Summary

A good insight in the condition of a belt conveyor is important since maintenance jobs are often expensive operations. Applying condition monitoring reduces maintenance costs as it allows scheduling maintenance operations, which keeps production downtime to a minimum, reduces belt conveyor damage costs and minimizes spare parts inventory size. However, with thousands of bearings in one belt conveyor system, it is often difficult, time consuming and inaccurate to predict which bearing is going to fail at what time.

This research is based on a technique that automatically detects damaged bearings in belt conveyor rollers, without any human intervention. Using L-Nodes from SOWNet, which are basically RFID-tags with a temperature sensor, the temperature inside the roller shaft is measured and transmitted to a receiver that is connected to a processor. Any sudden changes in temperature will indicate a possible bearing failure.
The goal of this research is to investigate the applicability of a Wireless Sensor Network in a belt conveyor, by investigating the influence of a metal environment on the nodes.

During this research, the nodes are submitted to multiple tests, measuring the signal strength at various distances, in a range from 0.5m to 5m with step size 0.5m, while varying only one parameter per test.

In Chapter 1, three preliminary tests are executed, in which the basic performance of the nodes is tested.
Preliminary test 1 is a temperature check, in which the temperature of 11 different nodes has been monitored during 10 minutes. One node seemed to be corrupt, and was therefore excluded from further tests.
In Preliminary test 2, the nodes have been tested on their signal strength in free space. The results appeared to vary which each node, which was unexpected and could not be explained.
Preliminary test 3 is a duration test, in which two nodes have been connected to the gateway for 24 hours. This test was performed to investigate the influence of any daytime activity in the building on the signal, as this may had caused the variation in results in Preliminary test 2. However, no significant influence was observed.

In Chapter 2, the nodes have been placed in a single shaft, and signal strength has been measured at various distances. Results appeared to be more consistent than in free space in Preliminary test 2, which was remarkable, but unexplainable. Shortly after this test, an explanation was found: The signal strength seemed to be influenced by the position of the power supply wires that connect the node with the battery. Bearing this in mind, the research was proceeded to the next test.

Chapter 3 describes the roller test, which is basically equal to the previous test, but now with an entire roller instead of a single shaft. Results of repetitive tests for each node seemed to be consistent, but between the nodes, there was still a difference in performance that could not be explained. However, some nodes lost connection with the gateway during the test, which implied that the signal strength came near its limit value of successful data transfer. This value seemed to be laying around -70 dBm.

In Chapter 4, the first frame tests have been performed. In the first part of Chapter 4, the frame has been equipped with only one roller (wing roller) and one node. In the second part the two other rollers are added.
During these tests, a new node configuration has been invented, which solved the mystery of the variation in node performances. With this new configuration, the battery was put together with the node inside the shaft, by which the power supply wires no longer disturbed the signal. Results were suddenly more consistent than they had ever been, and all nodes suddenly appeared to perform equally. From now on, all tests would therefore be performed with this new node configuration.

Chapter 5 describes the frame tests where all three rollers were supplied with a node, so that three nodes were tested simultaneously. The tests have been performed with the frame positioned both longitudinal and parallel to the gateway. However, in both configurations, the node in the centre roller could hardly establish a connection with the gateway.

In Chapter 6, a second frame has been added to the test setup. Each of the six rollers has been equipped with a node, so that 6 nodes were tested simultaneously. As it could be expected after the previous test, the nodes in the centre rollers could hardly establish a connection with the gateway.

It could now be concluded that in this configuration, the nodes were not suitable for the application of a wireless sensor network in a belt conveyor. For the centre node, the signal is too weak to get through the metal environment and establish a reliable connection with the gateway.