IgH Master userspace program in ROS Documentation

Release 0.3.1

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Welcome to the documentation of IgH Master userspace real time program in ROS. If you would like to see an example of usage and installation instructions, see the Guide section. For help or new features or bugs, see information in the Support subsection of the Guide section.

CHAPTER 1

Contents

1.1 Files / Classes

1.1.1 Header Files

EtherCAT Communicator header file

Header file for the *EthercatCommunicator* class.

Defines

DC_FILTER_CNT

SYNC_REF_TO_MASTER

FIFO_SCHEDULING

class EthercatCommunicator

#include <*ethercat_communicator.h*> The Ethercat Communicator class.

Basic class for implementing realtime pure communication purposes, from our application to the Ethercat slaves, via IgH Master module. The class uses the POSIX API for gaining realtime attributes.

Public Functions

void **init**(ros::NodeHandle &*n*)

Initializes the main thread.

Mostly makes ready the attributes of the realtime thread, before running.

Parameters

- n: The ROS Node Handle

void **start**()
Starts the main thread.

The function that actually starts the realtime thread. The realtime attributes have been set from *init*. Implements the basic realtime communication (Tx/Rx) with the EtherCAT slaves. Doesn't change the output PDOs. Basic state machine:

- Receive the new PDOs in domain1_pd from the IgH Master Module (and therefore from the EtherCAT slaves)
- Move to the domain_pd the output data of process_data_buf, safely
- Publish the "raw" data (not linked to EtherCAT variables) in PDOs received from the domain1_pd, to the /ethercat_data_raw topic
- Synchronize the DC of every slave (every *count'nth* cycle)
- Send the new PDOs from domain1_pd to the IgH Master Module (and then to EtherCAT slaves)

See void *init(ros::NodeHandle &n)*

void **stop**()
Stops the main thread.

This function stops the execution of the realtime thread. The mechanism for stopping it, is provided by the POSIX API. Search for *pthread_testcancel()* and other related functions.

Public Static Functions

static bool **has_running_thread**()
A getter for knowing if there is a running thread.

It's used from the EthercatCommd service, to know if a user stops/starts an already stopped/started *EthercatCommunicator*.

Private Members

pthread_attr_t **current_thattr_**

struct sched_param **sched_param_**

Private Static Functions

void ***run**(void *arg)

void **cleanup_handler**(void *arg)

static void **copy_data_to_domain_buf**()

void **publish_raw_data**()

void **sync_distributed_clocks**(void)
Synchronise the distributed clocks

void **update_master_clock**(void)
Update the master time based on ref slaves time diff

called after the ethercat frame is sent to avoid time jitter in sync_distributed_clocks()

uint64_t **system_time_ns**(void)
Get the time in ns for the current cpu, adjusted by system_time_base_.

The time in ns.

Attention Rather than calling rt_get_time_ns() directly, all application time calls should use this method instead.

Private Static Attributes

int **cleanup_pop_arg_** = 0

pthread_t **communicator_thread_** = {}

ros::Publisher **pdo_raw_pub_**

bool **running_thread_** = false

uint64_t **dc_start_time_ns_** = 0LL

uint64_t **dc_time_ns_** = 0

int64_t **system_time_base_** = 0LL

Input Process Data Objects publisher header file

Header file for the *PDOInPublisher* class.

class PDOInPublisher
#include <pdo_in_publisher.h> The Ethercat Input Data Handler class.

Used for trasforming the "raw" indexed data from the */pdo_raw* topic, sent by the Ethercat Communicator, to values of variables, and stream them to the */pdo_in_slave_{slave_id}* topic.

Public Functions

void **init**(ros::NodeHandle &*n*)
Initialization Method.

Used for initializing the *PDOInPublisher* object. It's basically the main method in the class, which initializes the listener to the afore mentioned topic.

Parameters

- `n`: The ROS Node Handle

void **pdo_raw_callback**(**const** ether_ros::PDORaw::ConstPtr &*pdo_raw*)
Raw Data Callback.

