

Comparative Analysis of Multi-Sensor Integration in the SENSE-Rai Framework Using Different Data Distribution Service Integrations

Background

SENSE-Rai project is all about creating new technologies and methods that help us process data better using artificial intelligence (AI). This project involves using both real and virtual sensors (e.g., cameras, lidars, etc.). It also includes standardized interfaces (ways for different systems to communicate) and various software and hardware pieces that help prepare the data.

These components are essential for improving smart sensor technology and AI that relies on sensors. The project aims to combine physical models (how things work in the real world) with data-driven models (predictions based on data) and also focuses on edge computing (processing data close to where it's collected, rather than in a distant server).

In a nutshell, SENSE-Rai is about developing tools and methods to collect, process, and analyze data more efficiently for AI applications.

Within the SENSE-Rai project, methodological and technological foundations are rigorously established, leading to the development of specific systems and their application in selected use cases. A key component of this project is the creation of a middleware layer using ROS2 as an interface unit. This middleware enables the seamless integration of various sensor systems, such as cameras, laser scanners, thermal sensors, spectrometers, and event cameras. It facilitates the control of data acquisition, calibration, and spatio-temporal referencing, along with pre-processing and quality measurement.

Goals

This thesis aims to investigate the integration of multiple sensors within SENSE-Rai systems, utilizing the ROS 2 framework. A comprehensive comparative analysis will evaluate the performance, scalability, and overhead of using ROS 2 with different Data Distribution Service (DDS) in terms of cost, license,

efficiency, optimization capabilities, the study also will propose and assess the potential for sensor technology transfer to the market for similar SENSE-Rai embedded systems.

Highlight: You will work closely with the German Aerospace Center (DLR) in Germany.

Objectives

- To compare the performance and scalability of multi-sensor systems with different DDS integration (e.g., eProsima Fast DDS, Eclipse Cyclone DDS, RTI Connex DDS, Zetascale Zenoh DDS integration).
- To quantify the network overhead introduced by using default DDS setting in comparison to others.
- To evaluate the potential for technology transfer of sensor integration techniques to similar SENSE-Rai-embedded systems, and based on the DDS comparative results, determine which mark is more suitable.

Expected Contributions

- Quantified metrics for the performance, scalability, and overhead of different DDS configuration for SENSE-Rai framework
- Recommendations for optimizing sensor integration and data processing in SENSE-Rai embedded systems.
- Insights into the market potential and applicability of advanced sensor technologies developed within the project.

Interested?

Please send us an email, write about your motivation to work on the subject, your background and transcripts, and at what stage of the master program you are. We will then set a meeting.

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