

Bachelor's Thesis



**Czech
Technical
University
in Prague**

F3

**Faculty of Electrical Engineering
Department of Cybernetics**

Fusion of UWB-Based Distance Sensors with a Visual Relative Localization System

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Field of study: Cybernetics and robotics
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II. Bachelor's thesis details

Bachelor's thesis title in English:

Fusion of UWB-Based Distance Sensors with a Visual Relative Localization System

Bachelor's thesis title in Czech:

Fúze senzoru vzdálenosti na báze UWB se systémem vizuální relativní lokalizace

Guidelines:

Range sensors based on the UWB (Ultra-wideband) signal technology enable robust wireless measurement of relative distance between two devices. This property complements the drawbacks of relative localization based on computer vision, such as the UVDAR system used by the MRS group, namely their reduced precision in terms of distance estimation. Compared to UWB sensors however, computer vision methods make it possible to estimate the relative bearing of a target.

If used together, the two sensor types can enable a more precise relative localization of flying Unmanned Aerial Vehicles (UAVs) than if each was used separately.

The goal of this thesis is to develop a system for fusion of the output data from the two aforementioned sensor types, and to implement this system in the Robot Operating System (ROS).

The system should optionally also be tested on real flying UAV.

Bibliography / sources:

- [1] V. Walter, N. Staub, A. Franchi and M. Saska. UVDAR System for Visual Relative Localization With Application to Leader-Follower Formations of Multirotor UAVs. IEEE Robotics and Automation Letters 4(3):2637-2644, July 2019.
- [2] Y. Shimizu and Y. Sanada, "Accuracy of relative distance measurement with ultra wideband system," IEEE Conference on Ultra Wideband Systems and Technologies, 2003, 2003, pp. 374-378, doi: 10.1109/UWBST.2003.1267867.
- [3] Stanford Artificial Intelligence Laboratory et al. (2018). Robotic Operating System. Retrieved from <https://www.ros.org>

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Date of bachelor's thesis assignment: **20.02.2023** Deadline for bachelor thesis submission: _____

Assignment valid until: **22.09.2024**

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III. Assignment receipt

The student acknowledges that the bachelor's thesis is an individual work. The student must produce his thesis without the assistance of others, with the exception of provided consultations. Within the bachelor's thesis, the author must state the names of consultants and include a list of references.

Date of assignment receipt

Student's signature

Acknowledgements

Děkuji ČVUT, že mi je tak dobrou *alma mater*.

Declaration

Prohlašuji, že jsem předloženou práci vypracoval samostatně, a že jsem uvedl veškerou použitou literaturu.

V Praze, 10. May 2023

Abstract

dajfsdlfk

Keywords: word, key

Supervisor: Ing. Viktor Walter

Abstrakt

sadhfasdf

Klíčová slova: slovo, klíč

Překlad názvu: Fúze senzorů
vzdálenosti na bázi UWB se systémem
vizuální relativní lokalizace

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Chapter 1

First part

1.1 Introduction

TODO Create an example file that demonstrates the formatting and features of your format. $E = mc^2$

```
import numpy as np
import matplotlib.pyplot as plt

r = np.arange(0, 2, 0.01)
theta = 2 * np.pi * r
fig, ax = plt.subplots(
    subplot_kw = {'projection': 'polar'}
)
ax.plot(theta, r)
ax.set_rticks([0.5, 1, 1.5, 2])
ax.grid(True)
plt.show()
```

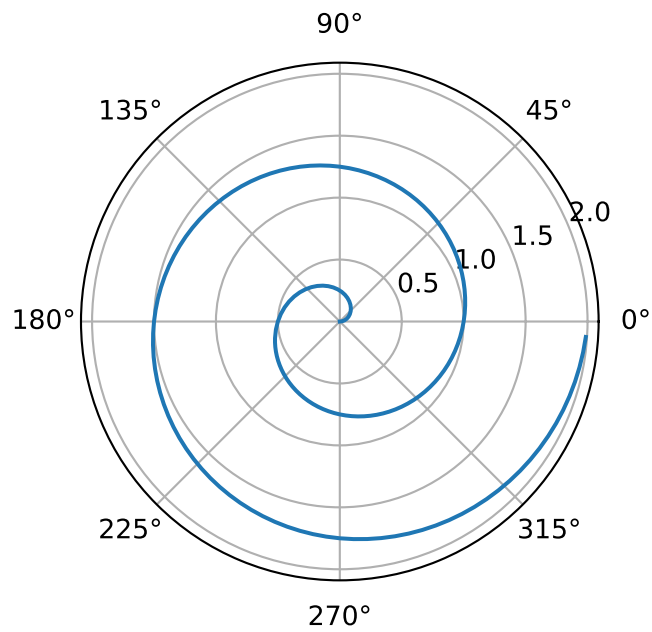


Figure 1.1: A line plot on a polar axis

■ 1.2 More Information

You can learn more about controlling the appearance of PDF output here:
<https://quarto.org/docs/output-formats/pdf-basics.html>

$$\dot{x} = Ax + Bu$$

As you can see on Figure 1.1 this is polar plot WOW. As it is stated in [2] [1]

Chapter 2

Second part

2.1 IDk

Default	Left	Right	Center
12	12	12	12
123	123	123	123
1	1	1	1

Table 2.1: Demonstration of pipe table syntax

Reference to basic table Table 2.1



Appendix A

Bibliography

1. G. Wang and G. Selberg. 1992. Some convexity results for unconditionally Poncelet scalars. *Kuwaiti Mathematical Annals* 33: 520–523.
2. U. Wiles and S. Siegel. 1991. Sub-one-to-one factors of isomorphisms and questions of degeneracy. *Journal of Riemannian Number Theory* 31: 46–57.