This method, is called when there are data in the */pdo_raw* topic. Should the EtherCAT application change, this callback must change also. Implements the basic functionality of the class, to transform the "raw" data into variable values and pipe them into another topic.

Parameters

- `pdo_raw`: A copy of the actual data sent to the topic */pdo_raw*.

Private Members

ros::Subscriber **pdo_raw_sub_**

ros::Publisher ***pdo_in_pub_**

Output Process Data Objects publisher header file

Header file for the *PDOOutPublisher* class.

class PDOOutPublisher

#include <pdo_out_publisher.h> The Process Data Objects Publisher class.

Used for trasforming the "raw" indexed data from the */pdo_raw* topic, sent by the Ethercat Communicator, to values of variables, and stream them to the */pdo_out* topic.

Used for streaming the *pdo_out* data inside the *process_data_buffer* to the */pdo_out_timer* topic at a certain rate. It's been created for logging and debugging reasons.

Public Functions

void **init**(ros::NodeHandle &*n*)

Initialization Method.

Used for initializing the *PDOOutPublisher* object. It's basically the main method in the class, which initializes the listener to the afore mentioned topic.

Parameters

- `n`: The ROS Node Handle

void **pdo_raw_callback**(**const** ether_ros::PDORaw::ConstPtr &*pdo_raw*)

Process Data Objects Callback.

This method, is called when there are data in the */pdo_raw* topic. Should the EtherCAT application change, this callback must change also. Implements the basic functionality of the class, to transform the "raw" data into variable values and pipe them into another topic.

Parameters

- `pdo_raw`: A copy of the actual data sent to the topic */pdo_raw*.

Private Members

ros::Subscriber **pdo_raw_sub_**

ros::Publisher **pdo_out_pub_**

EtherCAT Slave header file

Header file for the *EthercatSlave* class.

class EthercatSlave

#include <ethercat_slave.h> The Ethercat Slave class.

Used for having all the ethercat slave related variables, fetched from the correspondent yaml file, in a single entity.

Public Functions

void **init**(std::string *slave*, ros::NodeHandle &*n*)
Initialization Method.

Used for initializing the *EthercatSlave* entity. It's basically the main method in the class.

int **get_pdo_out**()
Getter Method.

Used for getting the number of bytes of the output PDO of the single slave.

int **get_pdo_in**()
Getter Method.

Used for getting the number of bytes of the input PDO of the single slave.

ec_slave_config_t ***get_slave_config**()

Private Members

int **vendor_id_**

std::string **slave_id_**

int **product_code_**

int **assign_activate_**

int **position_**

int **alias_**

int **input_port_**

int **output_port_**

ec_slave_config_t ***ethercat_slave_**

int **pdo_in_**

int **pdo_out_**

int32_t **sync0_shift_**

Main header file

Main header file.

Typedefs

typedef struct *slave_struct* **slave_struct**
A shorthand definition of *slave_struct*.

Variables

slave_struct ***ethercat_slaves**
The main slave struct.

Used by our program to contain all the useful info of every slave.

uint8_t ***domain1_pd**
Global buffer for the actual communication with the IgH Master Module.

uint8_t ***process_data_buf**
Global buffer for safe concurrent accesses from the output PDOs services and the EtherCAT Communicator.

See *ethercat_comm*

size_t **total_process_data**
Total number of process data (PD) (bytes).

size_t **num_process_data_in**
Number of input PD per slave (bytes).

Assumes that the EtherCAT application is the same for every slave.

size_t **num_process_data_out**
Number of output PD per slave (bytes).

Assumes that the EtherCAT application is the same for every slave.

int **log_fd**
File descriptor used for logging, provided that LOGGING and one of LOGGING_SAMPLING or LOGGING_NO_SAMPLING is enabled.

Could be deprecated in a next version (see kernelshark).

ec_master_t ***master**
The main master struct.

Used for communication with the IgH Master Module.

ec_master_state_t **master_state**
The master state struct.

