

Journal

Contents

Journal	1
Monday 29-01-2024 (project week 0)	1
Tuesday 30-01-2024 (project week 1)	1
Wednesday 31-01-2024 (project week 1)	2
Thursday 01-02-2024 (project week 1)	2
Friday 02-02-2024 (project week 1)	3
Monday 05-02-2024 (project week 1)	3
Tuesday 06-02-2024 (project week 2)	3
Wednesday 07-02-2024 (project week 2)	4
Thursday 08-02-2024 (project week 2)	4
Friday 09-02-2024 (project week 2)	4
Bibliography	5

Monday 29-01-2024 (project week 0)

Kristoffer

- At Beumer
- Started project
- Had meeting with Jonas discussing what to start with the first 2 weeks
- Read these papers:
 - A visual introduction to Gaussian Belief Propagation [1]
 - Distributing Collaborative Multi-Robot Planning With Gaussian Belief Propagation [2]
- Tried compiling examples from <https://github.com/aalpatya/gbpplanner> but faced issues with missing X11 headers, even though they were installed on my system.

Jens

At Beumer

- Starting with a meeting all three (Kristoffer, Jens, Jonas)
- Read papers:
 - A visual introduction to Gaussian Belief Propagation [1]
 - Distributing Collaborative Multi-Robot Planning With Gaussian Belief Propagation [2]
- Successful compilation and run of examples from <https://github.com/aalpatya/gbpplanner>.
 - Successfully created custom environment to attempt to highlight weaknesses of the current implementation.

Tuesday 30-01-2024 (project week 1)

Kristoffer

- Worked from home.

- Created GitHub repository <https://github.com/AU-Master-Thesis/gbp-rs> as we want to rewrite the <https://github.com/aalpatya/gbpplanner> in Rust.
- Looked at different Rust simulation/visualization tools to use.
 - <https://macroquad.rs/>
 - <https://nannou.cc/>
 - <https://bevyengine.org/>
- Decided to go with **bevy** as it has a lot of community support/solutions and we thought its ECS system is really cool!.
- We read through the introduction book for bevy, to learn the core concepts behind the ECS paradigm and how applications are structured in bevy.

Jens

From home

- Set up Rust project structure
- Looked at the visualisation tools with Kristoffer, discussing which to go with.
- Learned Bevy and ran some examples
 - Wrote some of the examples out and mix-matched some of it to learn how it all fit together.

Wednesday 31-01-2024 (project week 1)

Kristoffer

- At OrbitLab
- Continued to have issues compiling the code for <https://github.com/aalpatya/gbpplanner>.
- We both decided to re-flash our OS with NixOS.
- Spent some getting acquainted with the terminology and methodology of how to do things in NixOS
- Create a `flake.nix` for both our Rust port and `gbpplanner` to create a reproducible environment, where we can compile and run the code without issue.

Jens

At OrbitLab

- Re-flash OS to NixOS
 - Learn NixOS and contemplated using hyprland
 -

Thursday 01-02-2024 (project week 1)

Kristoffer

- At OrbitLab
- Continued learning about NixOS and setting up our development environment, with the tools we like to use.

- Spent some time trying to port the code from https://colab.research.google.com/drive/1-nrE95X4UC9FBLR0-cTnsIP_XhA_PZKW?usp=sharing#scrollTo=NzotHENoaY6g to our Rust implementation.

Jens

At OrbitLab

- Setting up NixOS and hyprland
- Migrating gbpplanner to Rust

Friday 02-02-2024 (project week 1)

Kristoffer

- Worked from home.
- Continued our attempt to port the code from https://colab.research.google.com/drive/1-nrE95X4UC9FBLR0-cTnsIP_XhA_PZKW?usp=sharing#scrollTo=NzotHENoaY6g to our Rust codebase.
- Jens wrote the code, while we both discussed how to port the Python code to Rust.

