Karlsruher Institut für Technologie

Acoustic SLAM with Gaussian Processes

Projektvorstellung von Oliver Neumann

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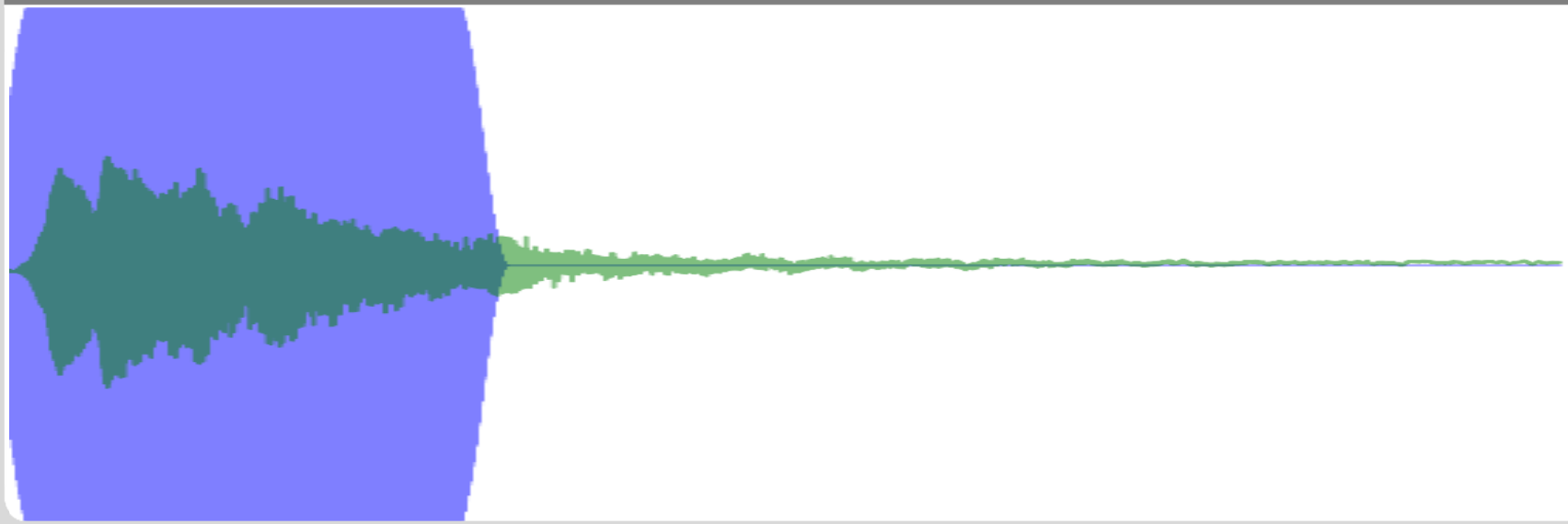
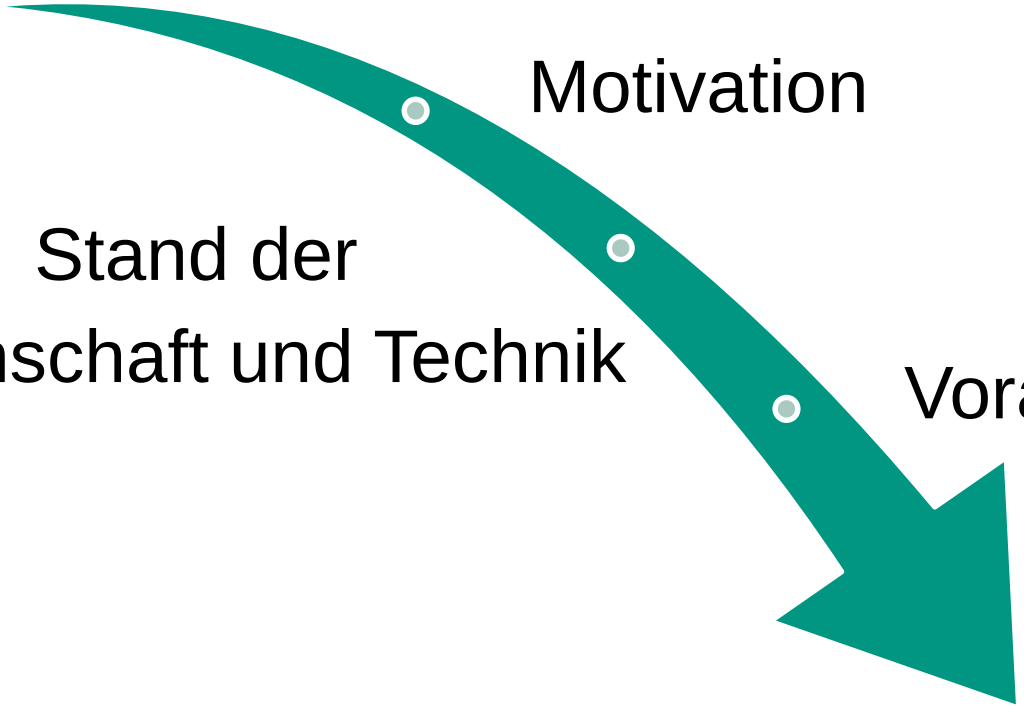
Institut für Anthropomatik und Robotik (IAR), Fakultät für Informatik



Agenda



Motivation

Stand der Wissenschaft und Technik

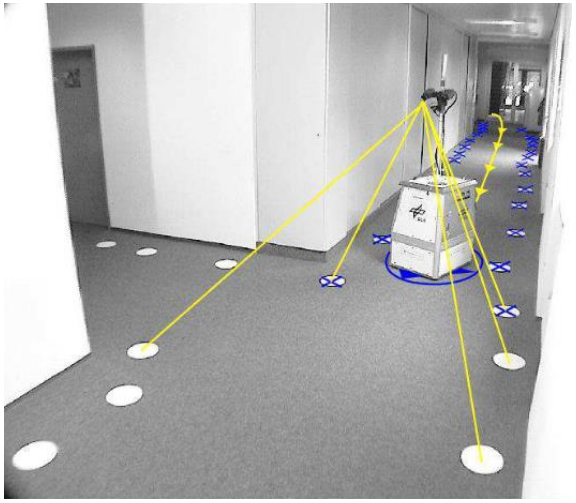
Vorarbeiten

Ziele des Projekts & Projektplan

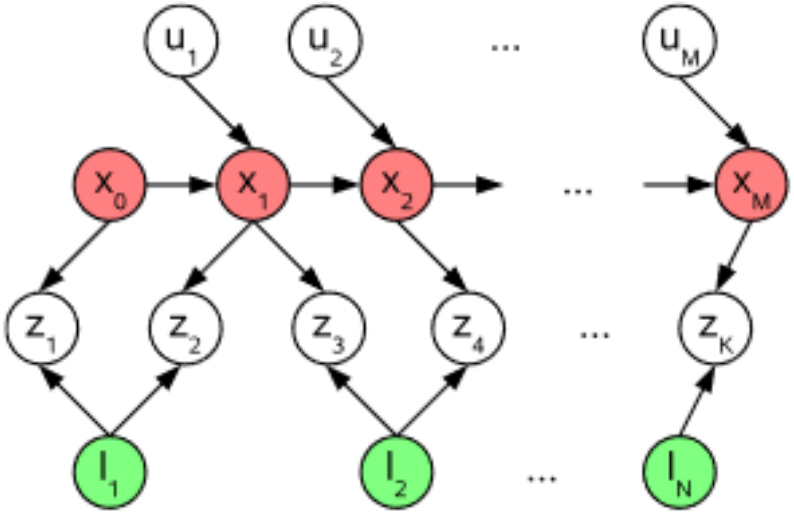
Motivation

SLAM: [Grisetti et al 2010]

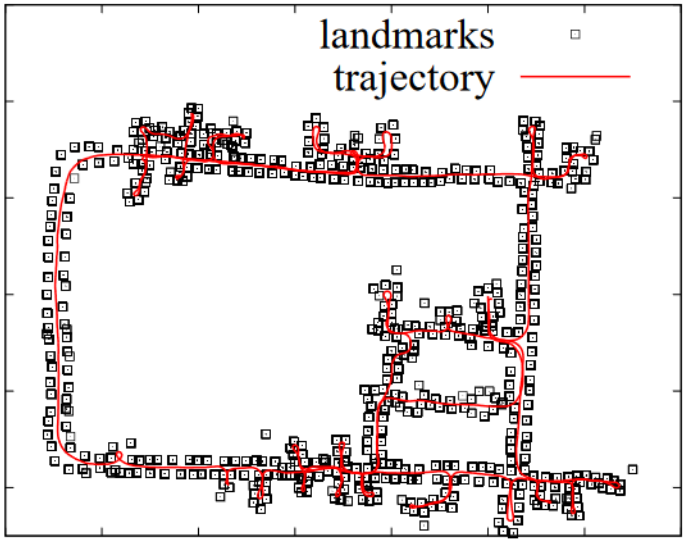
- Unbekannte Karte (**Mapping)**
- **Lokalisierung** in Karte
- Probabilistisches Verfahren
- Filtering vs Smoothing
- Graph basiert



[Grisetti et al 2010]

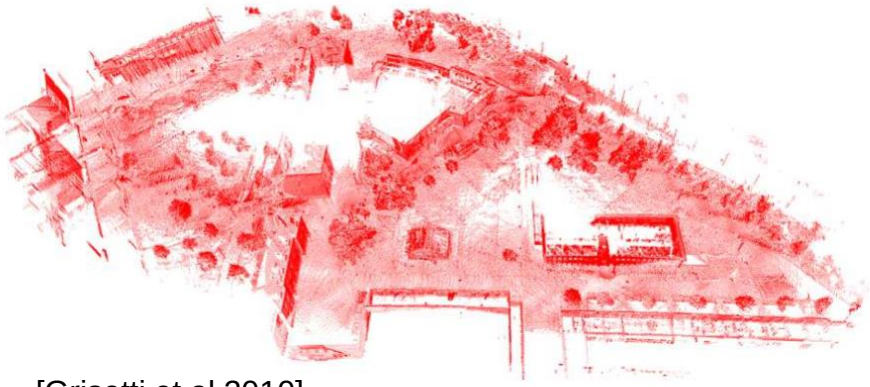


[Kaess et al 2008]