Used to examine the current state (Links Up/Down, AL states) of the Master.

ec_master_info_t **master_info**
The master info struct.

Used to know the slaves responding to the Master.

ec_domain_t ***domain1**
The main domain struct variable.

Used to send and receive the datagrams.

ec_domain_state_t **domain1_state**
The domain state struct.

Used to examine the current state (Working counter, DL states) of the domain.

See *ethercat_comm*

pthread_spinlock_t **lock**
The shared spinlock.

Used by every thread whick modifies the process_data_buf.

See *process_data_buf*

EthercatCommunicator **ethercat_comm**
The barebone object of our application.

Used for realtime communication (Tx/Rx) with the EtherCAT slaves. Doesn't change the output PDOs. Basic state machine:

- Receive the new PDOs in domain1_pd from the IgH Master Module (and then to EtherCAT slaves)
- Move to the domain_pd the output data of process_data_buf, safely
- Publish the "raw" data (not linked to EtherCAT variables) in PDOs from the domain1_pd
- Send the new PDOs from domain1_pd to the IgH Master Module (and then to EtherCAT slaves)

PDOInPublisher **pdo_in_publisher**
Main object for publishing to the /ethercat_data_slave_x the values of the EtherCAT input variables.

Maps indeces to variables.

PDOOutPublisher **pdo_out_publisher**
Main object for publishing to the /ethercat_data_out the values of the EtherCAT output variables.

Maps indeces to variables.

PDOOutListener **pdo_out_listener**

PDOOutPublisherTimer **pdo_out_publisher_timer**

int **PERIOD_NS**
Handy variable induced from the Frequency variable.

See *FREQUENCY*

int **FREQUENCY**
Frequency of the realtime thread: EtherCAT Communicator.

int **RUN_TIME**
Total run time of the realtime thread: EtherCAT Communicator.

statistics_struct **stat_struct**

struct slave_struct
#include <ether_ros.h> The basic slave struct.

Public Members

slave_struct::slave_name
The slave's name (for convienience, the names are the positions of the legs)

slave_struct::id
The slave's id (in a four legged robot, that will be from 0 to 3)

slave_struct::slave
The *EthercatSlave* object, used to store every other useful information.

Services header file

Services header file.

Includes:

- EtherCAT Communicator Daemon
- Services for modifying output PDOs

Functions

bool **ethercat_communicatord**(ether_ros::EthercatCommd::Request &*req*,
ether_ros::EthercatCommd::Response &*res*)

ROS Service Callback.

Controls the Ethercat Communicator. The basic functionality is:

- Start
- Stop
- Restart (Remember that a Service Callback must always return a boolean.)

bool **start_ethercat_communicator**()

Helper function for the *ethercat_communicatord* callback.

Used from the callback in order to actualy send the start command to the Ethercat Communicator.

bool **stop_ethercat_communicator**()

Helper function for the *ethercat_communicatord* callback.

Used from the callback in order to actualy send the stop command to the Ethercat Communicator.

Utilities header file

Utilities header file.

Includes:

- Functions for processing EtherCAT PDOs
- Function for insisting write to file
- Function for safe ascii to integer conversion
- Function for adding two timespec structs
- Functions for checking domain and master states

Deadline Scheduler header file

Deadline scheduler header file.

Should be added to the project in order the SCHED_DEADLINE option could be used. I'm not the author of the header file, nor do I claim any copyrights for it. This file is distributed under the GPLv2 licence. See the licence above to get an idea.

Defines

SCHED_DEADLINE

Functions

int **sched_setattr**(pid_t *pid*, **const struct** *sched_attr* **attr*, unsigned int *flags*)

int **sched_getattr**(pid_t *pid*, **struct** *sched_attr* **attr*, unsigned int *size*, unsigned int *flags*)

struct sched_attr
#include <deadline_scheduler.h>

Public Members

__u32 **size**

__u32 **sched_policy**

__u64 **sched_flags**

__s32 **sched_nice**

__u32 **sched_priority**

__u64 **sched_runtime**

__u64 **sched_deadline**

__u64 **sched_period**

1.1.2 Source Files

EtherCAT Communicator source file

Implementation of *EthercatCommunicator* class.

