

RFID Reliability Technique for Single Tag Interrogation

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Improving the read reliability of individual Radio Frequency Identification (RFID) tags is important to the military's goal of achieving a supply chain management system with item level tagging. Item level tagging improves the ability of suppliers to plan, meet demands and streamline business processes. The benefits to the military are a better inventory management, better productivity and improved asset tracking.

The goal of a supply chain management system with item level tagging, was first demonstrated by Walmart, when she mandated her top 100 suppliers to be RFID ready by 2005. The DoD also issued a similar mandate, and committed to the implementation item-level tagging with RFID technology, with additional funding and the issue of policies to suppliers.

Due to the limitations of the current RFID technology, Walmart and the DoD have only been able to implement pallet level tagging. 100% read reliability for pallet level tagging has not been achieved, and hence, item level tagging, which requires multiple tags to be read simultaneously, is not yet achievable.

Accurate tag reads are vital for the successful implementation of a RFID system. The objective of this study is to improve the read reliability of RFID systems. This study looks at the current RFID technology, focusing on the problems and limitations of the technology, when deployed in a single tag to single reader environment. Several factors may affect the read reliability of an RFID system. They include speed, distance, orientation, coding techniques, power, sensitivity and error detection. Many of these factors result in signal attenuation, which reduces the signal-to-noise ratio (SNR). Simulink models are used to study the effects of the factors listed above. The simulation runs shall examine the variation of the bit error probabilities as SNR changes.

Data is typically coded using on-off keying (OOK) in the existing RFID systems. Our simulations revealed that with OOK, an SNR of 12.5 dB is required to achieve a bit error rate of 10^{-4} . Often, due to environment conditions, orientation of tags, and other uncontrollable factors, this SNR is not attainable.

This research explores alternative coding techniques with the aim of finding techniques that yield better bit error rate performance, looking at repetition coding, code shift keying, and a combination of the two. With repetition coding, performance is improved by approximately 4 dB when each bit is repeated five times, resulting in a SNR of 8.5 dB for a bit error rate of 10^{-4} . The use of code shift keying (CSK) requires a SNR of 8.5 dB to achieve the same bit error rate performance of 10^{-4} . The final method of coding, which involves the repetition of each bit before CSK, achieves a 2.5 dB improvement over the previous methods, requiring a SNR of 6 dB. This is a coding gain of 6.5 dB as compared to OOK.

This research examines the building block of the item-level tagging goal of Walmart and DoD, improving the individual read reliability of a single tag in a single reader environment. The use of CSK with repetition coding reveals a lower requirement for SNR, achieving a better read reliability, thereby making the RFID system more reliable.