

# Tag Position Estimation in RFID Systems

by

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Yi Li

*To my parents*



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# Abstract

In order to find people, locate intruders and navigate patients along a building, various wireless positioning technologies have been researched. Compared with the other wireless positioning techniques, RFID has some obvious advantages of low cost, long lifespan and energy efficiency. All these advantages make RFID a good choice to implement wireless positioning systems in an indoor environment.

Radio frequency identification (RFID) is a technology that utilizes electromagnetic waves to convey information between an RFID reader (also called as an interrogator) and an RFID tag in order to identify and track the object to which the tag is attached. According to the power sources of RFID tags, RFID systems can be divided into two types: active RFID and passive RFID. While active RFID systems are better for outdoor localization, passive RFID systems are more suitable for indoor positioning. For the special modulation scheme 'backscattering' of passive RFID systems, we can estimate the position of tags according to the phase differences between the transmitted signal and the backscattered signal (PDOA).

In this thesis, we have proposed a structure that can be used to measure the phase differences between the transmitted signals and the backscattered signals. After proposing the structure, it is analyzed mathematically. Some simulations with the software Simulink are also performed to theoretically verify the effectiveness of the proposed structure.

According to the proposed structure, we set up a hardware platform. Using the hardware, several tests were made and based on the analysis of the test results, the effectiveness and efficiency of the proposed structure has been verified practically.



# Statement of Originality

This work contains no material that has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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Signed

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Date



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*Yi Li (May 2012)*



# Conventions

## Typesetting

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This thesis is typeset using the L<sup>A</sup>T<sub>E</sub>X2e software.

The fonts used in this thesis are Times New Roman and Sans Serif.

## Referencing

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Referencing and citation style in this thesis are based on the Institute of Electrical and Electronics Engineers (IEEE) Transaction style [1].

For electronic references, the last accessed date is shown at the end of a reference.

## Units

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The units used in this thesis are based on the International System of Units (SI units) [2].

## Spelling

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The Australian English spelling is adopted in this thesis.





# Abbreviations

**ASK** Amplitude Shift Keying

**CW** Continuous Wave

**FD-PDOA** Frequency Domain PDOA

**GPS** Global Positioning System

**IEC** International Electrotechnical Commission

**ISO** International Organization for Standardization

**PDOA** Phase Difference Of Arrival

**PSK** Phase Shift Keying

**RF** Radio Frequency

**RFID** Radio Frequency Identification

**RSSI** Received Signal Strength Indication

**SD-PDOA** Spatial Domain PDOA

**TDOA** Time Difference Of Arrival

**TD-PDOA** Time Domain PDOA

**UWB** Ultra-WideBand

**WLAN** Wireless Local Area Network



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