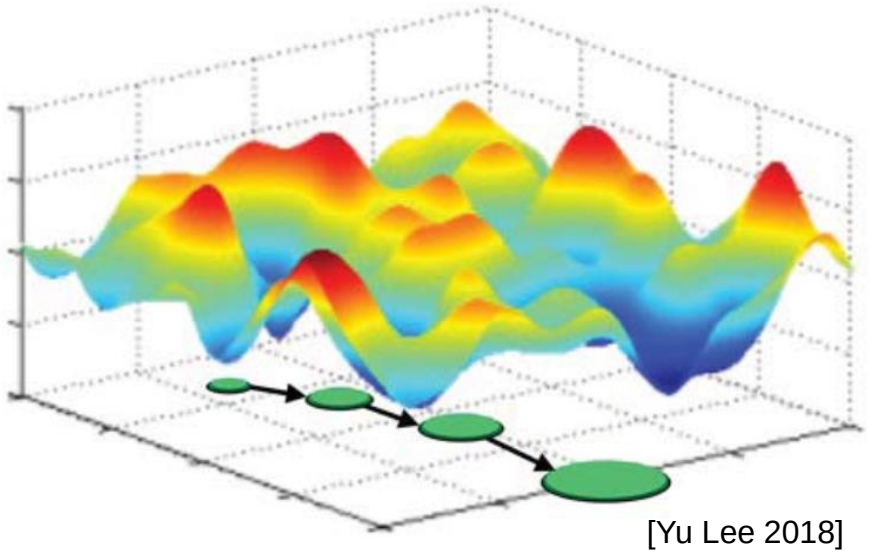


[Grisetti et al 2010]

Motivation



[Grisetti et al 2010]



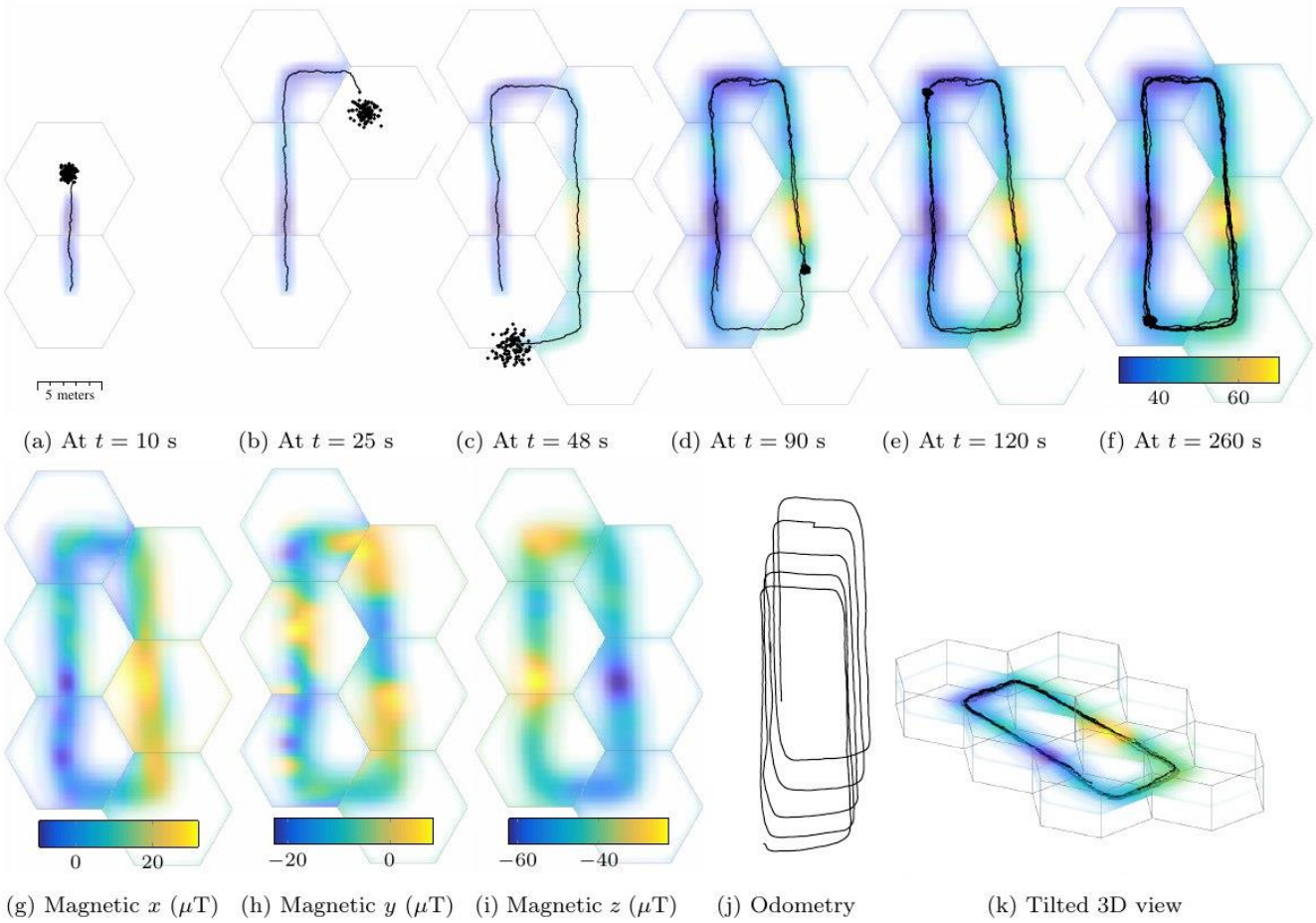
[Yu Lee 2018]

Diskrete Landmarken

Kontinuierliche Funktion

Stand der Wissenschaft und Technik

Scalable Magnetic Field SLAM in 3D using Gaussian Process Maps



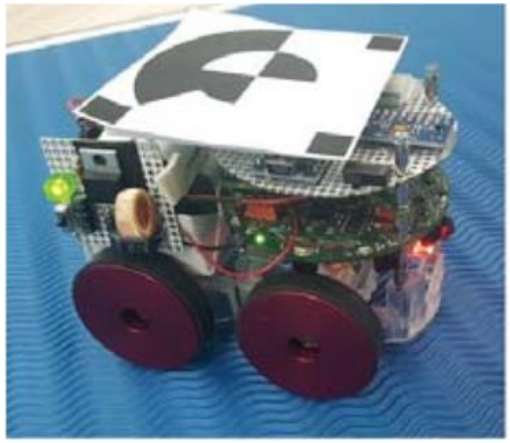
(a) At $t = 10$ s (b) At $t = 25$ s (c) At $t = 48$ s (d) At $t = 90$ s (e) At $t = 120$ s (f) At $t = 260$ s

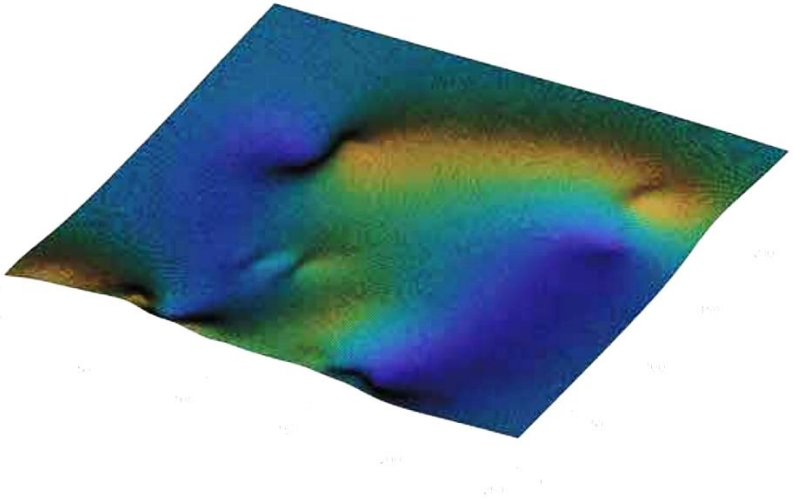
(g) Magnetic x (μT) (h) Magnetic y (μT) (i) Magnetic z (μT) (j) Odometry (k) Tilted 3D view

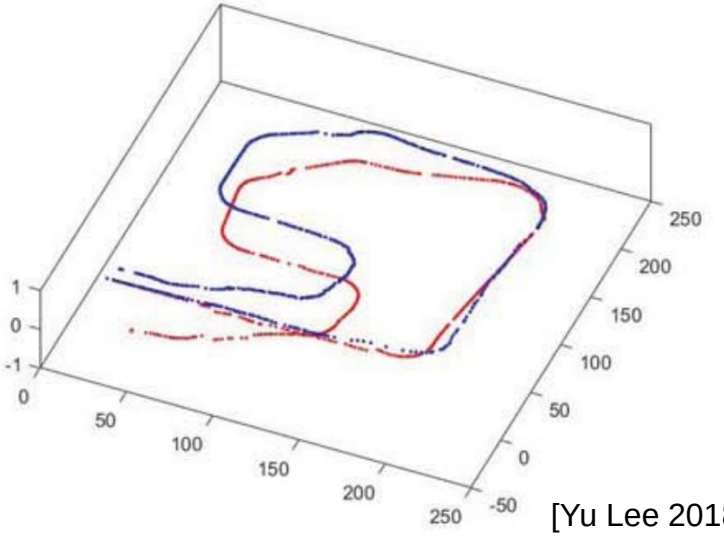
[Kok Solin 2018]