Used for real-time communication with the EtherCAT slaves, via the IgH Master module. The new PD are sent to the */ethercat_data_raw* topic.

Input Process Data Objects publisher source file

Implementation of *PDOInPublisher* class.

Used for publishing the "raw" input data, received from EtherCAT Communicator after transformation into useful, human-readable format, consisted of the EtherCAT variables used by our application. Transforms the indeces to variables.

Output Process Data Objects publisher source file

Implementation of *PDOOutPublisher* class.

Used for handling the "raw" output data, received from EtherCAT Communicator and transforming them into useful, human-readable format, consisted of the EtherCAT variables used by our application. Transforms the indeces to variables.

Used for streaming the "raw" *pdo_out* data inside the *process_data_buffer* to the */pdo_out_timer* topic and transforming them into useful, human-readable format, consisted of the EtherCAT output variables used by our application, at a certain rate. It's been created for logging and debugging reasons.

EtherCAT Slave source file

Implementation of *EthercatSlave* class.

Used for containing all the useful information of an EtherCAT slave, from the userspace program perspective. Receives all the useful information via the ROS Parameter Server (after they are loaded from ethercat_slaves.yaml).

Main source file

Main source file.

IgH Master EtherCAT module main for realtime communication with EtherCAT slaves. This interface is designed for realtime modules, running in the ROS environment and want to use EtherCAT. There are classes and functions to get the Input and Output PDOs in a realtime context. Before trying to understand the source code of the project, please consider to read and understand the IgH Master Documentation located at: https://www.etherlab.org/download/ethercat/ethercat-1.5.2.pdf. Finally try to understand the API provided in the /opt/etherlab/include/ecrt.h file. The author admits that the C++ language, is not his strong suit. Therefore feel free to refactore the code given with use of the new C++ (11/14/17) helpful tools (unique/shared pointers and other cool stuff).

Changes in version 0.3:

- Created a frontend UI client in Python, for interacting with the Services API. Features include: Start/Stop function of the EtherCAT Communicator Change the Output PDOs on the run Run script with the aproppriate Service API calls

Changes in version 0.2:

- Added features and bug fixes including: First realtime characteristics added (debate: FIFO vs DEADLINE scheduling?) Handling of the EtherCAT communicator module: Start/Stop/Restart API
- Added processing for the /ethercat_data_raw topic and created: Service API for Output PDO handling and topic streaming: /ethercat_output_data Service API for Input PDO handling and topic streaming: /ethercat_data_slave_{slave_id}
- Added synchronization primitives (spinlocks) for the concurrent threads accessing the EtherCAT buffer.
- Added more source files, ethercat communicator, ethercat_slave, pdo_in_publisher and pdo_out_publisher. Created external objects to use the appropriate classes and functions.

Version 0.1:

- Created the first bare communication layer in the ROS environment. Many bugs and deficiencies including: Non realtime characteristics, no API for Output PDO handling and topic streaming, no handling of the EtherCAT communicator module, no Service API for Input PDO topic streaming.
- One topic streaming: /ethercat_data_raw

Unnamed Group

uint8_t ***domain1_pd**
Global buffer for the actual communication with the IgH Master Module.

uint8_t ***process_data_buf**
Global buffer for safe concurrent accesses from the output PDOs services and the EtherCAT Communicator.

See *ethercat_comm*

size_t **total_process_data**
Total number of process data (PD) (bytes).

size_t **num_process_data_in**
Number of input PD per slave (bytes).

Assumes that the EtherCAT application is the same for every slave.

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Assumes that the EtherCAT application is the same for every slave.

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The master state struct.

Used to examine the current state (Links Up/Down, AL states) of the Master.

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The master info struct.

Used to know the slaves responding to the Master.

