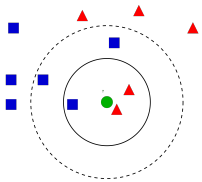

Machine Learning-based Indoor Localization for Micro Aerial Vehicles

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27th July 2016

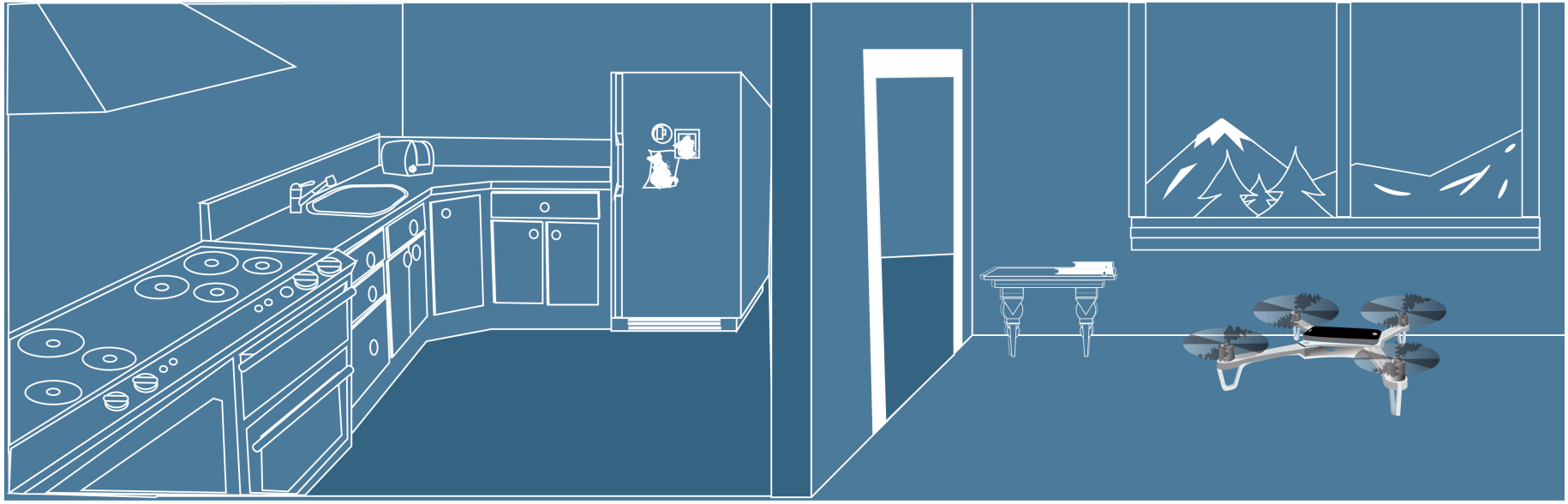
Radboud Universiteit

TU Delft Delft University of Technology

Louis Vuurpijl

Guido de Croon
Roland Meertens

MOTIVATION

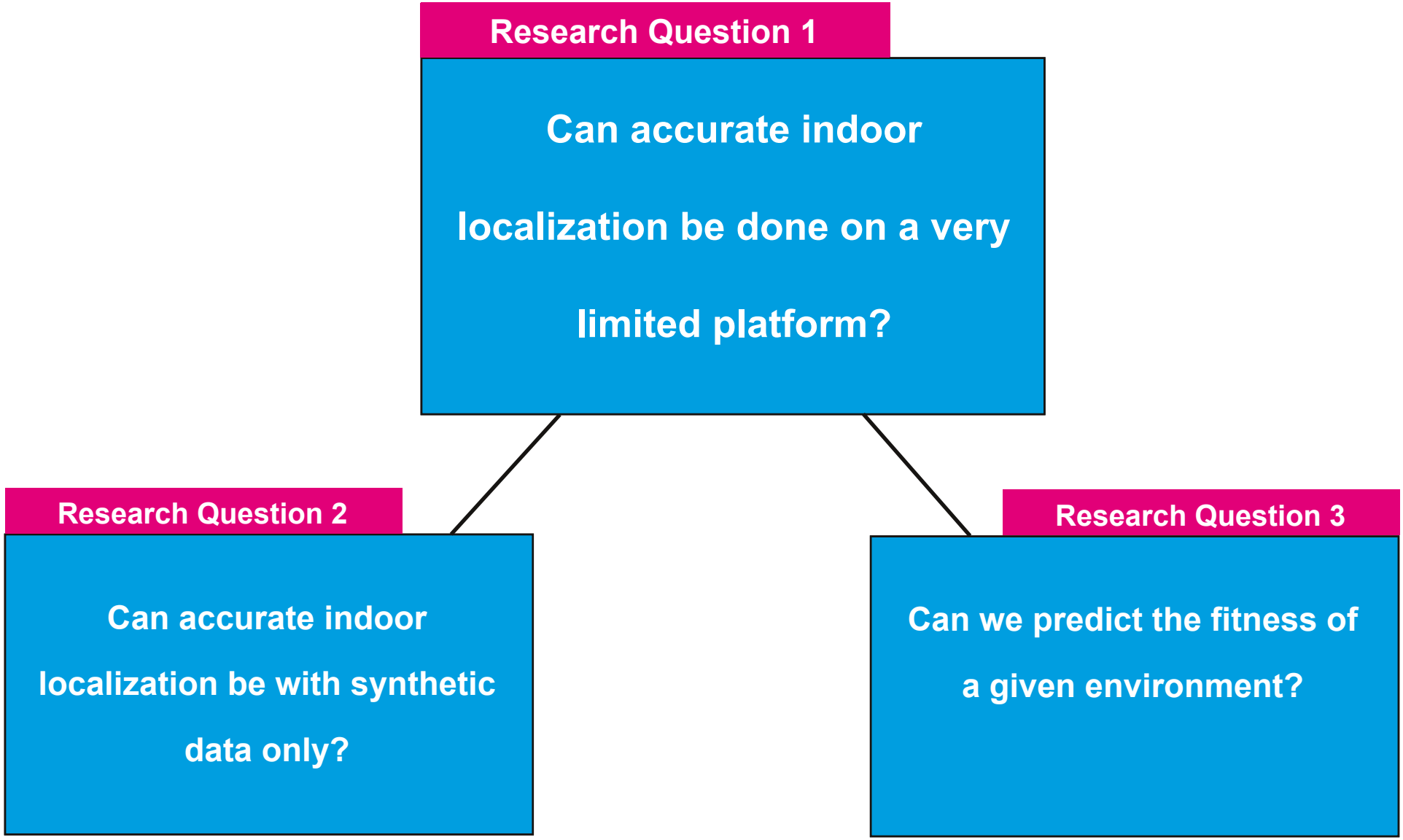


MOTIVATION

Research Question

Can accurate indoor localization be done on a very limited platform?