Stand der Wissenschaft und Technik

Terrain Field SLAM and Uncertainty Mapping using Gaussian Process

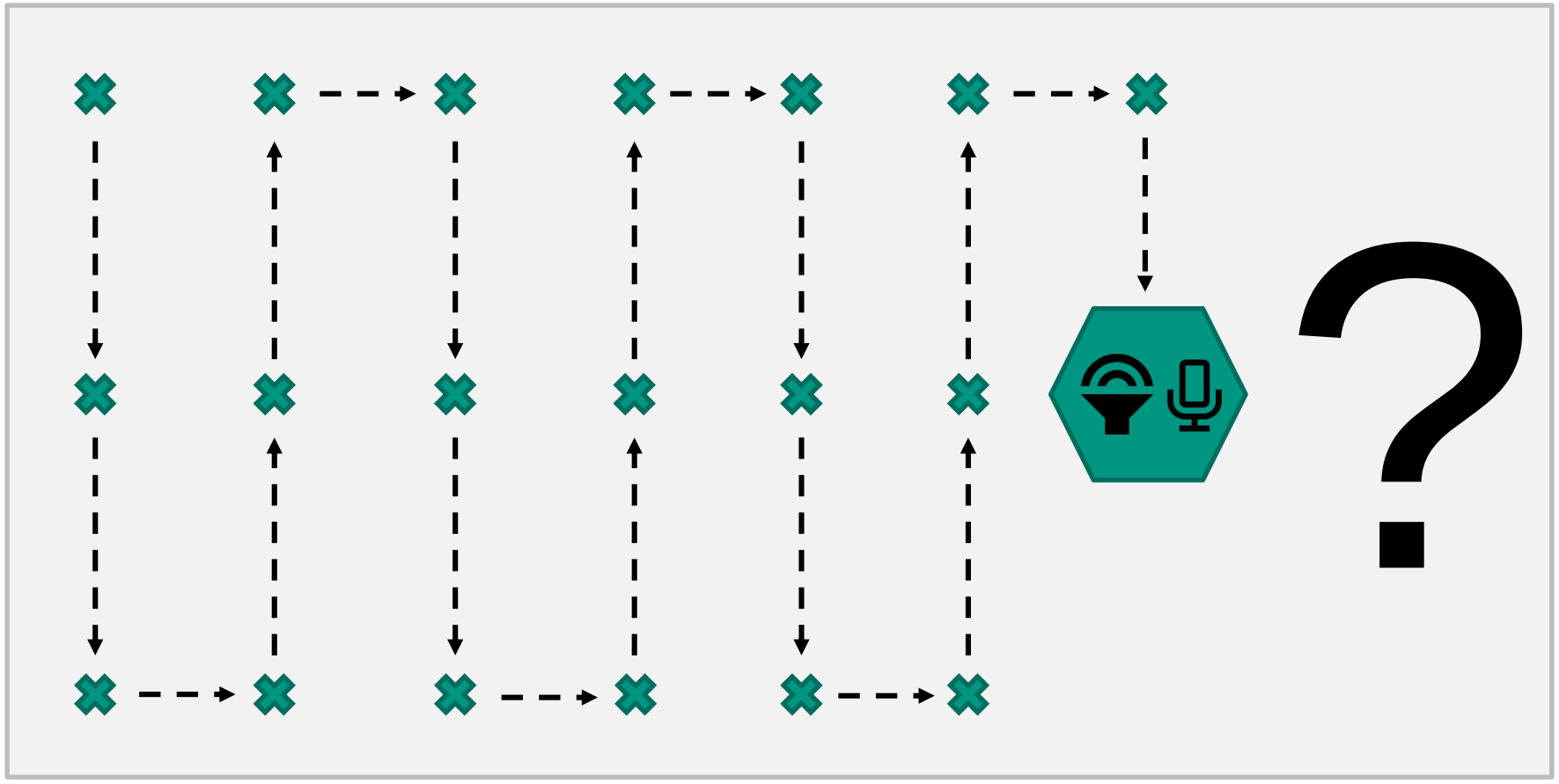






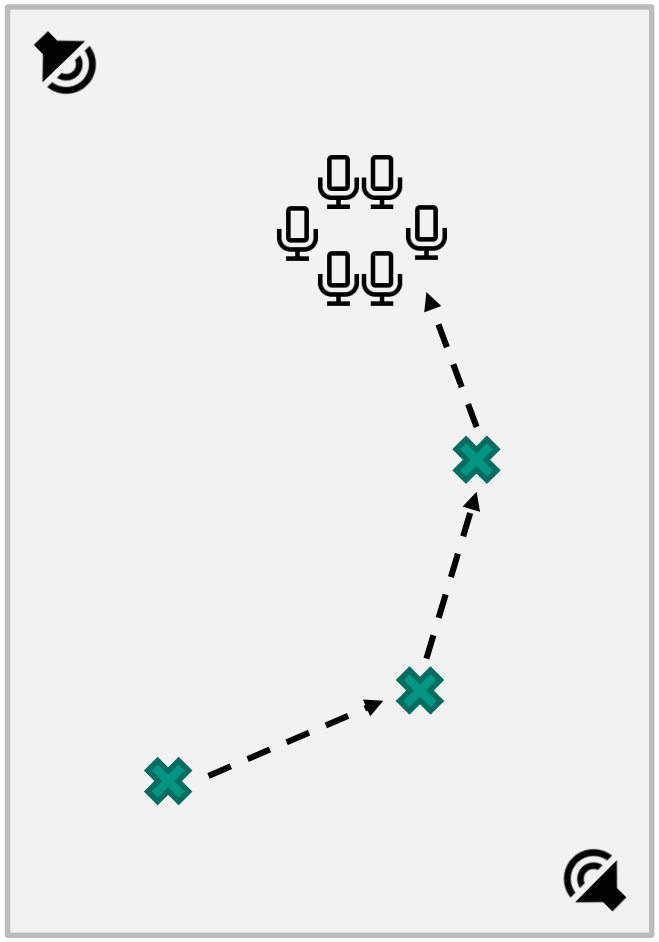
[Yu Lee 2018]

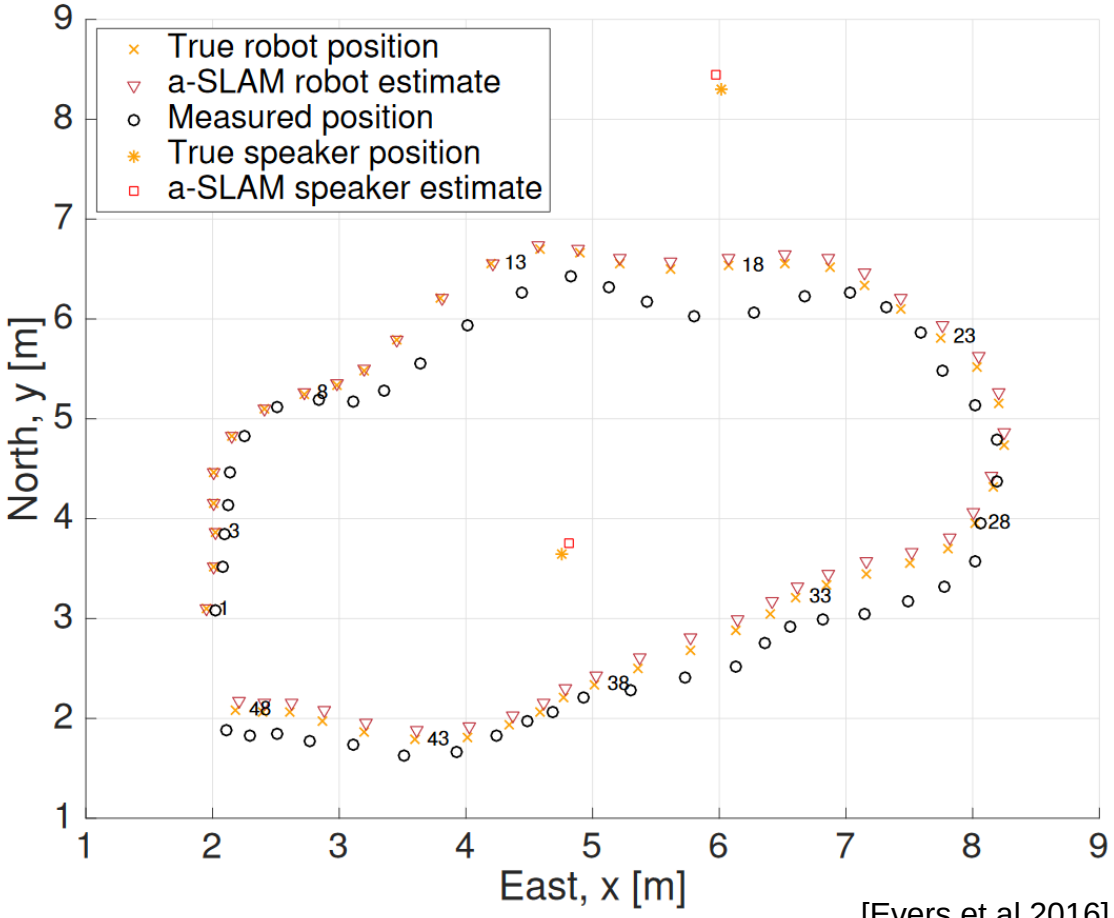
Stand der Wissenschaft und Technik



Stand der Wissenschaft und Technik

Acoustic Simultaneous Localization and Mapping (A-SLAM)
of a Moving Microphone Array and its Surrounding Speakers

