IPIN’2011

Survey of Optical Indoor Positioning Systems

Session 2 – Optical Systems

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Overview of Indoor Positioning Technologies

Contents

- Introduction
- System Approaches Classified by Reference Information
- Conclusion

Introduction

How get 3D from 2D images?

- views from multiple cameras
- single camera, multiple views

Two architectures / applications

- ego-motion
- tracking and mapping objects

Combined: SLAM

Introduction

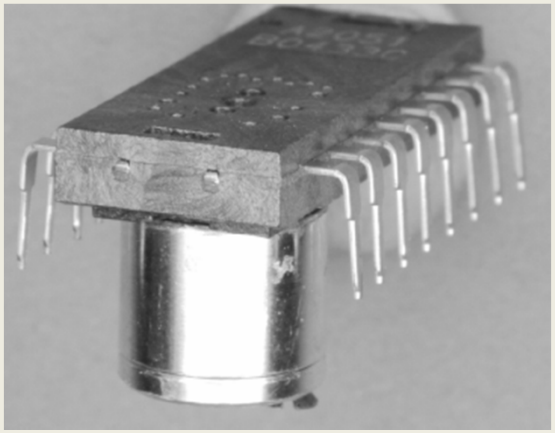
Success of optical positioning systems
is driven by improvement & miniaturization of

- detectors (i.e. CCD sensors)
- actuators (i.e. lasers)
- computing
- data transmission rates
- image processing algorithms

Introduction

Reported Parameters:

Accuracy:	0.05 mm – 30 cm
Coverage:	1.5 m – km (scalable)
CCD Size:	16 × 16 – 2000 × 2000 × 4
Frame Rate:	1 Hz – 2300 Hz
Camera Cost:	1.35 € – 100’000 €



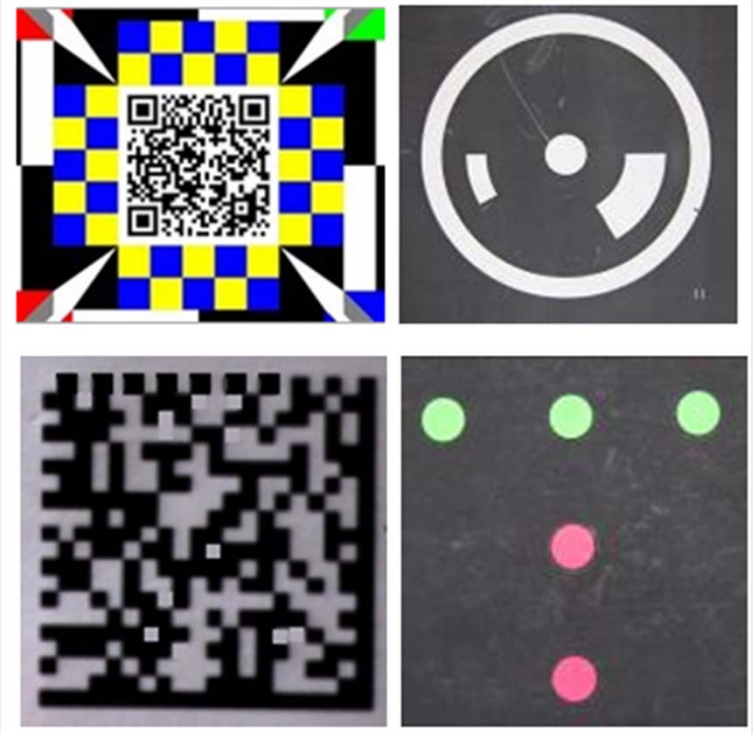
How can reference information be obtained?