Jens

From home

- Rust migration

Monday 05-02-2024 (project week 1)

Kristoffer

- At Beumer
- Read recent survey paper from 2023 [3].
 - No mention of any paper/approach using Gaussian Belief Propagation.
 - Many newer paper use AI methodologies.
 - Neural Network based
 - Genetic Algorithms
 - Ant Colony
 - artificial bee colony algorithm
 - Lin–Kernighan–Helsgaun heuristic algorithm (dunno, names sounds interesting)
 - Dynamic Particle Swarm Optimization (PSO) [ref: 126,128]

Jens

At Beumer

- Struggling to set up hyprland with displaylink
- Ended the struggle, and joined Kristoffer in continuing the Rust migration.

Tuesday 06-02-2024 (project week 2)

Jens

From home

- Collaborative coding to migrate to Rust
 - Fixed a lot of compiler errors

Wednesday 07-02-2024 (project week 2)**Jens**

At 5124-139

- Attempted to continue for a while with the generic factor-graph gbp library we have been attempting to make, however, it had become too much of a headache so:
 - Started over, in a much simpler fashion
 - Supported with chatGPT
 - Supported as sparring partner, and made sure to understand things more precisely
 - Also added journal entries for all my previous weeks

Thursday 08-02-2024 (project week 2)**Kristoffer**

At 5124-139

- Continued working on the rewrite of gbpplanner in rust.
- Spent some time playing around with the C++ Eigen library, to confirm how various matrix operations and matrix slicing work, to correctly port them to rust.
- Reread parts of the methodology section, to better understand some of the math.

Jens

At 5124-139

- Working with Kristoffer to continue translation to Rust.
- Decided to split the work load.
 - I looked at Bevy, and learned further how to work it.
 - Implemented an input-manager, such that the user can press keys on the keyboard or gamepad to interact with the simulation.
- Applied some keybinds like movement, boost to change movement speed, and toggling of a dynamic unknown object in the simulation.
 - The toggling is currently only done by setting alpha to 0/1, which should later also disable/enable the actor's hitbox.

Friday 09-02-2024 (project week 2)**Kristoffer**

From home

- Found a similar paper to the [2] called Robot Web [4], that had

some interesting demo videos on their [website](#).

- My intention is to read it over the weekend or next week, to see how it differs from [2].
- Continued working on the port to Rust.
 - Abstracted the robot radius into a trait `BoundingBox`, where i am right now creating a impl for a `BoundingBox2d`
 - Created an abstraction for the `CommunicationMedia`
 - Tried using Julia to verify some of the math, but had issues getting the `Distributions` package to compile on `NixOS`
- Still need to figure out how Messages are exchanged between robots, in a way that it is decoupled from running the simulation in a single thread with the same address space to a multiprocess system.

16 weeks 4 days left to hand-in deadline

Bibliography

- [1] J. Ortiz, T. Evans, and A. J. Davison, “A visual introduction to Gaussian Belief Propagation”, *arXiv preprint arXiv:2107.02308*, 2021.
- [2] A. Patwardhan, R. Murai, and A. J. Davison, “Distributing Collaborative Multi-Robot Planning With Gaussian Belief Propagation”, *IEEE Robotics and Automation Letters*, vol. 8, no. 2, pp. 552–559, 2023, doi: [10.1109/LRA.2022.3227858](https://doi.org/10.1109/LRA.2022.3227858).
- [3] N. Abujabal, R. Fareh, S. Sinan, M. Baziyad, and M. Bettayeb, “A comprehensive review of the latest path planning developments for multi-robot formation systems”, *Robotica*, vol. 41, pp. 1–26, 2023, doi: [10.1017/S0263574723000322](https://doi.org/10.1017/S0263574723000322).
- [4] R. Murai, J. Ortiz, S. Saeedi, P. H. Kelly, and A. J. Davison, “A robot web for distributed many-device localisation”, *IEEE Transactions on Robotics*, 2023.