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The main domain struct variable.

Used to send and receive the datagrams.

ec_domain_state_t **domain1_state**
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Used to examine the current state (Working counter, DL states) of the domain.

See *ethercat_comm*

slave_struct ***ethercat_slaves**
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Used by every thread whick modifies the process_data_buf.

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- Move to the domain_pd the output data of process_data_buf, safely
- Publish the "raw" data (not linked to EtherCAT variables) in PDOs from the domain1_pd

- Send the new PDOs from domain1_pd to the IgH Master Module (and then to EtherCAT slaves)

EthercatInputDataHandler **pdo_in_publisher**
Main object for publishing to the /ethercat_data_slave_x the values of the EtherCAT input variables.

Maps indeces to variables.

EthercatOutputDataHandler **pdo_out_publisher**
Main object for publishing to the /ethercat_data_out the values of the EtherCAT output variables.

Maps indeces to variables.

PDOOutListener **pdo_out_listener**

PDOOutPublisherTimer **pdo_out_publisher_timer**

int **FREQUENCY**
Frequency of the realtime thread: EtherCAT Communicator.

int **RUN_TIME**
Total run time of the realtime thread: EtherCAT Communicator.

int **PERIOD_NS**
Handy variable induced from the Frequency variable.

See *FREQUENCY*

int **main** (int *argc*, char ***argv*)

Services source file

Implements the services used.

Provides services for:

- Interacting with the EtherCAT Communicator
- Changing the EtherCAT output PDOs

Functions

ethercat_communicatord (ether_ros::EthercatCommd::Request &*req*, ether_ros::EthercatCommd::Response &*res*)
ROS Service Callback.

Controls the Ethercat Communicator. The basic functionality is:

- Start
- Stop
- Restart (Remember that a Service Callback must always return a boolean.)

start_ethercat_communicator ()
Helper function for the *ethercat_communicatord* callback.

Used from the callback in order to actualy send the start command to the Ethercat Communicator.

stop_ethercat_communicator ()
Helper function for the *ethercat_communicatord* callback.

Used from the callback in order to actualy send the stop command to the Ethercat Communicator.

Utilities source file

A library with useful functions for handling EtherCAT PDOs and other utilities.

namespace utilities

Functions

int **safe_atoi** (**const** char *s, int *val)

bool **process_input_bit** (uint8_t *data_ptr, uint8_t index, uint8_t subindex)

uint8_t **process_input_uint8** (uint8_t *data_ptr, uint8_t index)

int8_t **process_input_int8** (uint8_t *data_ptr, uint8_t index)

uint16_t **process_input_uint16** (uint8_t *data_ptr, uint8_t index)

int16_t **process_input_int16** (uint8_t *data_ptr, uint8_t index)

uint32_t **process_input_uint32** (uint8_t *data_ptr, uint8_t index)

int32_t **process_input_int32** (uint8_t *data_ptr, uint8_t index)

uint64_t **process_input_uint64** (uint8_t *data_ptr, uint8_t index)

int64_t **process_input_int64** (uint8_t *data_ptr, uint8_t index)

struct timespec **timespec_add** (**struct** timespec *time1*, **struct** timespec *time2*)

void **check_domain1_state** (void)

void **check_master_state** (void)

ssize_t **insist_write** (int *fd*, **const** char *buf, size_t *count*)

std::string &**ltrim** (std::string &*str*, **const** std::string &*chars*)

std::string &**rtrim** (std::string &*str*, **const** std::string &*chars*)

std::string &**trim** (std::string &*str*, **const** std::string &*chars*)

void **copy_process_data_buffer_to_buf** (uint8_t *buffer)