- Deployed Coded Targets
- Projected Targets
- 3D Building Models
- Image Sequences
- Additional Sensors
- Systems without Reference

Reference from Deployed Coded Targets

+ robustness
+ high accuracy
+ simple detection
+ global reference
+ identification

- only local coverage
- target deployment

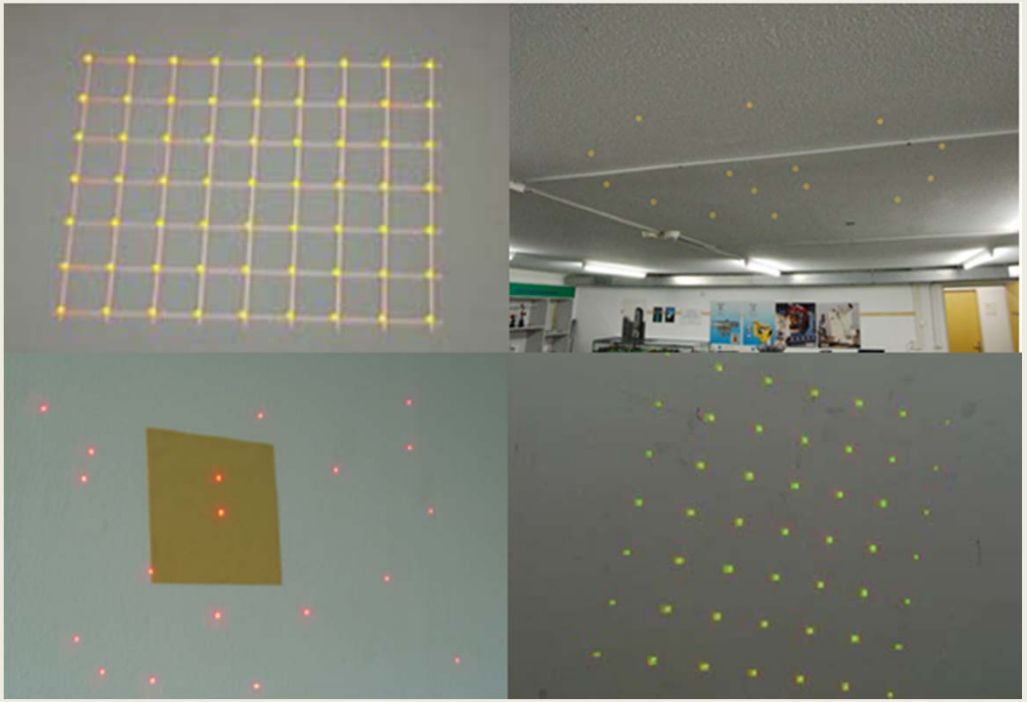


Upper right: Mark (2011)

Reference from Projected Targets

+ no physical deployment
+ simple detection

- direct view needed
- disturbing light
- local coverage



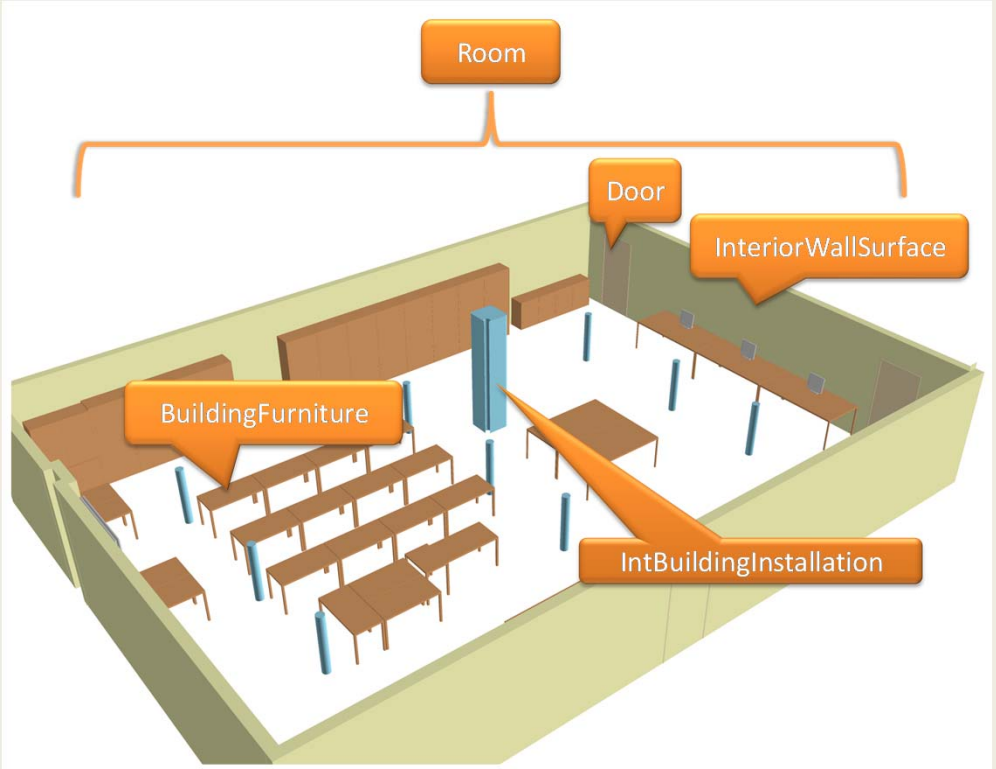
Upper left: TrackSense Grid, upper right: CLIPS laserspots, lower left: laserspots of Habbecke, lower right: diffraction grid of Popescu