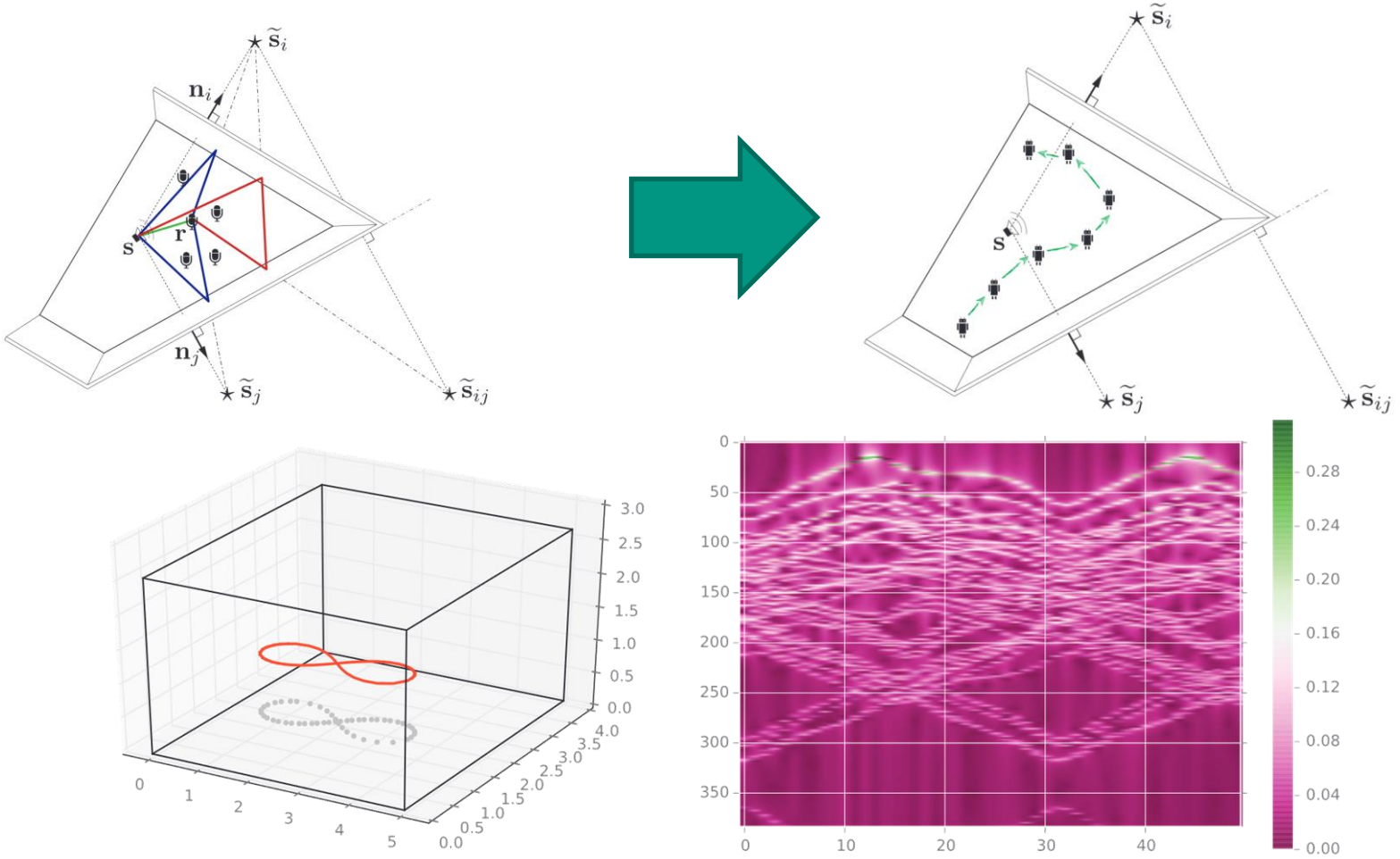




[Evers et al 2016]

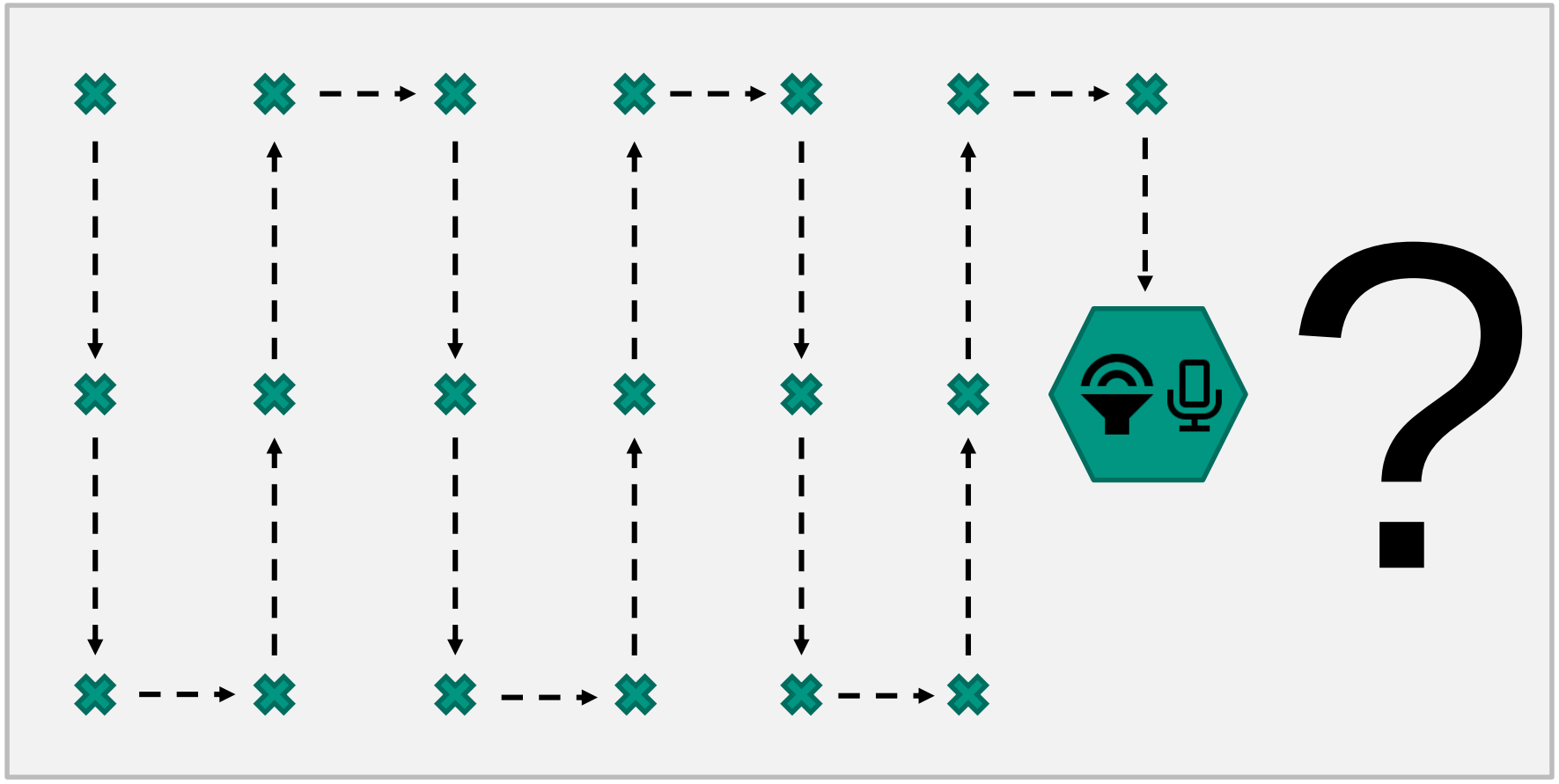
Stand der Wissenschaft und Technik

From Acoustic Room Reconstruction to SLAM



[Dokmanic et al 2016]

Vorarbeiten



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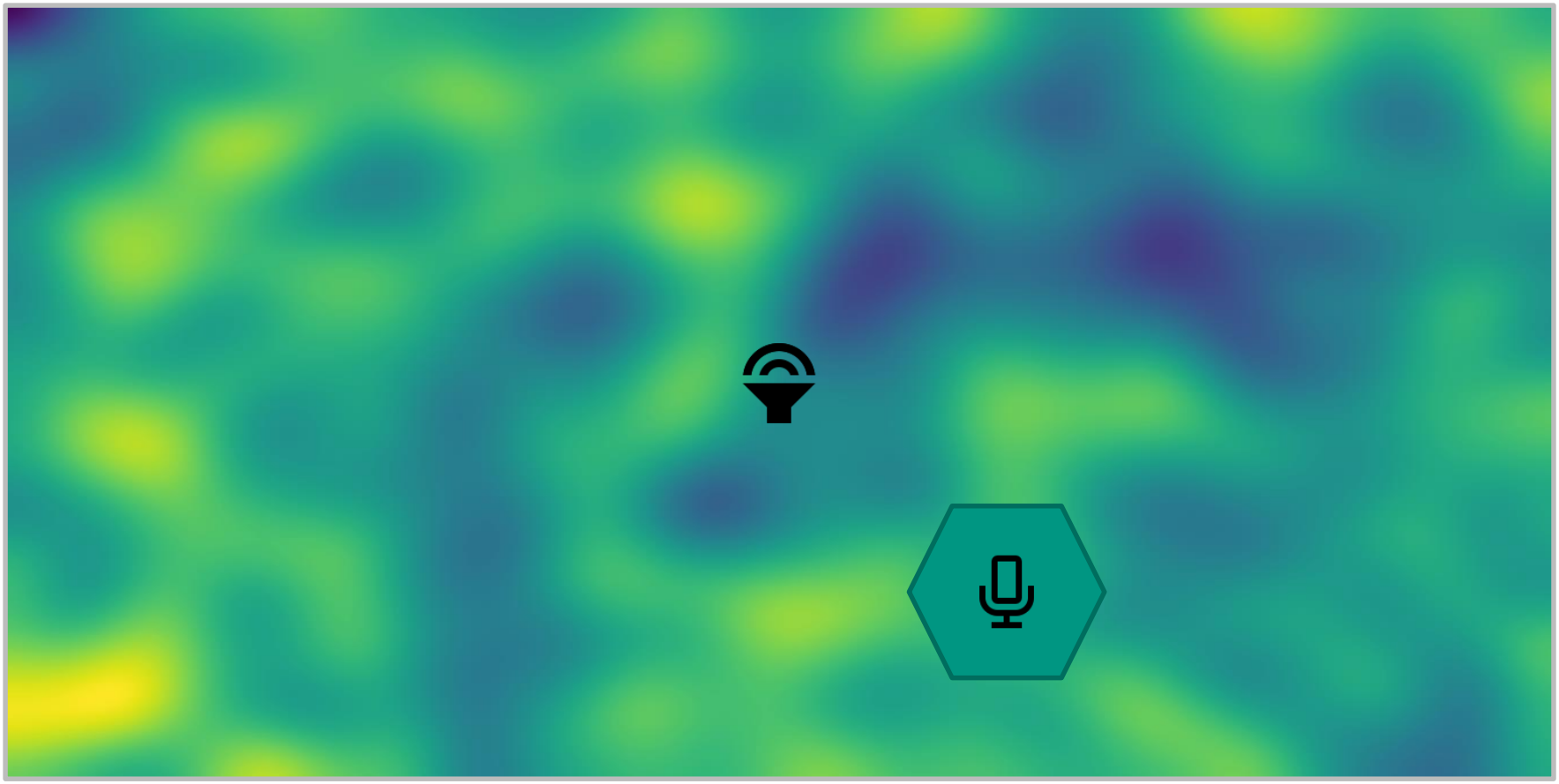