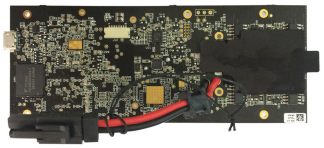
RESARCH QUESTIONS

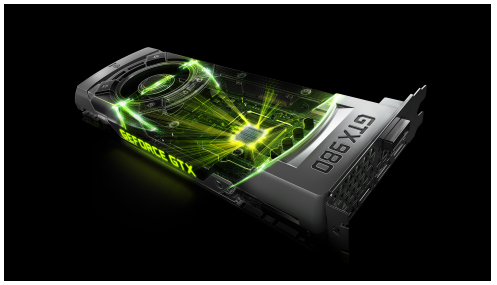


SETTING

Camera

Processor





Datalink

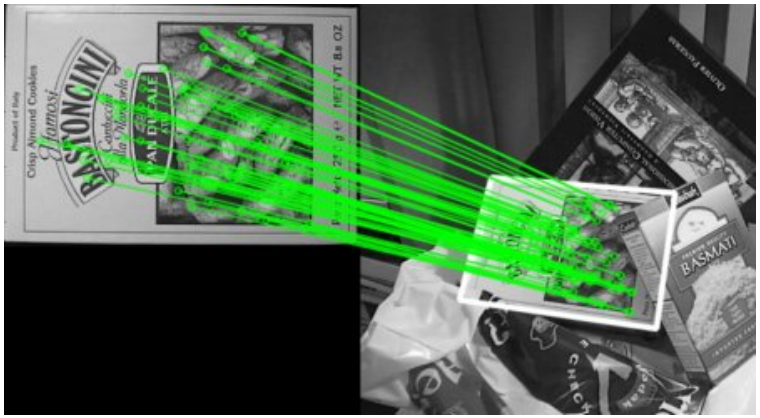
OUTLINE

- Existing Methods
- Machine Learning-based Approach
- Flight Tests & Simulations
- Discussion & General Discussion
- Conclusion & Future Work

OUTLINE

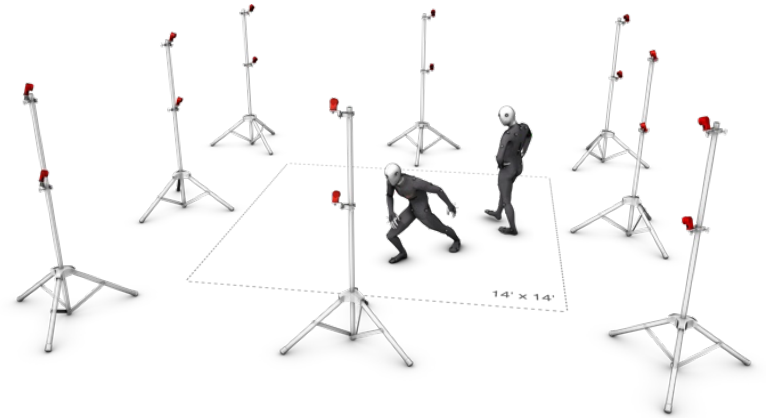
- Existing Methods
- Methods
- Experiments and Results
- Discussion
- Conclusion

