Real Time EtherCAT Master

Legged Team / Control Systems Lab / School of Mechanical Engineering / National Technical University of Athens

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Presentation Contents

- Intro to EtherCAT
- What is Ethelab?
- ROS2 wrapper for Etherlab
 - Package's structure
 - List of services/topics/messages
 - A simple master-slave communication (led blinking)
- Case study: Laelaps II quadruped by CSL Legged Robots Team
- How to extend ether_ros2

EtherCAT Communication Protocol





EtherCAT Technology

EtherCAT is a high-performance, low-cost easy to use Industrial Ethernet technology with a flexible topology. Key features:

- Full Duplex Communications.
- Master-Slave Architecture.
- Fastest industrial Ethernet technology.
- Suitable for both centralized & decentralized system architectures.
- Open technology.
- Proven technology, widely used in many fields (Robotics, Power Plants, Wind Turbines, Medical devices etc.).

Laelaps II Quadruped



built by the legged team @CSL[csl-ep.mech.ntua.gr]



Hardware Overview

- 2-DoF Legs actuated by high power motors.
- Decentralized Control Architecture.
- High resolution Feedback Sensing (e.g. EtherCAT Force-Torque Sensors etc.)
- High Frequency (10 kHz) PWM Current Control, integrated in EtherCAT Network.
- Modular Design (Still under Development).
- Flexible Torso for agility.

Laelaps II EtherCAT Network





Master



Slave



EtherCAT Network Components

- EtherCAT Master Intel NUC8i7HVK (hades canyon) running UBUNTU 20.04 with Preemptive-rt patched Kernel 5.4
- 4x Leg EtherCAT slaves for control, utilized with bare-metal microcontrollers (Ti's TMS320F28379D)
- 2x IMUs integrated in EtherCAT network
- Default Loop Rate: 2.5 kHz
- Custom Master: EtherLAB Master API, with ROS capabilities
- Alternative Master: Beckhoff's Twincat 3, running on Windows 10

Real Time EtherCAT master for ROS



EtherCAT + ROS(2) = Ether_ros(2)

Developed by Mike Karamousadakis as part of his Diploma Thesis @ CSL



PACKAGE TIMELINE until June 2021





Mastrogeorgiou



Indicative results





ether_ros

Similar ROS packages for EtherCAT Master

- Deprecated ROS Industrial SOEM
- SOEM package
- ANYbotics forked SOEM package

Why ether_ros ?



- Proven in a demanding hard Real-Time application
- The modularity of ROS meets the functionality of EtherLAB
- Complete integrability of EtherCAT protocol
- Kernel Space runtime, with user-space API vs. userspace runtime of SOEM (and its latency drawbacks)
- Advanced Diagnostic features

Members of the legged team involved in the project





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THANK YOU

...and see you in New Orleans!

check our work @ csl-ep.mech.ntua.gr

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