Chapter 2

The Counting Scale of the HTWG Konstanz

This chapter describes the installation around the counting scale under study in the HTWG Konstanz including his mechanical design and measurement electronics.

2.1 Mechanical design

The referred counting scale, consists mainly on a steel container over a metal grate that lies onto four weight sensors at the corners with foam mufflers in between. The whole set is installed on another larger main grate (see figure 2.1) playing the role of an artificial ground. Last modifications of the scale [2] introduced also a set of 50mm wide *Sylomer R* boards (on blue in the picture) between the sensors and the main grid in order to improve the mechanical behavior of the installation.

Figure 2.1: *Mechanical installation of the experimental counting scale in the laboratories of the HTWG Konstanz*

The function of the main grate is to allow the simulation of ground vibrations. This is done with the help of an unbalanced electrical motor fixed at one side over the main grate. The frequency of the motor can be controlled and set to a desired value. Induced vibrations are transmitted trough the structure affecting the measures in the same way ground vibrations would do.

2.2 Measurement electronics

Weight sensors are of the class *RD* provided by DigiSens. Their performance is based on the linear relation of the vibrating frequency of a string and the strength applied on it. The design schema on figure 2.2 shows how the weight is transmitted to the string increasing its strength and vibrating frequency. This frequency is measured with the help of a laser device. The conversion of this value into a weight value is then straightforward.

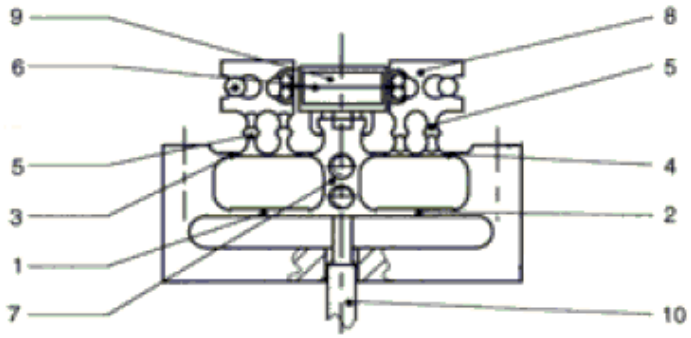

Figure 2.2: *Schema of a RD sensor*

Sensors data acquisition is performed with a data acquisition target provided of an ATMEGA 128 microprocessor. The target receives the reading of the four weight sensors and, after processing the data, sends the result to a DigiSens control panel (figure 2.3), as well as to a computer in which they can be shown, saved and post-processed. Figure 2.4 shows the target and a sensor as they are installed at the grid. Figure 2.5

The main tasks of the microprocessor are to add the values of the four sensors, to set and to deduct the *zero-state* weight value and to run the on-line algorithm for detecting the weight leaps out and counting the units falling in the scale. However, these tasks can be skipped over if desired reducing the function of the microprocessor to receive, to add and to transmit the four weight sensor outputs. In the moment this thesis started, a *Multi-Level Hinkley Detector* (as explained in chapter 4) was implemented and running on the microprocessor providing the count of the pieces on the scale if this option was selected.

Figure 2.3: DigiSens's control panel

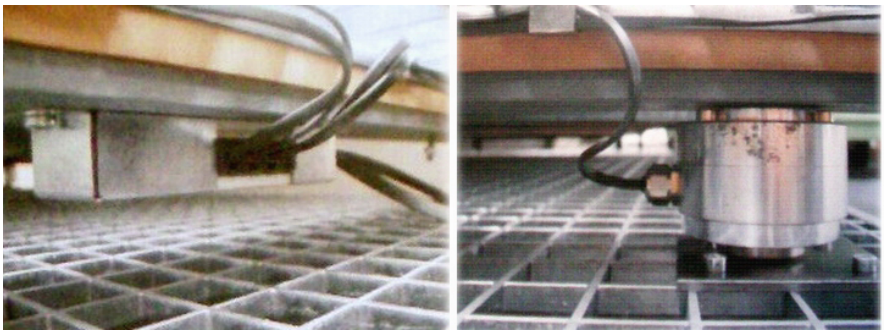

Figure 2.4: Installed devices: Data acquisition target and weight sensor

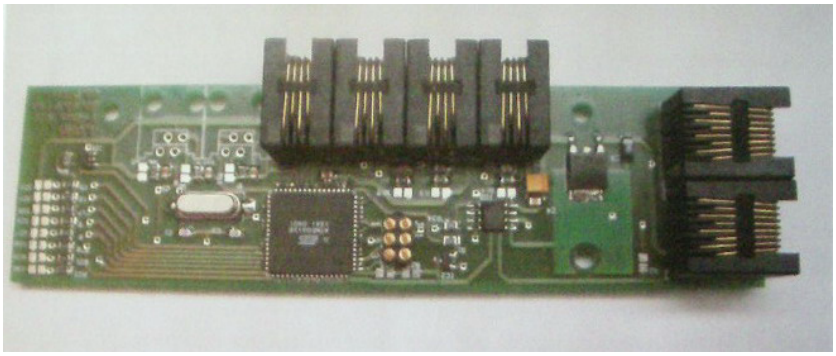

Figure 2.5: Data acquisition target

2.3 Typical raw data

The product whose count is to be performed is a component of a manual gear box and has a weight of 147g. Each weight sensor can measure up to 500Kg. Since the weight is distributed onto four of them, up to 2000Kg total weight can be measured (including the container and the grid).

It is also interesting to know some data concerning the frequencies of the whole measuring system. Weighing frequency is set by the microprocessor at 27Hz, while the sensor string oscillation frequency is 15KHz when not loaded. Oscillations of the sensor string are checked out by the laser device with a sampling rate of 1Mhz.

Since vibrations on the ground, when strong enough to affect the installation, are typically around 10Hz, no aliasing effect is expected. Furthermore, no aliasing effect would also be expected even if the vibrations of the ground were 27Hz or higher, since the counting of the sensor string oscillations are carried out continuously with 1Mhz sampling rate. This means that the measures the microprocessor gets every 37 milliseconds (27Hz) are a kind of *average value* of the weight during the whole sample period.