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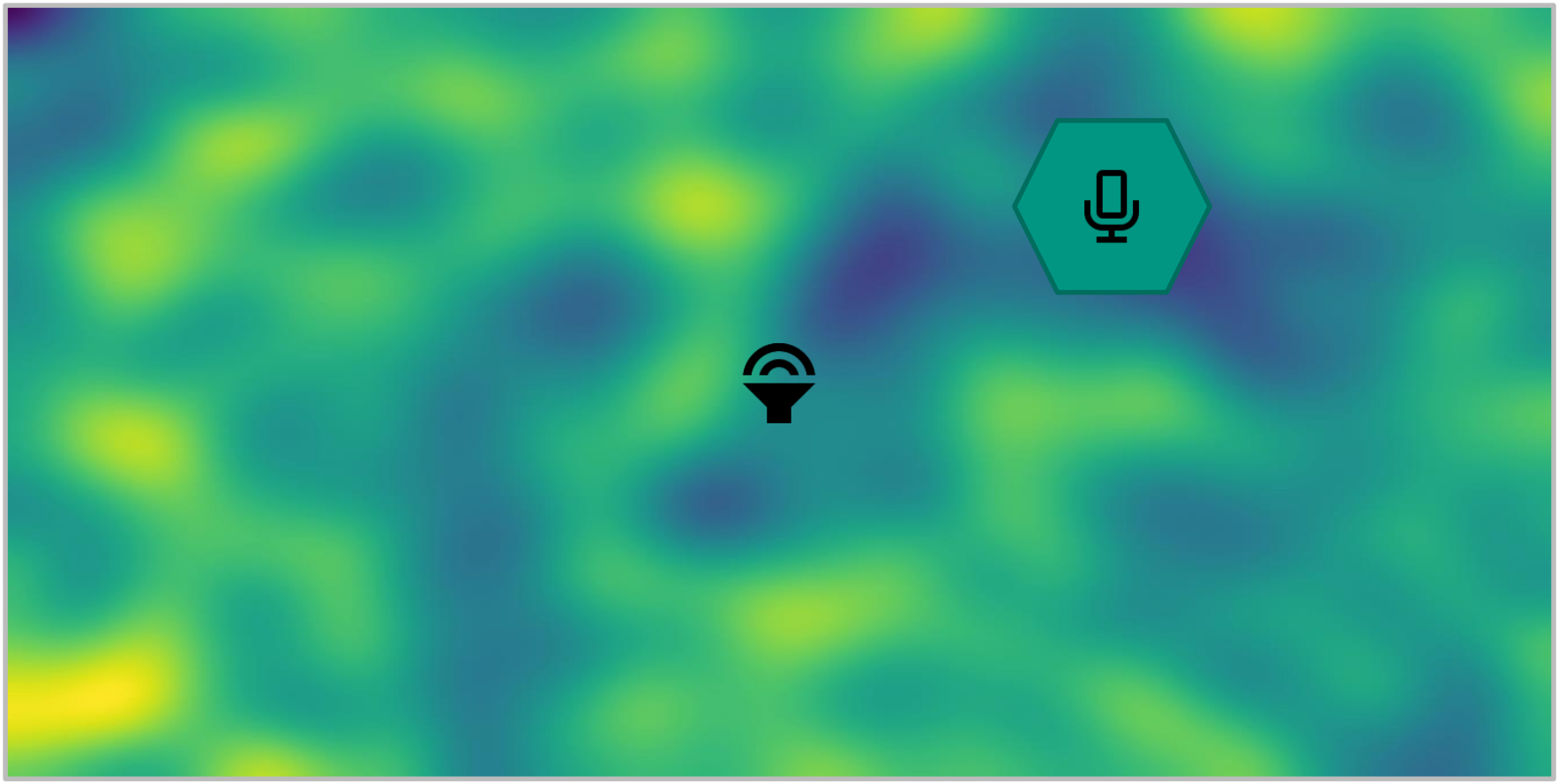

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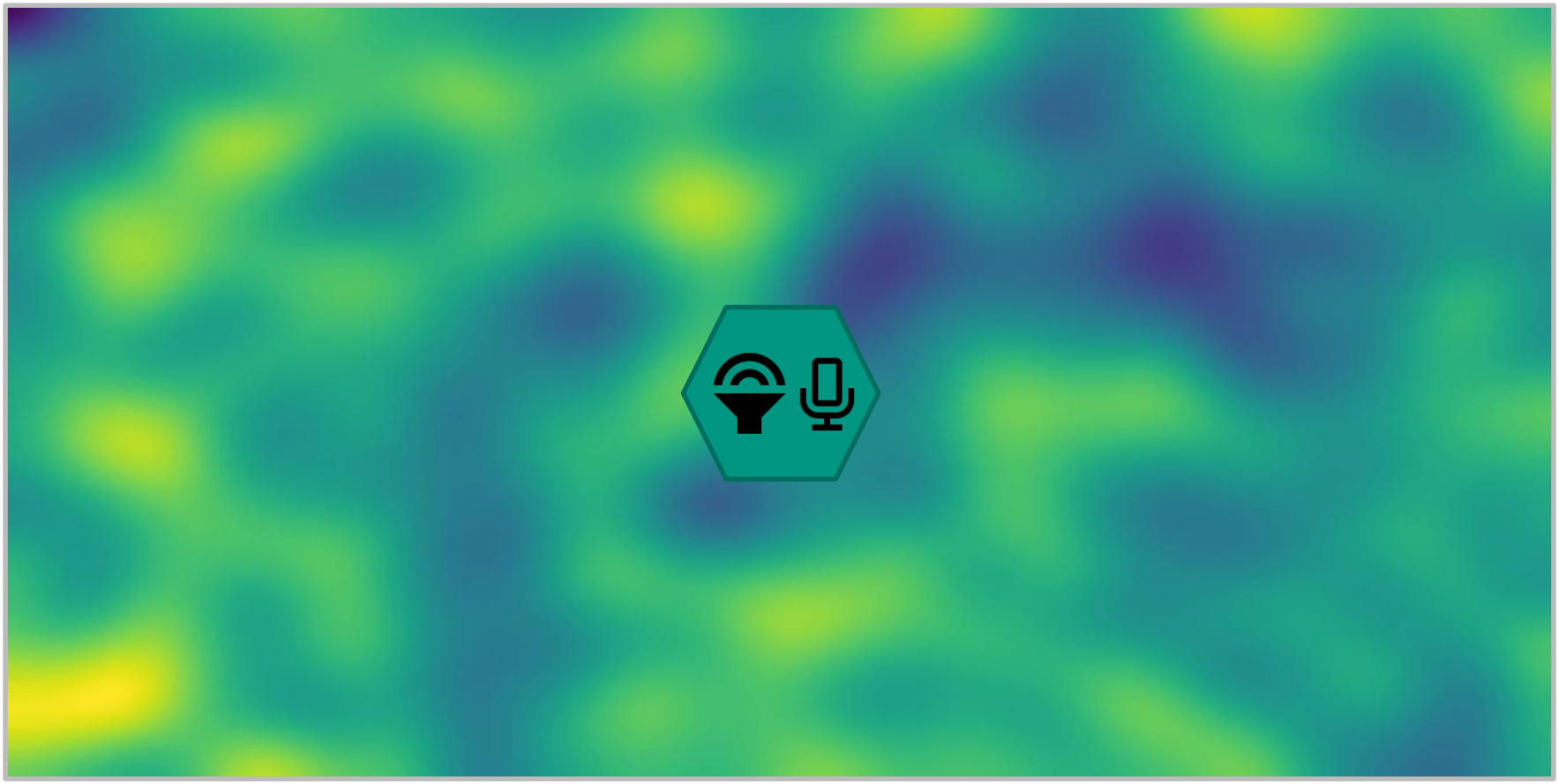

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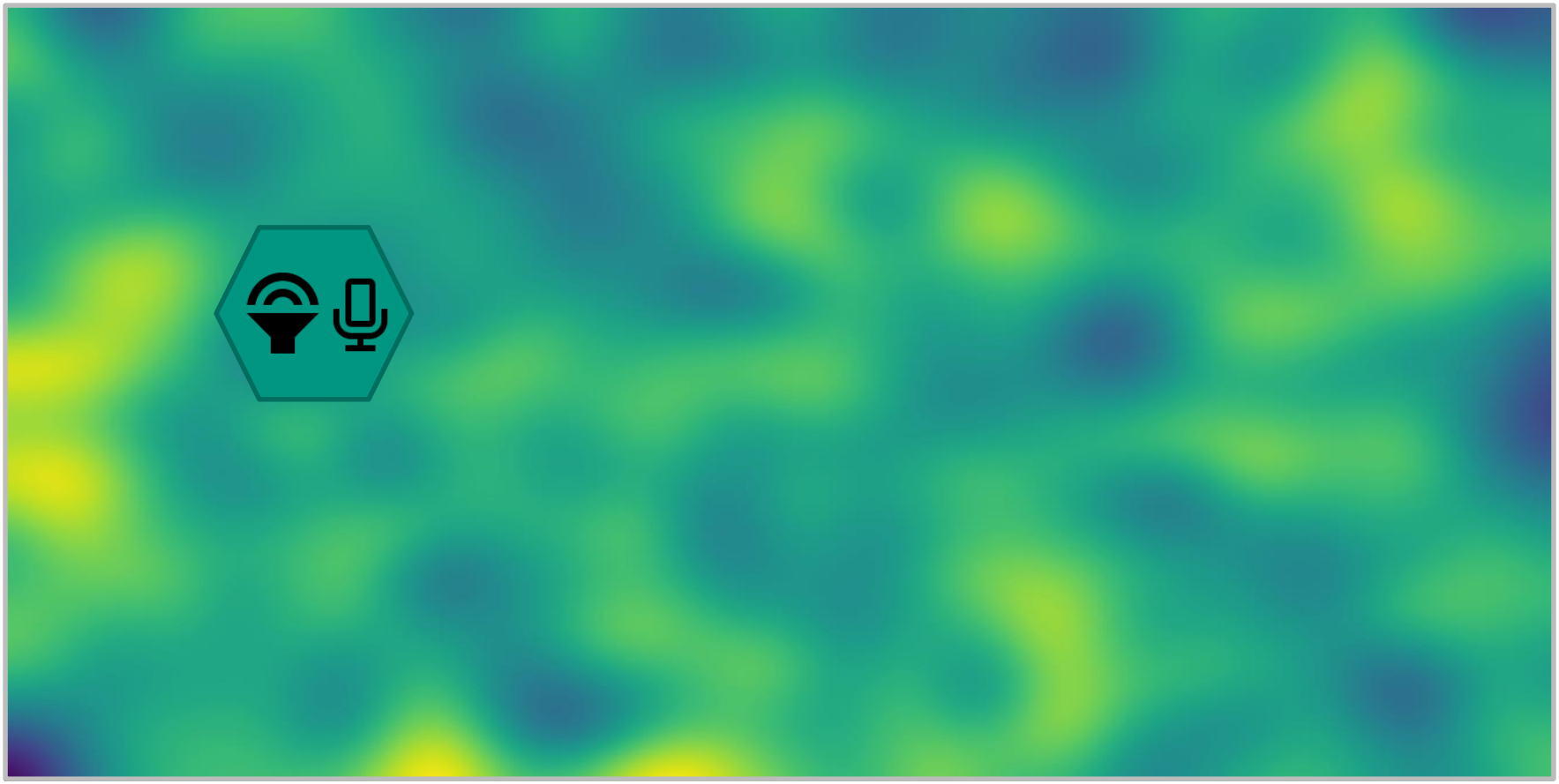

