved the best modelling accuracy in describing the grain drying process. More precisely, the proposed model has achieved a root mean squared error (RMSE) of 2.776 × 10-17. It is worth to highlight that, unlike previous efforts which aimed at modelling conveyor-belt grain drying systems, the advantage of the proposed modelling technique is that it can be directly applied to model the drying system regardless of the dryer shape, and moreover regardless of the size and physical properties of the grains to be dried. In addition, the resulting model can be readily employed in control applications to design suitable dryer controllers.

Keyword: Conveyor-belt grain dryers; Grain drying; NARX models; Sigmoid network