Weighing System by Load Cell Response Rectification Method

Karunamoy Chatterjee, Department of Electronics & Communication Engineering, Bankura Unnayani Institute of Engineering, Bankura, India

Sankar Narayan Mahato, Department of Electrical Engineering National Institute of Technology, Durgapur, Burdwan, India

Subrata Chattopadhyay, Department of Electrical Engineering, National Institute of Technical Teachers Training & Research-Kolkata, Kolkata, India

ABSTRACT

In the area of mass production, the products are weighted using load cell based weighting system. A load cell may be capacitive or resistive, is an uncontrollable weighing device. Load cell response rectification can be used to speed up the process of measurement. This paper investigates the application of analog adaptive techniques in load cell response rectification and modeling of an accurate weighing system by using that load cell. The load cell is a sensor with an oscillatory output in which the measurand contributes to response parameters. Thus, a compensation filter needs to track variation in measurand whereas a simple, fixed filter is only valid at one load value. To facilitate this investigation, computer models for the load cell and the adaptive compensation filter have been developed and implemented in PSpice. Simulation results are presented demonstrating the effectiveness of the proposed compensation technique.

Keywords: *Accuracy, Direct-Sequence-Spread-Spectrum, Mass Measuring, Noise, Sensor*

1. INTRODUCTION

The weighing of articles is an essential part of modern life. There is a constant need for knowing the exact weigh of many items, e.g., food, ingredients for production, pharmacology, chemistry, technology, etc. The type and the number of products that require weigh control are increasing. Consequently, the legal requirements of government bodies internationally are trying to maintain the same constant pace. In production, this means high accuracy and efficiency of weighing are also constantly high on the agenda. Continuation of this trend brings benefits for both the customer and the producer. That is, manufacturing efficiency is increased and hence profitability while package quality and quantity are assured to the customer's satisfaction. In the area of mass production, products are weighed using electronic weighing scale, as shown in Figure 1, that weigh a package fast and accurately. Load cells are used in a variety of industrial weighing system. Since information processing and control systems cannot func-

DOI: 10.4018/ijmtie.2012070104

Figure 1. Home electronic weighing scale

tion correctly if they receive inaccurate input data, compensation of the imperfections of the sensors is one of the most important aspects of sensor research. Influence of unwanted signals, non ideal frequency response, parameter drift, non-linearity, and cross-sensitivity are the five major defects in primary sensors (Brignell & White, 1994). In the new generation of sensors, called intelligent or smart sensors, the influence of these imperfections has been dramatically reduced by using signal processing techniques. Some sensors such as load cells have an oscillatory out- put, which need time to settle down. For dynamic measurement, it is important to make a decision on the measured as fast as possible. Dynamic measurement refers to the ascertainment of the final value of a sensor signal while its output is still in oscillation. It is used to speed up the process of measurement. One example of processing that can be done on the sensor output signal is filtering to achieve response rectification. Several methods have been reported addressing this problem. Software techniques for sensor compensation are reviewed in Brignell (1991). Digital adaptive techniques have been used in (Shi, White, & Brignell, 1993) for load cell response rectification. An artificial neural network has been proposed for dynamic measurement which needs a learning phase (Almondarresi Yasin & White, 1999). Other methods such as employing kalman filter (Halimic & Balachandran, 1995) and estimation with recursive least square (RLS) procedure (Shu, 1993) have also been applied for dynamic weighing systems. Almost all the above reported methods are based on digital signal processing techniques which need analog-to-digital convertors.

2. LOAD CELL RESPONSE RECTIFICATION

The primary sensor is considered as a system with transfer function G(s). The general principle for eliminating the transient time is shown in Figure 2. A filter having the reciprocal characteristic of the sensor is cascaded with it. There-fore, the transfer function of the whole system is "unity" which means that any changes in the input transfer to the output without any distortion. The response of a load cell can change for different measurand. For example, the characteristic of a load cell changes when a load is applied to it because the mass of the load contributes to the inertial parameters of the system. Therefore the transfer function of the filter should change accordingly. In other words, a fixed filter can be used only for one specific load value. The general equation for

Related Content