Reference from 3D Building Models

Matching of detected objects with building data base

+ no local deployment of reference nodes
+ large coverage, low costs

- matching not reliable
- building model required



Kohotek et al. (2010)

Reference from Images Sequences

View-based approach: image sequence data

+ no local deployment of reference nodes

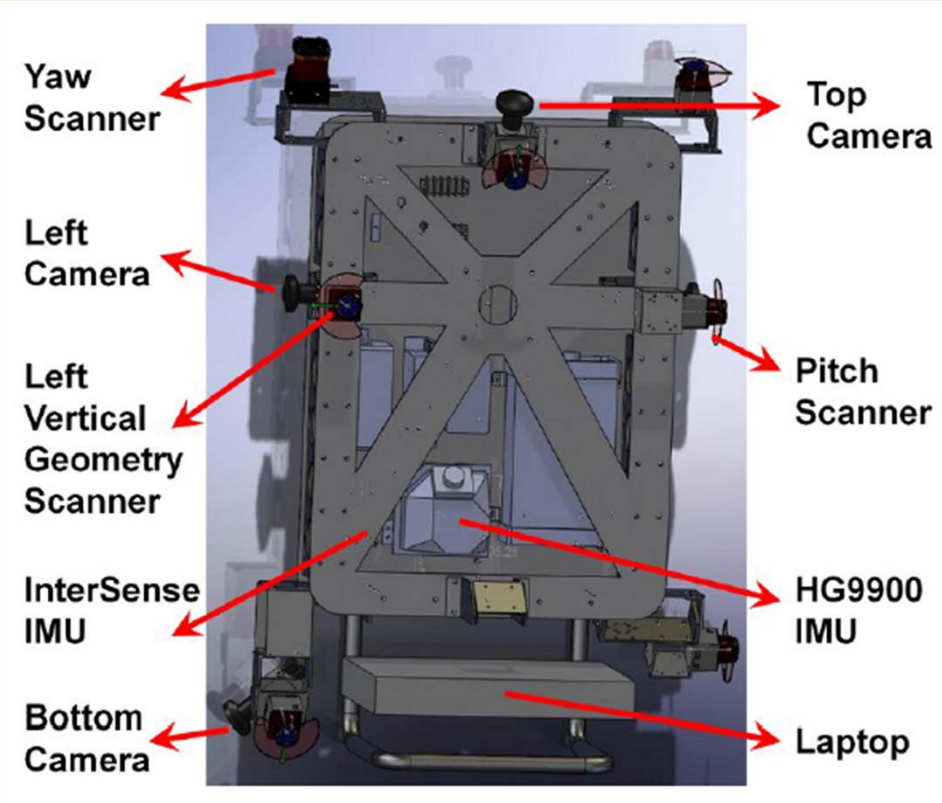
- processing cost high
- challenge for real-time
- drift if no database

Reference from Additional Sensors

Hybrid Techniques

+ absolute reference, scale, enhanced accuracy, coverage or robustness

- higher complexity



Liu et al. (2010)

Systems Without Reference

Relative Position Changes, Tracking Mobile Objects

+ high precision

- only relative changes

Bürki et al. (2010)

Conclusion

Optical indoor positioning systems achieve accuracy levels of 0.05 mm – dm

High precision systems for industrial metrology and surveying

Low-cost solutions serve mass market

High measurement rates for precision navigation, real-time mapping and pose estimation

Potential using additional sensors