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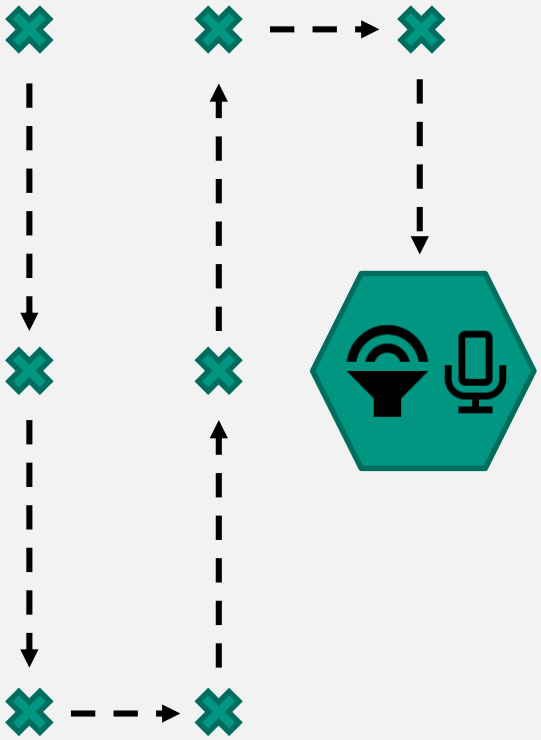
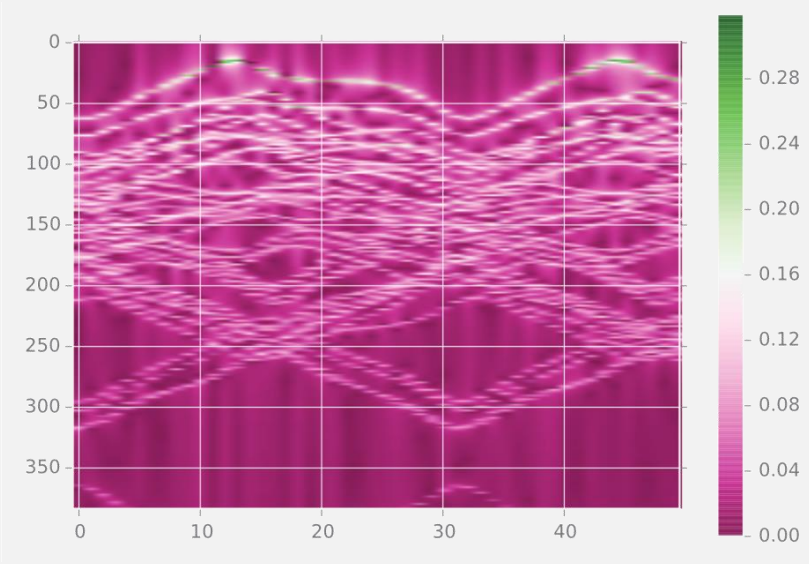




?

[Dokmanic et al 2016]