METHODS FOR INDOOR LOCALIZATION

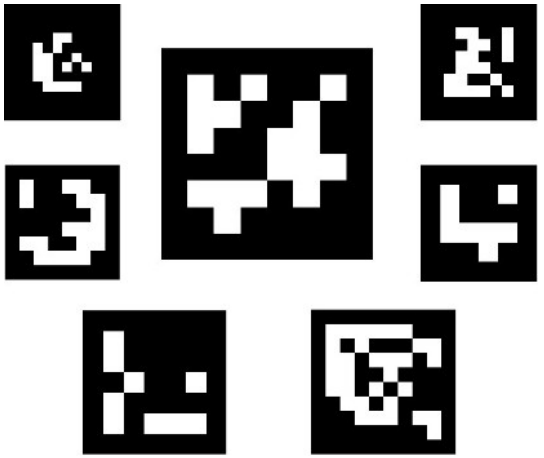


SIFT + homography finding

Laser range finder

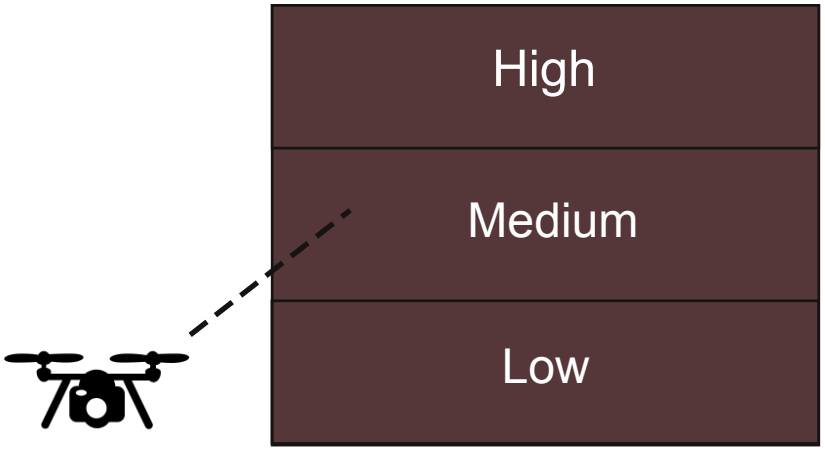


Motion tracking system

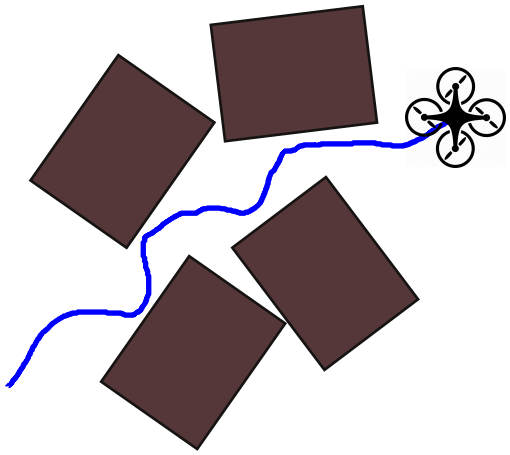


Markers

FOUNDATION

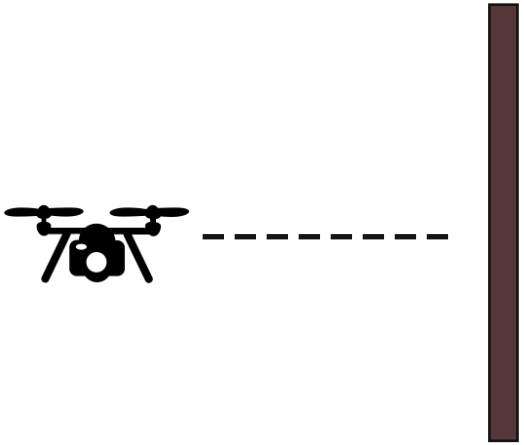


Height control



Obstacle Avoidance

Safe Landing Spot Detection



Distance Measurement

CHALLENGES / CONTRIBUTIONS

Continuous regression problem

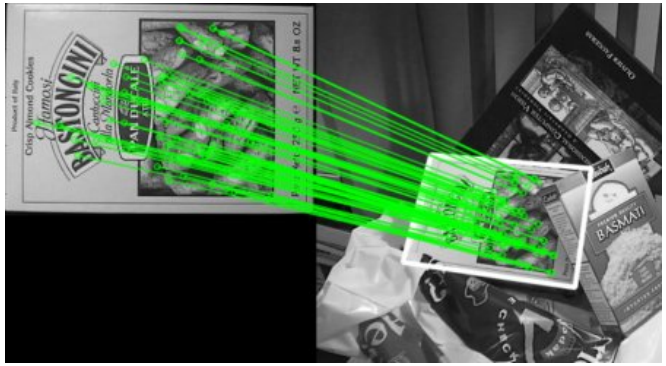
Low performance platform

Embedded systems programming (C)

