Demo of a Robot Web for Distributed Many-Device Localisation

***Abstract*— We will present a demonstration of a Robot Web for Distributed Many-Device Localisation. Robot Web is a distributed network of robots or other devices that can collaborate to achieve global localisation by making measurements of each other through efficient ad-hoc peer-to-peer communication. The system utilises Gaussian Belief Propagation on the underlying nonlinear factor graph, which describes the probabilistic structure of all observations made by robots internally or of one another. In this proposed demonstration, we will show Robot Web running on a multi-robot simulation with an interactive GUI.**

I. INTRODUCTION

This is a proposal for a demonstration of the work "A Robot Web for Distributed Multi-Device Localisation" [1]. In this work, a distributed network of robots or other devices that make measurements of each other collaboratively localises via ad-hoc peer-to-peer communication. The method is based on an algorithm called Gaussian Belief Propagation, a probabilistic algorithm which is based on message passing to perform marginal inference.

We will present an interactive demonstration, with multiple functionalities to highlight the efficiency and flexibility of the algorithm. Robot Web is fully decentralised and has been shown to perform well with real-world robots as well. For simplicity of implementation, the demonstration is executed on a single process, using multi-threading to simulate the multi-robot setup.

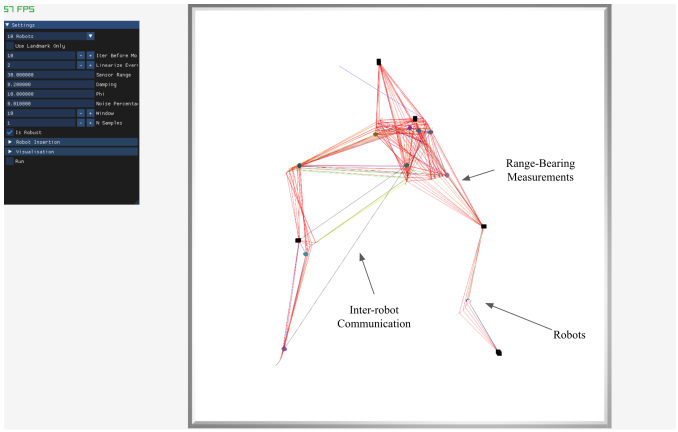

Fig. 1. Overview of the GUI. There is the main simulation in the centre with an interactive GUI box on the left.

As shown in Fig 1, the demonstration will have a main simulation in the middle, with simulation settings dynamically configurable via a GUI on the left. For example, one can change the number of robots, the communication frequency, range bearing distance threshold, etc., live using the provided GUI.

Furthermore, we demonstrate the dynamic addition of robots in the demo. As shown in Fig 2, robots can be added to the scene dynamically. In the beginning, the newly added robot has no initial prior knowledge about its position; however, after a few observations, it can accurately localise itself relative to other robots.

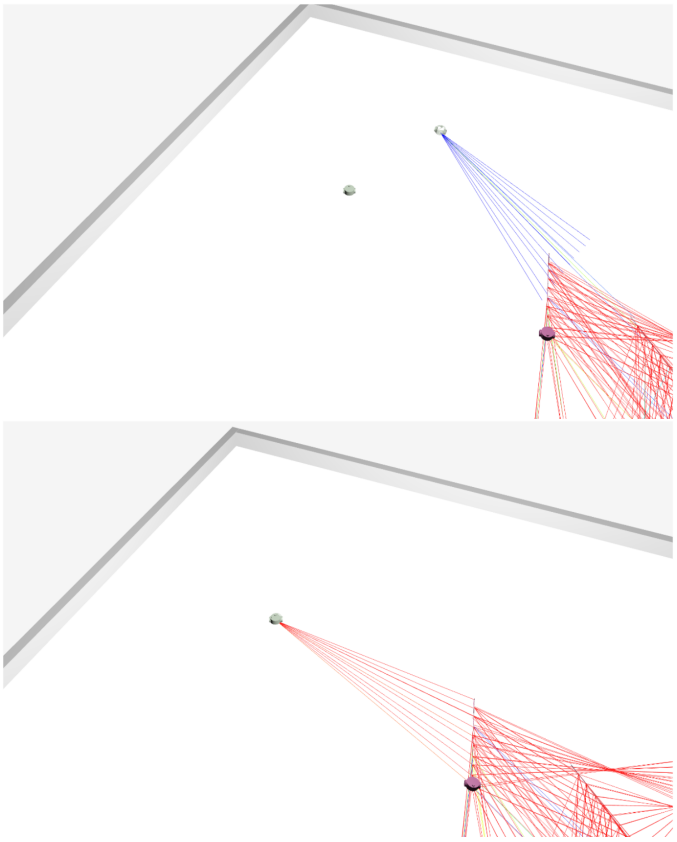

Fig. 2. Demonstration of adding a new robot into the simulation. The robot is poorly initialised in the above case; however, it immediately re-localises after a few observations.

II. FORMAT OF THE DEMO

We envision that for this demo, a simple table with an electrical socket, and optionally a monitor or screen, will suffice. To make the demo more interactive for the audience, we plan to let participants change parameters on the fly, allowing them to experience firsthand how robust the system truly is.

REFERENCES

[1] Riku Murai, Joseph Ortiz, Sajad Saeedi, Paul HJ Kelly, and Andrew J Davison. A robot web for distributed many-device localisation. *arXiv preprint arXiv:2202.03314*, 2022.