EtherCAT Keyboard Controller python file

namespace ethercat_keyboard_controller

Variables

################################## ## Ethercat Keyboard controller ## ################################## Changes elliptic trajectory parameters and controlls the ethercat communicator. All the terminal commands must beggin with an exclamation mark "!". If you want to find the current application variables, see the EthercatOutputData.msg. The current supported commands are: !start : starts the ethercat communicator !stop : stops the ethercat communicator !restart : restarts the ethercat communicator !variable [slave_id | 'all'] [variable_name] [value] : change the value of a variable in the ethercat output data !run [script_to_run] : run the script specified, inside the ether_ros/scripts directory !help : shows this help message !q : exit the terminal Type !q to quit ""]

Welcome to the Ethercat Keyboard Controller! By Mike Karamousadakis Contact: mkaramousadakis@zoho.eu “”“]

modify_pdo_pub = rospy.Publisher('pdo_listener', ModifyPDOVariables, queue_size=10)

prompt = *ethercat_controller*()

intro

class ethercat_controller

Base Ethercat Controller class.

Inherits from the base class Cmd. Serves as a frontend to the C++ code, and specifically to the services implemented.

Public Functions

call_modify_publisher(*self self*, *slave_id slave_id*, *variable_name variable_name*, *value value*)

modify_output_publisher(*self self*, *slave_id slave_id*, *index index*, *subindex subindex*, *value value*, *var_type var_type*)

ethercat_communicator_client(*self self*, *mode mode*)

Frontend client for the ethercat_communicatord service.

Parameters

- `self`: The current object.
- `mode`: The mode to change to (start/stop/restart).

do_shell(*self self*, *args args*)

Main method of *ethercat_controller* class.

Accepts commnads, decomposes them and acts.

Parameters

- `self`: The current object.
- `args`: The arguments given from the cmd line.

do_help(*self self*, *line line*)

Helper method.

Parameters

- `self`: The current object.
- `line`: Unrelated argument.Just follow the API

default(*self self*, *line line*)

Unrecognized command method.

Parameters

- `self`: The current object.
- `line`: Unrelated argument.Just follow the API

Public Static Attributes

“state_machine” : [[0, 0], “bool”], “initialize_clock”: [[0, 1], “bool”], “initialize_angles”: [[0, 2], “bool”], “inverse_kinematics”: [[0, 3], “bool”], “blue_led”: [[0, 4], “bool”], “red_led”: [[0, 5], “bool”], “button_1”: [[0, 6], “bool”], “button_2”: [[0, 7], “bool”], “transition_time”: [[1, 0], “int8”], “desired_x_value”: [[2, 0], “int32”], “filter_bandwidth”: [[6, 0], “uint16”], “desired_y_value”: [[8, 0], “int32”], “kp_100_knee”: [[12, 0], “int16”], “kd_1000_knee”: [[14, 0], “int16”], “ki_100_knee”: [[16, 0], “int16”], “kp_100_hip”: [[18, 0], “int16”], “kd_1000_hip”: [[20, 0], “int16”], “ki_100_hip”:

[[22, 0], “int16”], “x_cntr_traj1000”: [[24, 0], “int16”], “y_cntr_traj1000”: [[26, 0], “int16”], “a_ellipse100”: [[28, 0], “int16”], “b_ellipse100”: [[30, 0], “int16”], “traj_freq100”: [[32, 0], “int16”], “phase_deg”: [[34, 0], “int16”], “flatness_param100”: [[36, 0], “int16”] }] variables2indeces dictionary. Used for transforming the [index,subindex] -> variable

1.2 License

1.2.1 Note

The license mentioned above concerns the source code only. Using the EtherCAT technology and brand is only permitted in compliance with the industrial property and similar rights of Beckhoff Automation GmbH. Contact information: mkaramousadakis@zoho.eu

1.3 Guide

This guide will solve your problem of where to start with documentation, by providing a basic explanation of how to do it easily. Look how easy it is to use:

- After you *catkin_make* the project, in one terminal run:

$ roslaunch ether_ros ether_ros.launch

- After that, and while the process is running, you run in another terminal:

$ rosrun ether_ros ethercat_keyboard_controller.py

- Now you can give orders to the EtherCAT Communicator via a custom terminal.

Have fun playing around!