Ground truth estimation

IDEA

Preflight phase

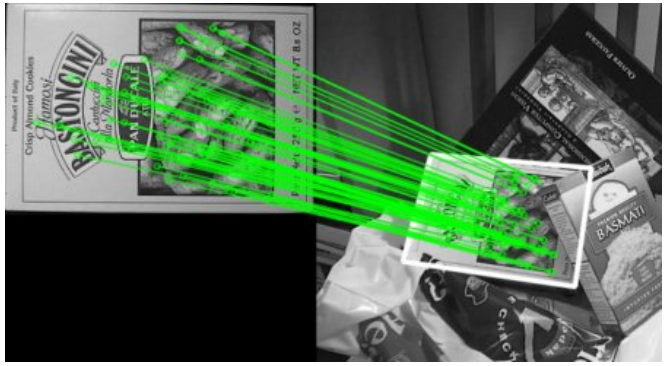


frequencies	x	y
	200	300
	700	210
	⋮	⋮
	111	210

Training Data

(computational) effort

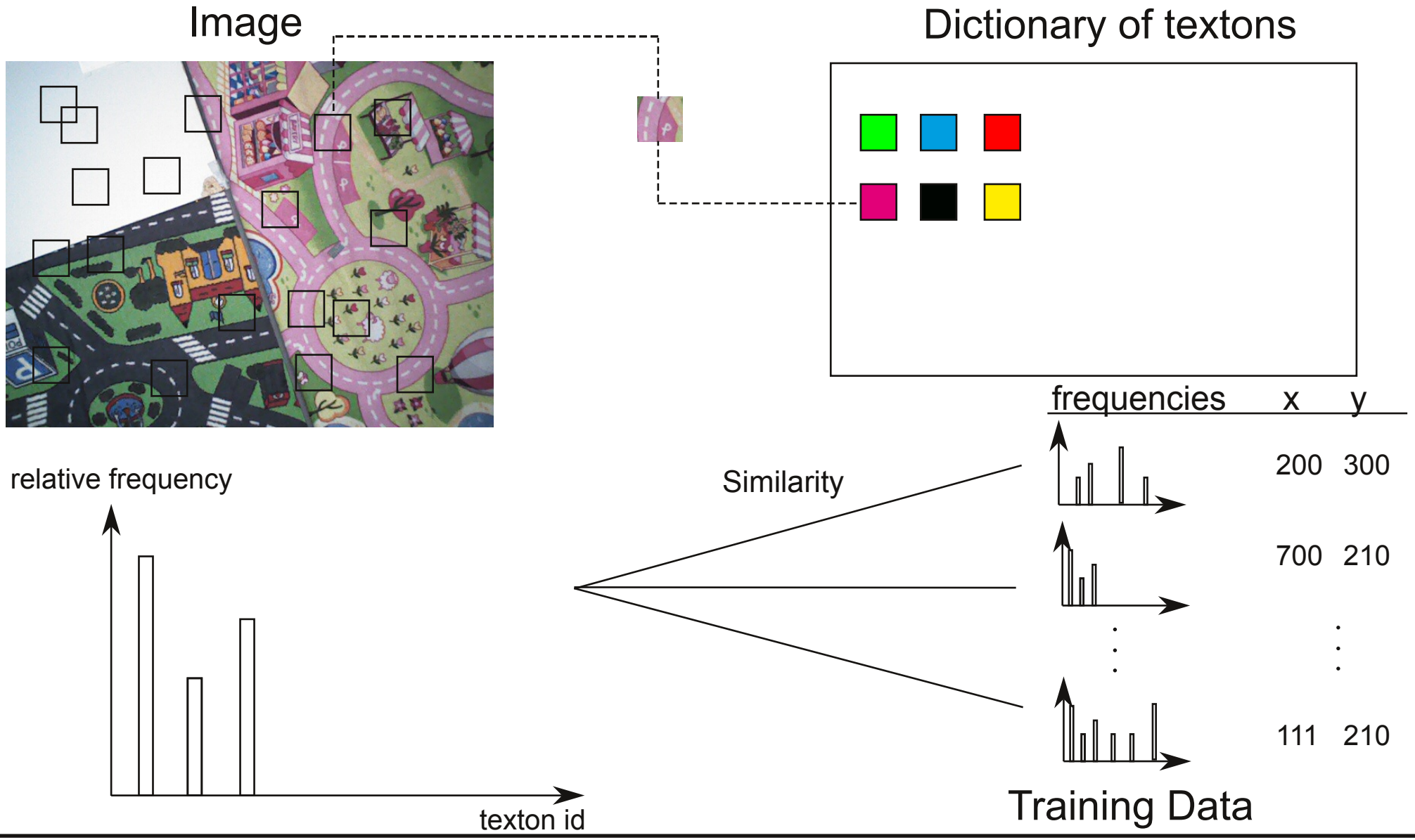
Flight phase



