Visible Light Localization Using Incumbent Light Fixtures

Chi Zhang[1], Shipei Zhou[2], Xinyu Zhang[1] [1]*University of Wisconsin-Madison* [2]*Peking University*

Introduction

Visible Light Localization:

LoS propagation: ***robust, multipath-free***

Densely deployed landmarks: ***high accuracy***

Existing works show 10cm to 1m accuracy

However, ***LED beacons needs extra circuits***!

- Extra ***manufacturing cost***
- Huge ***retrofitting effort***

LiTell (MobiCom'16):

Uses ***incumbent fluorescent lights*** as landmarks and ***smartphone cameras*** as sensors, requires ***zero*** retrofitting cost.

However, ***cameras are energy-hungry***!

LiTell2:

LiTell with low-cost, energy efficient photodiodes (PDs)

Key challenges:

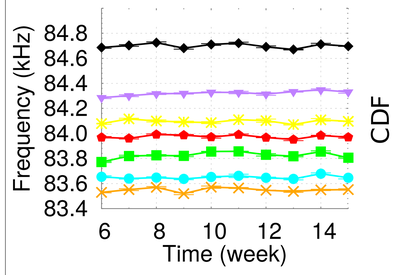
- PD has no spatial resolution
- Irregular fixture and shadowing defeat RSS propagation modeling

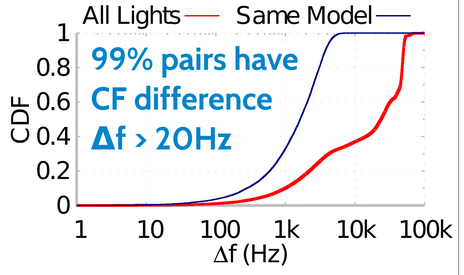
How it works

Fluorescent and LED light drivers add ***high frequency (10k to 100 kHz)*** to light's emission

Manufacture variations make the frequency ***diverse*** and ***unique***

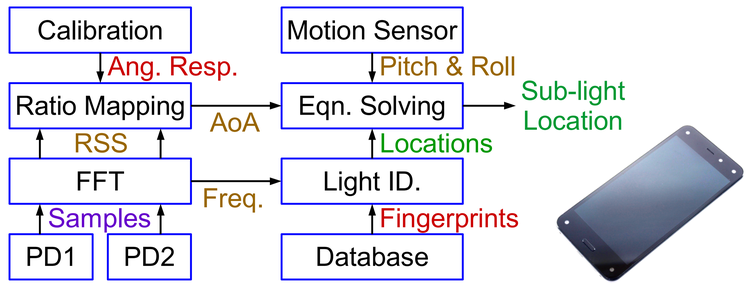
Can be seen as ***characteristic frequency (CF)***, which is ***stable*** over time





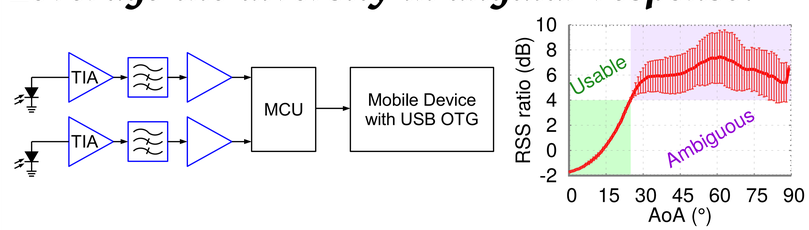
LiTell2's solution:

- Use multiple lights to provide diversity
- Rely on AoA instead of RSS information
- Further reduce deployment efforts with automated fingerprinting process, based on Google's Project Tango



How can PD measure AoA?

Leverage the diversity in angular response!



AoA to Location

- Dynamic range of PD allows capturing lights both near and far
- Diversity in CF forms FDMA, enabling simultaneous extraction of multiple light identities and AoAs
- 3 lights lead to 3D location fix, 4 eliminates need for compass

Fingerprinting is easy:

- Plug the dongle into the Tango tablet
- Take a walk throughout the building
- Match the generated trace to floorplan
- Done!