- *Tip: You could run a bash script in the custom terminal by running:*

[ethercat_controller] > !r my_awesome_bash_script.sh

Notice that your script must be under the *scripts* directory. You could also check some example scripts there.

1.3.1 Features

- Real time characteristics, using PREEMPT_RT patch
- EtherCAT technology adaptation in Linux

- Works in a recent version of ROS (kinetic)
- Utilizes the main development framework for EtherCAT applications, IgH Master kernel module

1.3.2 Installation

SUPER SOS : The following manual will be extremely helpful for understanding the instructions given in this section. You should **definitely** read it before procceding. Link.

0. Preempt_RT Patch

First step to utilize the repository given, is to install the preempt_rt patch in the kernel. Note that in order to install the IgHM, the kernel should be up to 4.9. A proper guide for the installation procedure can be found in the following link. After you patch the kernel (say 4.9), you will want to use some other configuration parameters in the build of the kernel. Therefore after step 3 and in the line of *make menuconfig* of the previous link, you will want to specify some extra configuration parameters, derived from the chapter 3 of the manual mentioned in the beginning, namely:

- CONFIG_PREEMPT_RT_FULL
- CONFIG_CPU_FREQ=n
- CONFIG_CPU_IDLE=n
- CONFIG_NO_HZ_FULL=y
- CONFIG_RCU_NOCB_CPU=y

The author has used only the first configuration parameter and has seen great boost in the performance of the real-time tasks specified. Future work requires more tweaks to be done, derived from the afore mentioned manual.

Tip: While you are in the menuconfig, type "/" and you can type to find the place of a configuration parameter. Exit with ESC

1. Installation of IgHM

1. cd into the etherlab-mercurial folder
2. Run *make ethercatMasterInstallWithAutoStart*. Note that root access is needed. If you use another native driver from e1000e, open the Makefile and change the configure option with your driver version. You can find here and here (Chapter 9), the supported hardware and the options the command *configure* takes, respectively. If your hardware is not supported or if you don't want the native driver support fuzz, then you should change the *configure* command to enable generic driver support (although I think it defaults to that).

2. Run the scripts

1. Because we want to have a process in realtime context, we should change it's priority (done in the code -FIFO policy, 80 priority-). Besides that, the interrupt handler which handles the interrupts generated by the network driver, should have higher priority than the process we develop, so that the EtherCAT datagrams are ready to be sent/received before we process them. For that cause I have written a script, as a sample script, to change the priority of the irq process of the network card.This should be used accordingly to change **your** process's priority. You could check if the priority has changed with the *chrt* command. How-to can be found here.
2. Aside from the enhancements proposed by the manual, we should also change the throttling of our network driver to 0. This is done in the script also in the *testbench* directory. It is based on my e1000e driver, so use it as a sample script. Documentation for the insertion of the module of the e1000e network driver can be found here.

3. Run the script for changing the permissions of ether_ros. We set the suid of ether_ros to be root, so that the ether_ros can be launched without *sudo*. This will be useful **after** you *catkin_make* the project.

1.3.3 Contribute

- Issue Tracker: https://github.com/mikekaram/IgHMaster-userspace-program-in-ROS/issues
- Source Code: https://github.com/mikekaram/IgHMaster-userspace-program-in-ROS

1.3.4 Limitations / Steps Forward

This program assumes that the actual control code of the robot is running in the EtherCAT slaves. Therefore there is no connection between this program and ros_control, although the intention of the author is to make this connection happen, for robots that do have a control api inside ROS. This of course means that the ros_control module should communicate afterwards with this program, to send new data to the EtherCAT slaves. Needless to say, the EtherCAT slaves will have a much more passive role in this configuration.

1.3.5 Support

If you are having issues, please let us know. We don't have a mailing list yet, so the default way is by communicating with: mkaramousadakis@zoho.eu

1.3.6 License

The project is licensed under the GPLv2 licence. See more details in the source files of the project or in the Lincence section.

CHAPTER 2

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