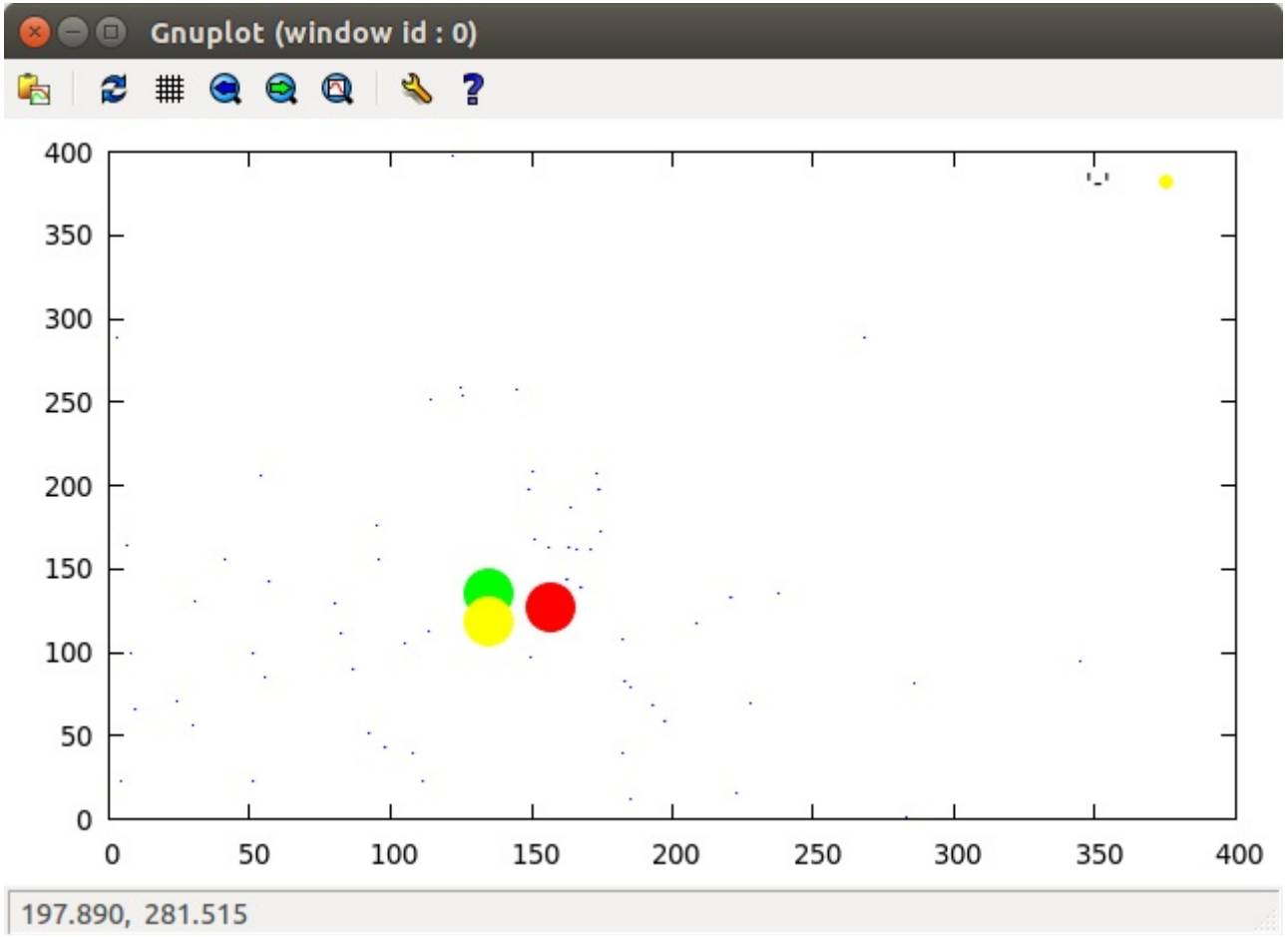
OUTLINE

- Related Work
- **Methods**
- Experiments and Results
- Discussion
- Conclusion

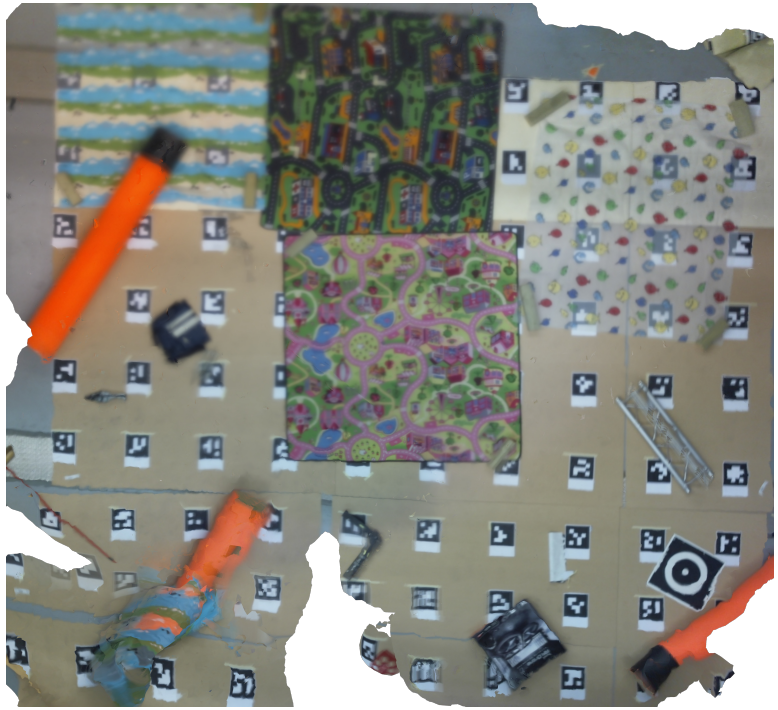
MACHINE-LEARNING APPROACH



PARTICLE FILTER