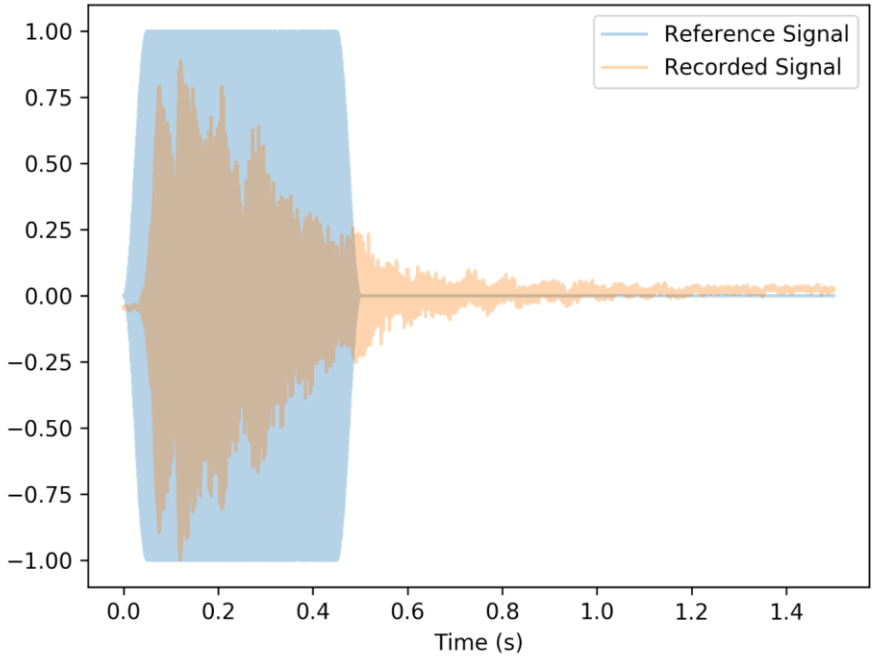
Vorarbeiten

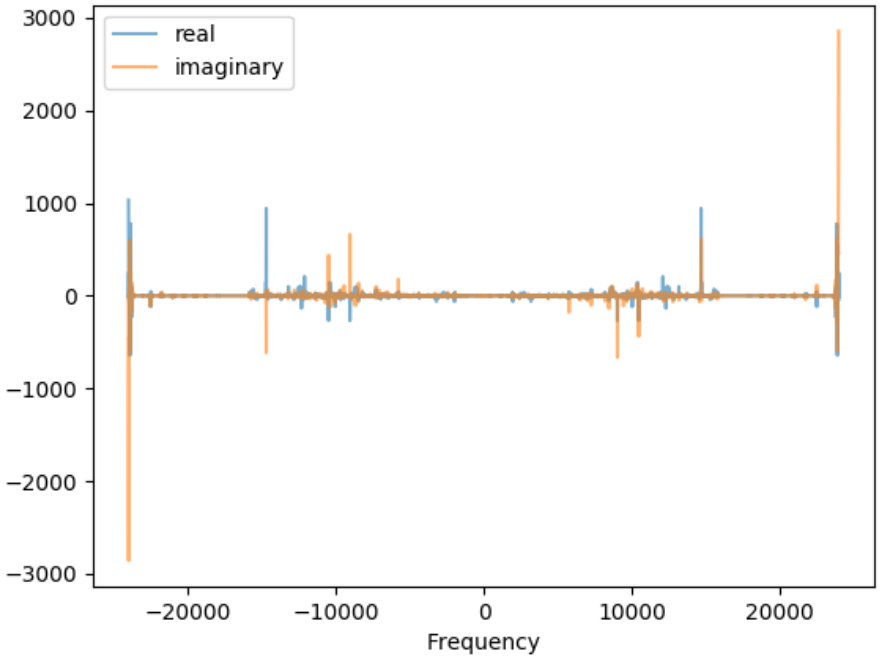
Raum Impulsantwort

$$y(t) = g(t) * x(t)$$

$$Y(s) = G(s) \cdot X(s)$$

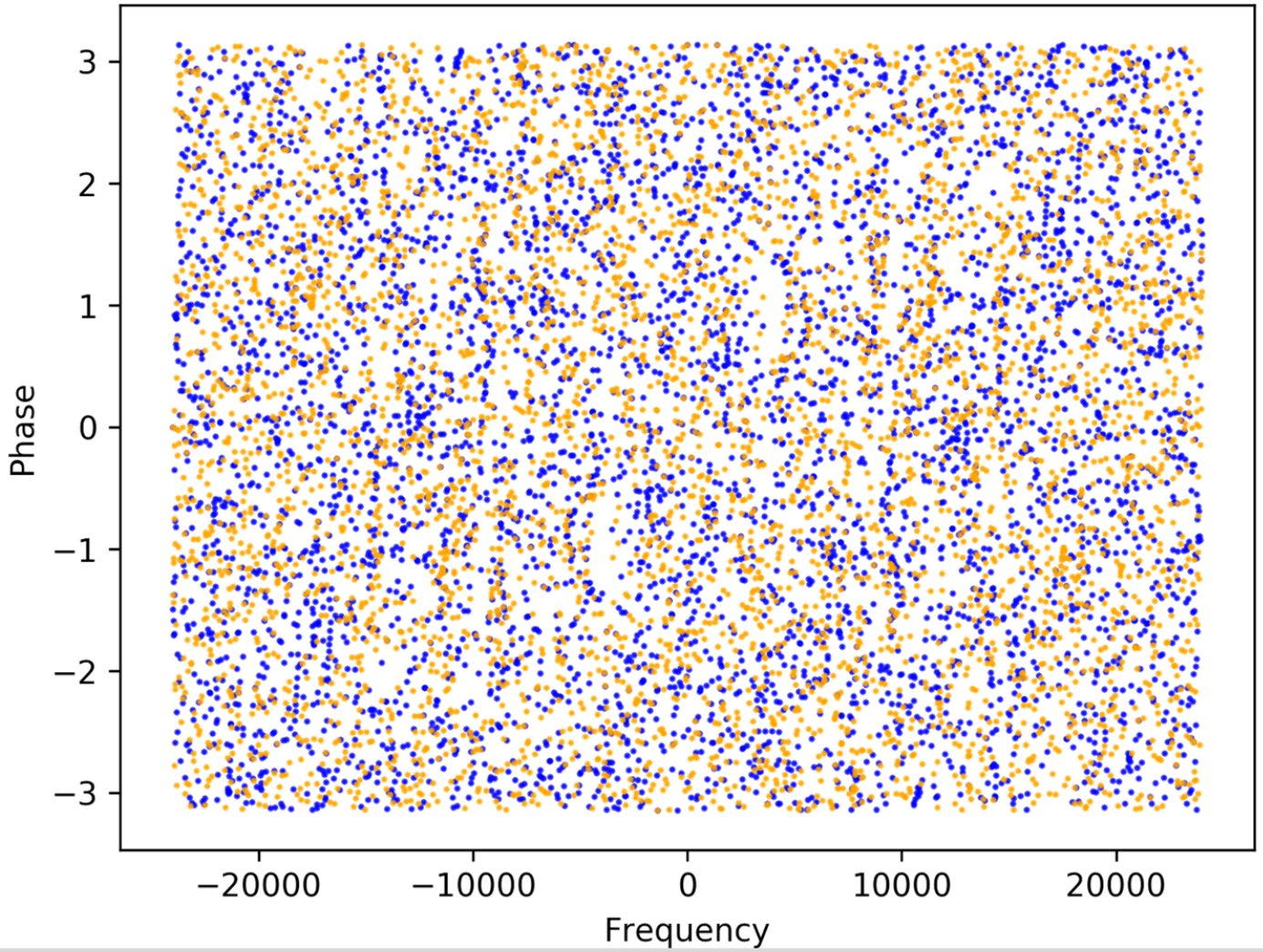
$$G(s) = \frac{Y(s)}{X(s)}$$





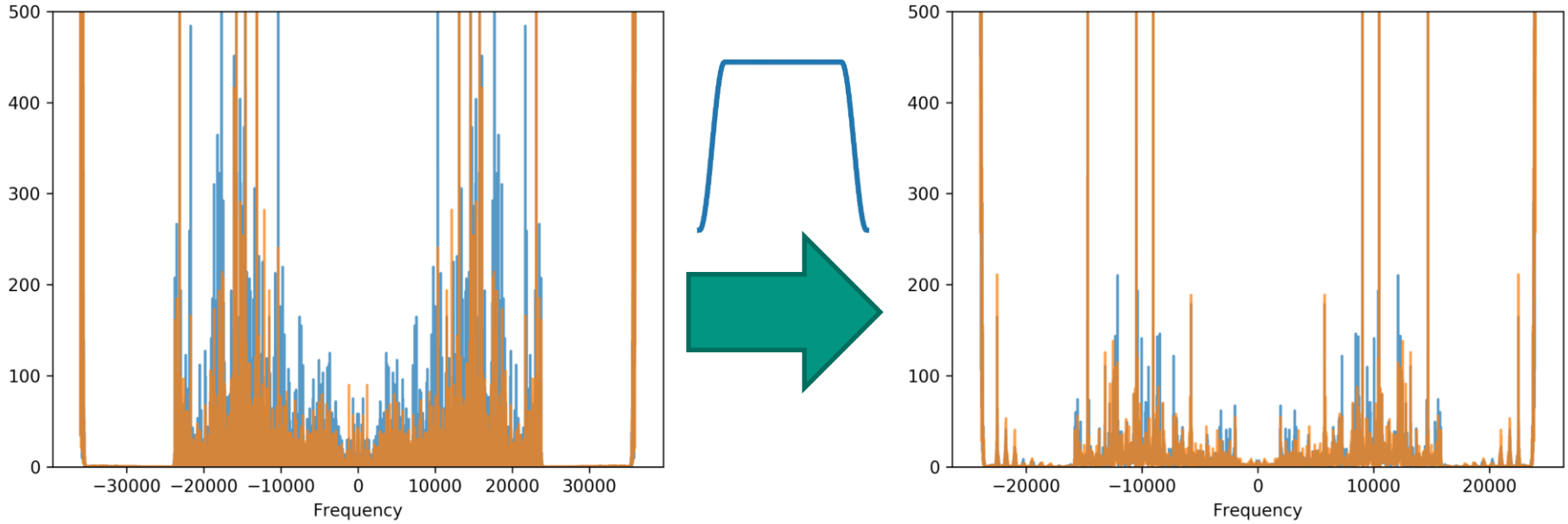
Vorarbeiten

Betrachtung der Phase



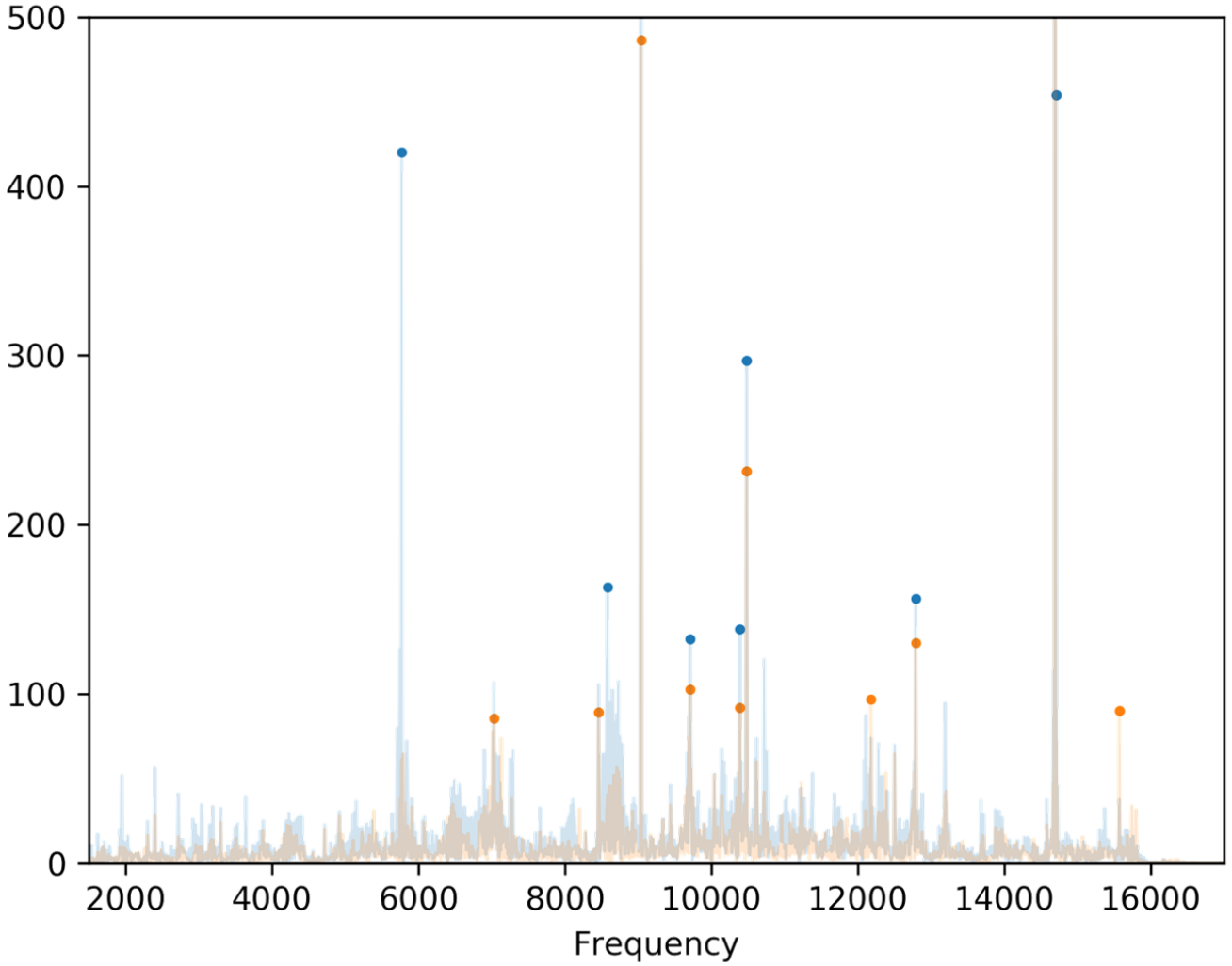
Vorarbeiten

Kontinuität durch Fensterfunktion



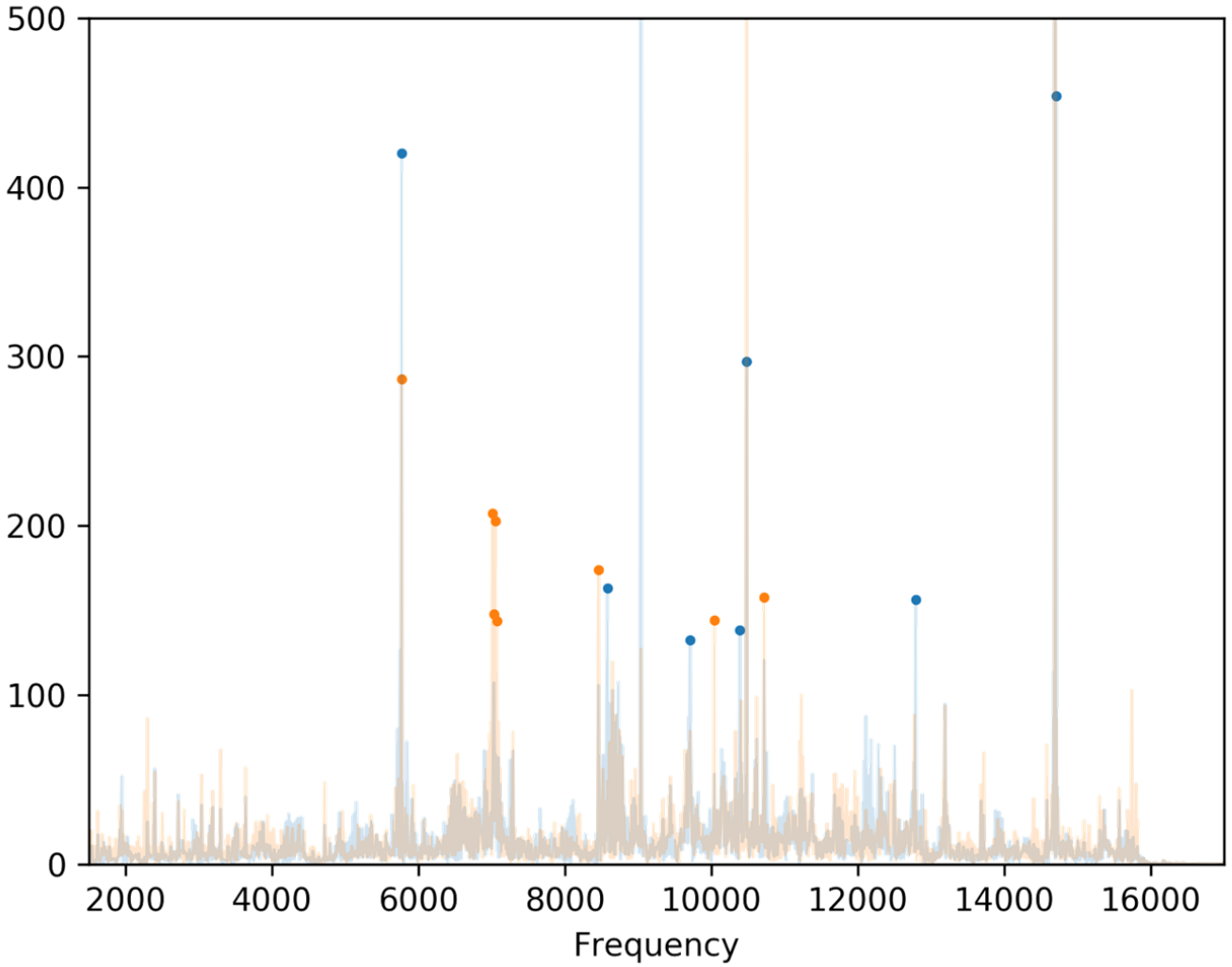
Vorarbeiten

Betrachtung der Spitzen in Magnitude – Gleiche Position



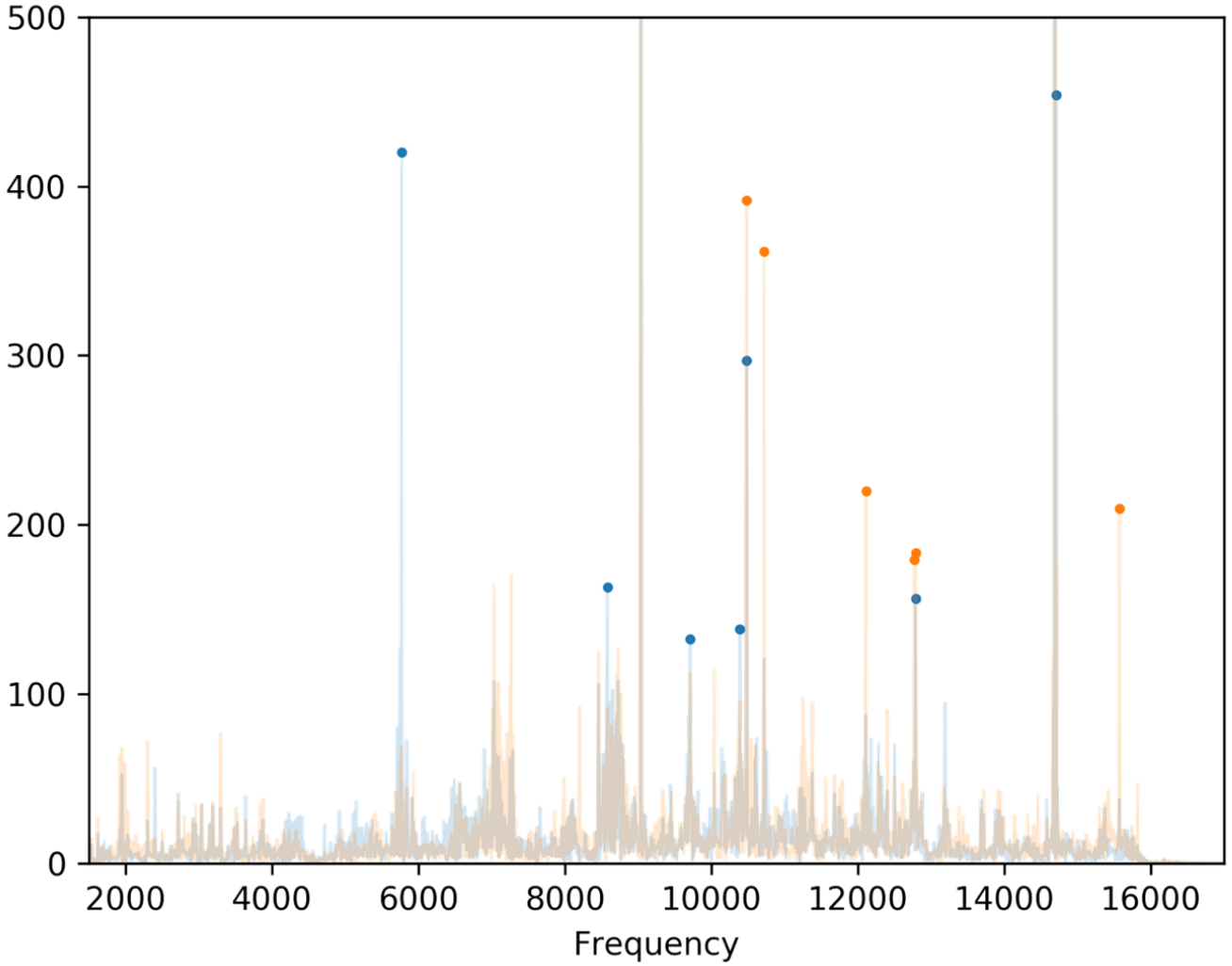
Vorarbeiten

Betrachtung der Spitzen in Magnitude – Verschiedene Position gleicher Raum



Vorarbeiten

Betrachtung der Spitzen in Magnitude – Verschiedene Räume



Projekt

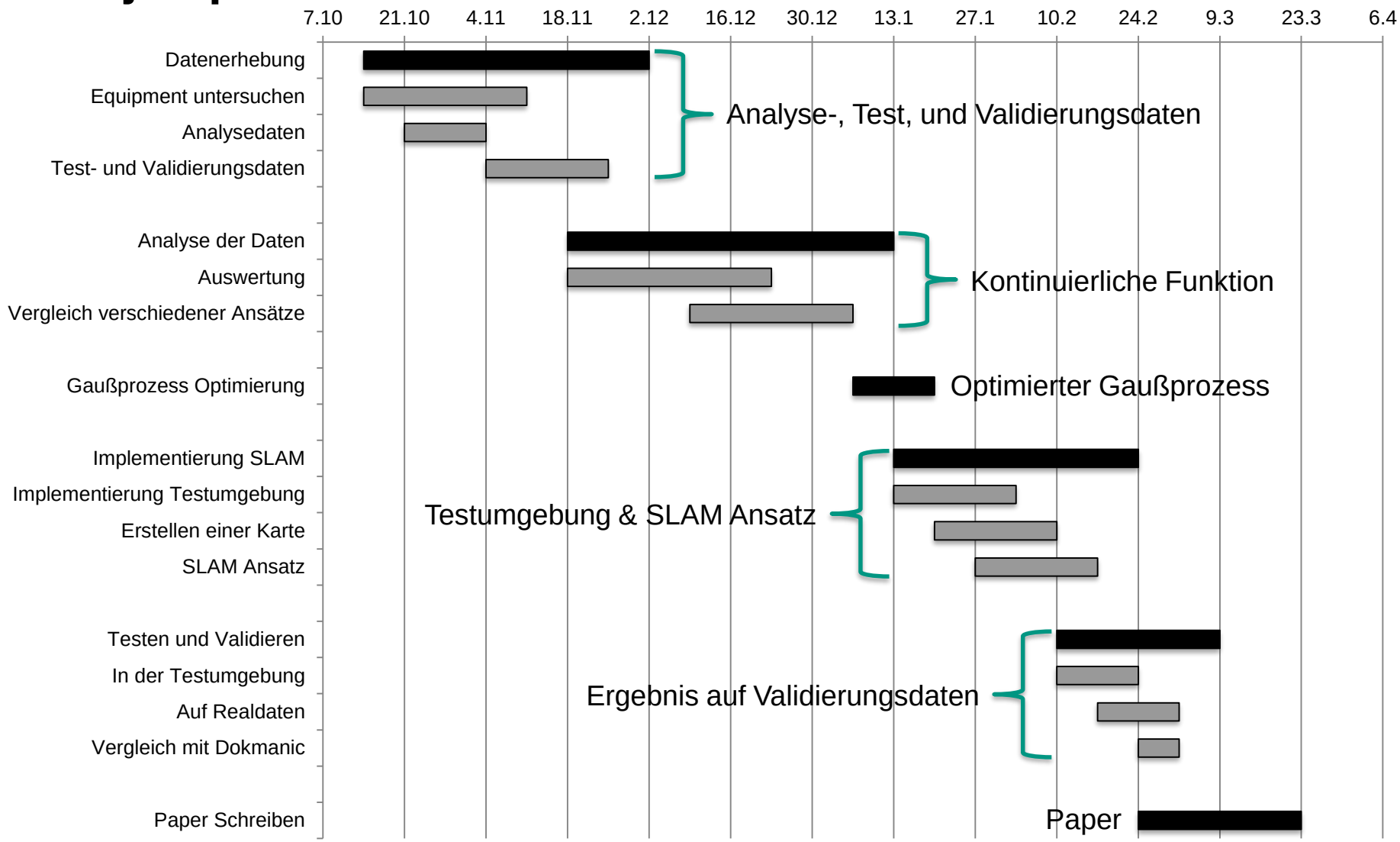
Forschungsfrage

- Kann eine Roboterplattform mithilfe einer IMU, eines Lautsprechers und einem Mikrofon sich in Innenräumen lokalisieren?

Aufgaben und Ziele

- Datengenerierung (Analyse-, Test und Validierungsdaten)
- Kontinuierliche Funktion aus Signal mit Gaußprozess
