

This thesis was submitted to the Institute of Mechanism Theory, Machine Dynamics and Robotics

# Cross-Compiling ROS2 Humble to WebAssembly

Master Thesis

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Aachen, 31 March 2023



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## **Master Thesis**

by Isabel Paredes B.Sc.

Student number: 415723

### **Cross-Compiling ROS2 Humble to WebAssembly**

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Supervisor: Dipl.-Ing. Martin Mustermann

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### **Statutory Declaration in Lieu of an Oath**

Isabel Paredes

Student number: 415723

I hereby declare in lieu of an oath that I have completed the present Master Thesis titled

### **Cross-Compiling ROS2 Humble to WebAssembly**

independently and without illegitimate assistance from third parties. I have used no other than the specified sources and aids. In case that the thesis is additionally submitted in an electronic format, I declare that the written and electronic versions are fully identical. The thesis has not been submitted to any examination body in this, or similar, form.

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## Formula symbols and indices

### Lower case latin letters as formula symbols

$a$	$\frac{\text{m}}{\text{s}^2}$	acceleration
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### Upper case latin letters as formula symbols

$A$	$\text{m}^2$	surface
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### Lower case greek letters as formula symbols

$\alpha$	—	Weighting factor
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### Upper case greek letters as formula symbols

$\Omega$	$\frac{\text{rad}}{\text{m}}$	Angular frequency
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### Indices

$a$	Amplitude
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## List of abbreviations

### General abbreviations

**FFT**          Fast-Fourier-Transformation

**WASM**        Web Assembly

## **1. Introduction**

Motivation for work

## **2. Literature Review**

### **2.1. ROS on Web**

### **2.2. Web Tools**

### **2.3. Unreal WASM??**

### **3. Concept Realization**

Ideal scenario: - click on a link and run ROS - connect to a robot via bluetooth - share simulations and algorithms

## **4. Technical Levels**

### **4.1. User Levels of Interaction**

### **4.2. Technical Levels of Implementation**

## **5. Scope of Tasks**

- Middleware replacement (why sockets don't work)
- JavaScript "ROS master"

## **6. Methodology**

- Development environment - Building tools - Testing tools (chrome, firefox)

## **7. Middleware Implementation**

- What does the middleware do? - ROS supported middleware implementations - Why it needs to be replaced - Minimal implementation (minimal set of functions) - Design of middleware packages (tree diagram or something)



## 8. Package Building Process

- Emscripten - Colcon - Toolchains

## 9. Design of Web Elements

- Web workers, what are they? why are they needed?
- Communication channels - Registry of topics/subs/pubs - Message handling

## **10. Package Management and Distribution**

- Automating package building - robostack?

## **11. Concept Assessment**

- Survey - Performance measures - Limitations

## 12. Summary

## **13. Outlook**

- Compiling on the browser - Packaging Gazebo - WASI

## List of Tables

## List of Figures



## A. Illustrations

## B. Tables