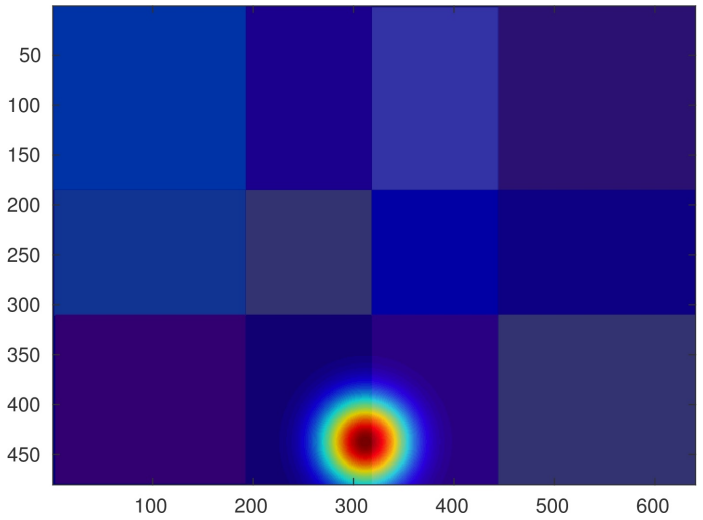


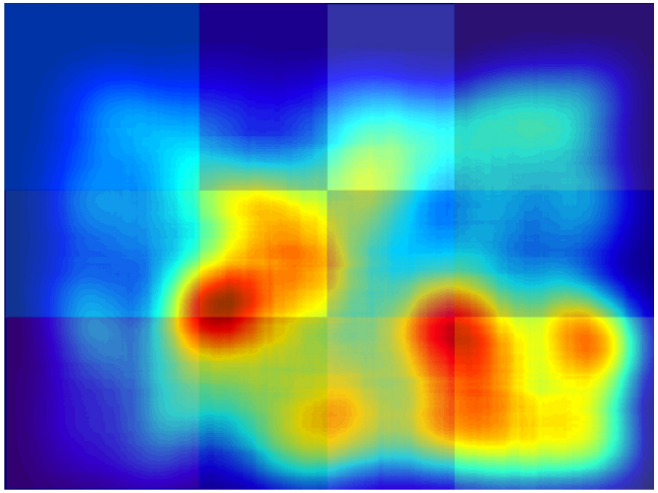
GROUND TRUTH ESTIMATION



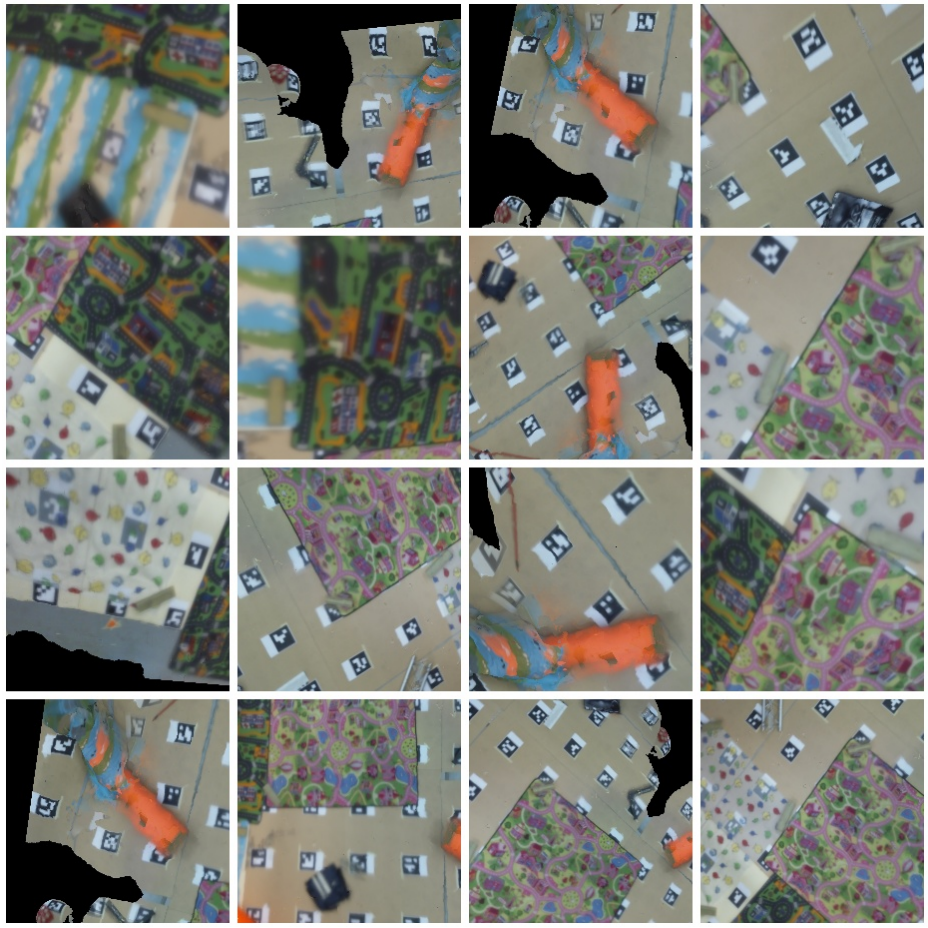
ENVIRONMENTAL MODIFICATION

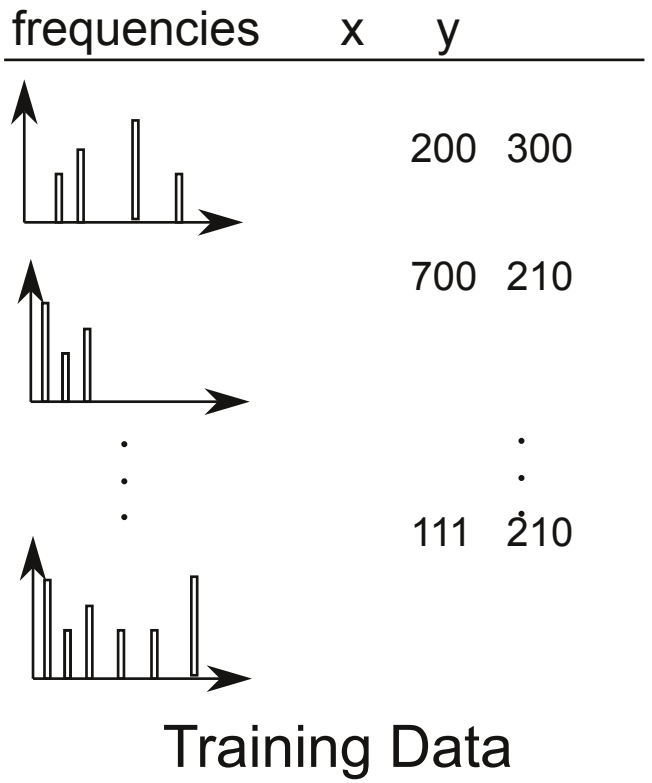
MAP EVALUATION





SYNTHETIC FLIGHT





OUTLINE

- Related Work
- Methods
- **Experiments and Results**
- Discussion
- Conclusion

EXPERIMENTS

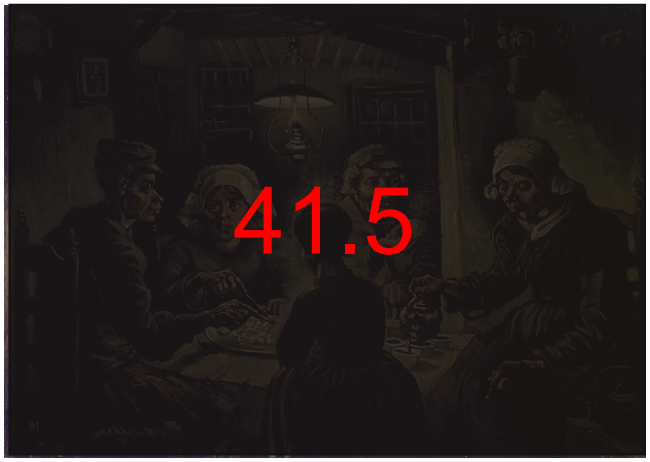
- Simulated flights
- Map evaluation
- Real-world Target Landing
- Real-world Navigation

