

# Exploiting LED Rolling-Shutter Effect in Indoor Positioning System Modern Mobile Communications

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## Abstract

It has been very mature to locate one's position in the outdoors using GPS like satellite positioning systems in a relatively acceptable deviation. However, Indoor Positioning System (IPS), still cannot be available in modern indoor environment such as airport or grand shopping plazas due to several constraints. But IPS has been proved to be very useful in the perspective future by the industry. Although this topic has been researched in recent 10 years in many related methods, there are two key issues of hardware cost against accuracy that cannot make a good balance between one another. In this article, we first give some research on related works of indoor positioning system, mainly on five systems of RADAR[00], Centaur[12], Cricket[04], Ubicarse[14], and Luxapose[14], then we fulfill the detail implementation of Luxapose, one method exploits visible light communication to realize IPS and evaluate its performance on some key factors of accuracy and available limit distance.

*Keywords:* IPS , AoA , Rolling Shutter, VLC

## 1. Introduction

Smart devices with cameras and LEDs are abundant in today's environment. This abundance creates an untapped opportunity for using these devices for wireless communication. Meanwhile, even if localization technology based on GPS developed maturely, we find the inconvenience with indoor localizations in malls or airports, which in fact in great need of the technology support of indoor localization since the environment is complex.

Indoor localization serves these situations, and it can detect a wireless user's gesture, movement, or can do location-based authentication. In this article we draw a novel way by exploiting the LED lights to realize this indoor localization problem.

This report does some survey on existing indoor localization methods and introduces some representative works in section 2. In section 3 we explicit the major task of Luxapose, involving the working scenario and techniques we planned to utilize, then we give a detailed definition of the indoor localization with LED AoA algorithm. In section 4 we introduced how the system been built on different modules. In section 5 we make an evaluation on several key metrics of location distance and accuracy and look forward to some future work that are needed to be worked on.

## 2. Related Works

Indoor localization has been worked on for years since its demand in industry is badly. We review four major representative work based on RF, acoustic, and MIMO techniques, the four main methods today in research of indoor localization. We analysis their defects to show the advancement in our work of Indoor Localization with LEDs.

### 2.1 RF-based Localization [Radar (2000)] [Centaur (2012)]

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### 2.2 Acoustic-based Localization [Cricket (2004)]

### 2.3 MIMO-based Localization [Ubicarse (2014)]

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### 3. Problem Definition and Algorithm of Luxapose

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## 4. System Modules Implementation

## 5. Evaluation and Conclusion

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