- Erstellen einer Karte
- Implementierung von SLAM
- Testen und Validieren
- Aussage über Anwendbarkeit von SLAM

Projektplan



* Eine Woche entspricht 2 Werktagen bzw. 16h bei 12 ECTS

Quellen

[Grisetti et al 2010] Giorgio Grisetti, Rainer Kümmerle, Cyrill Stachniss and Wolfram Burgard 2010;
A Tutorial on Graph-Based SLAM

[Kaess et al 2008] Michael Kaess, Ananth Ranganathan and Frank Dellaert 2008;
iSAM: Incremental Smoothing and Mapping

[Yu Lee 2018] Hyeonwoo Yu and Beomhee Lee 2018;
Terrain field SLAM and Unvertainty Mapping using Gaussian Process

[Kok Solin 2018] Manon Kok and Arno Solin 2018;
Scalable Magnetic Field SLAM in 3D using Gaussian Process Maps

[Evers et al 2016] Christine Evers, Alastair H. Moore and Patrick A. Naylor 2016;
Acoustic Simultaneous Localization and Mapping (A-SLAM)
of a moving Microphone Array and its Surrounding Speakers

[Evers Naylor 2018] Christine Evers and Patrick A. Naylor 2018;
Acoustic SLAM

[Dokmanic et al 2016] Ivan Dokmanic, Laurent Daudet and Martin Vetterli 2016;
From Acoustic Room reconstruction to SLAM