MAP EVALUATION

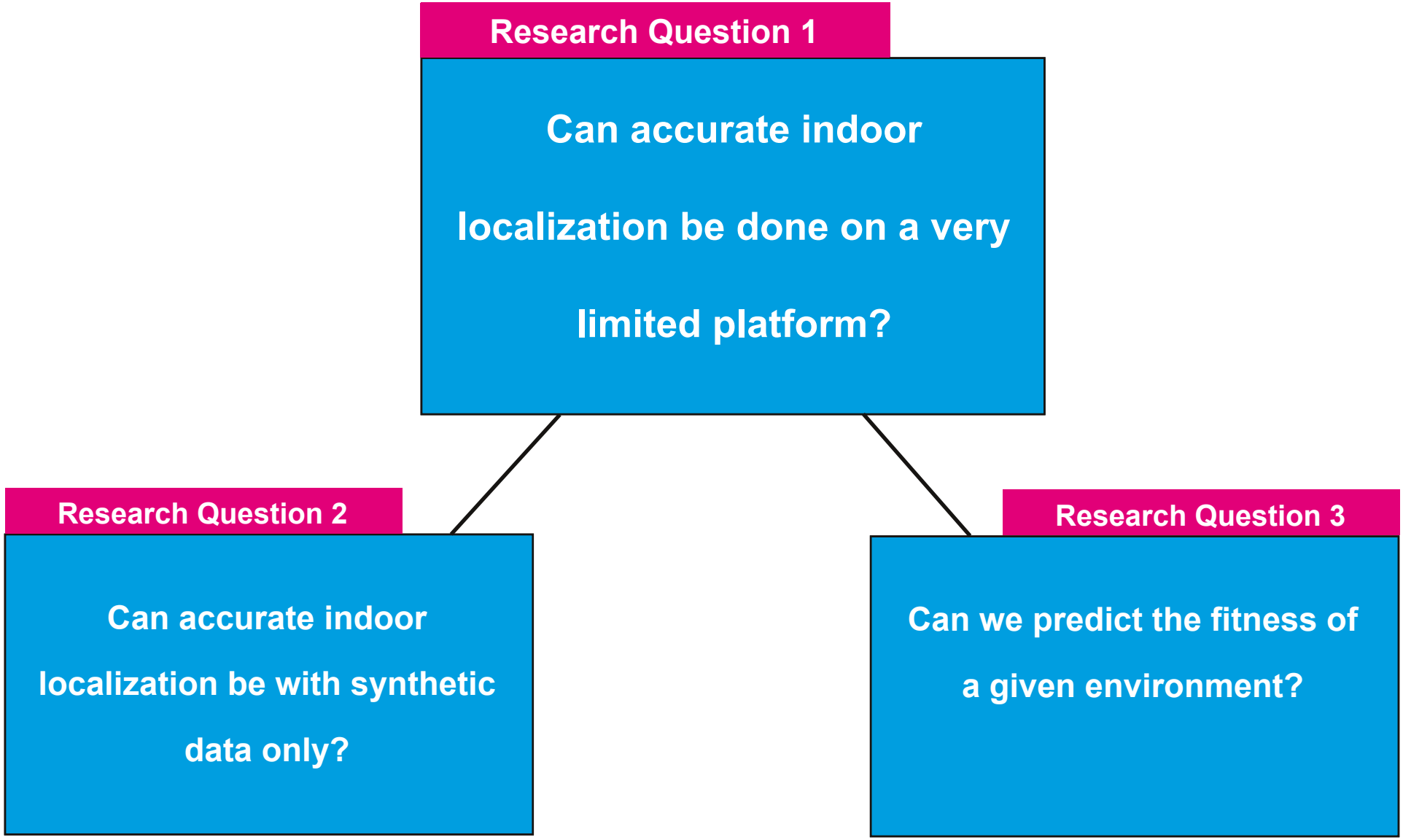





MAP EVALUATION



DISCUSSION


Research Question 1
Can accurate indoor localization be done on a very limited platform?
Research Question 2
Can accurate indoor localization be with synthetic data only?
Research Question 3
Can we predict the fitness of a given environment?

DISCUSSION

map evaluation algorithm could predict real-world performance
target landing within acceptable accuracy

DISCUSSION

Limitations:

- no height control or rotations yet
- robustness to differerent lighting conditions

Future research directions:

- bridge reality gap between synthetic and real-world data
- automatic map generation (evolutionary algorithm)

CONCLUSION

EFFICIENT INDOOR LOCALIZATION