

**Dissertation title:**

**Low Interference Data Transmission in a Dynamic Production Environment  
(Störungsunempfindliche Informationsübertragung in dynamischer  
Produktionsumgebung)**

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**This work proposes a solution for wireless field bus communication with ultra-wide band (UWB) technology in manufacturing environments. A wireless field bus offers an important improvement to the smart factory due to increasing requirements for connectivity, adaptability and flexibility. Reliable data transmission for control and production data acquisition in a plant is a crucial issue. In particular, field devices are connected by wire so far but to increase the flexibility a wireless transmission is essential. This paper points out the potential of a wireless field bus and shows how it supports the seamless transit from the virtual to the real factory. In this work we analyze the requirements of a wireless field bus in the manufacturing environment. Different possibilities of a wireless connection are compared and the conclusion is that UWB is the appropriate technology and meets the requirements to be a reliable communication system. Our implementation strategy illustrates the advantages of wireless field bus communication with UWB and suggests how to realize a dynamic reconfigurable control and sensor network.**

**In the first step the requirements and constraints of manufacturing environment was analyzed and a wireless field bus bridge was designed. After comparing different possible wireless communication technologies the transmission in the ultra-wide band was chosen.**

**The transmitter and the receiver were designed modular, so in the second step the single modules could be simulated, assembled and measured separately. A manufacturing environment specific channel was created to get more accurate simulation results. Furthermore a band pass filter plus an envelope detector were designed. The coder and pulse generator were realized in a FPGA. An interface to the common field bus Profibus was created to integrate this wireless bridge in a manufacturing environment**

**The measurements of this setup showed that the signal can be transmitted, but there is major difficulty with discrete components and the modular structure that way that the signal was observable but the data was not detectable with the envelop detector.**

**In order to determine the best type of IR-UWB modulation a software defined radio system with direct sequence synthesizers is convenient. For this purpose**

on the transmitter side a digital-analog-converter (DAC) with 25 GS/s controlled by FPGA feeds directly the UWB antenna. On the receiver side the received signal is amplified by a low noise amplifier (LNA) and converted to a digital signal by an analog-digital converter with as well 25 GS/s. The digital signal is further processed with a FPGA. This enables the adaptation of transmission parameters during operation. Thereby the transmission parameter, channels, antennas and RF components can be investigated. A specific antenna on the Vivaldi-principle was developed improving the transmittance.

With the first test bench it was not possible to reach the intended data rate, so it was necessary to start with a lower data rate. Measurements show that the transmission works also in rough environment with no line of sight. To make sure a low bit error rate a test file was transmitted and the difference checked.

To get a better transmission rate and better energy efficiency an integrated solution can be pursued.