High Speed Weighing System Analysis via Mathematical Modelling

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Abstract

In-process electronic high speed weighing systems play an important role in the highly automated, continuously evolving industrial world of today. They are an essential component in sorting, grading and quality control within a diverse range of industries, including; robotics, automotive and food. Load cells are considered to be the definitive force sensor for industrial weighing systems. Load cell output is in the form of an oscillatory response in which the measurand contributes to the response characteristics. Current methods require the oscillatory response to settle in order to achieve an accurate measurement. This is time consuming and speed limiting.

The focus of this paper is to find alternative weighing analysis methods for a system which utilises two load cells, placed either side of a carrier travelling on a chain conveyor, running at speeds of 10 items a second. It is necessary to determine the value of the measurand in the fastest time possible to speed up the process and increase throughput. This has been approached by mathematically modelling the system to allow accurate prediction of the weights passing the load cells before the settling time of the oscillatory response. Models of harmonic motion have been considered for the motion of a load cell.

An experimental system was built and weighing data collected for different speeds and loads. Spectral analysis of the weighing data was analysed to determine dominant frequencies and estimate system parameters.

This thesis describes the work done on load cell modelling and improving an in-process electronic weighing system by successfully predicting the weight during the transient period of the oscillatory response. The assumptions and results of both simulations and experimental data are presented.

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