GENESIS – Module Based Design
Learning Report

LTTS
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Details

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Contents

Certificates:

Matlab On Ramp:

MathWorks | Training Services

Progress Report

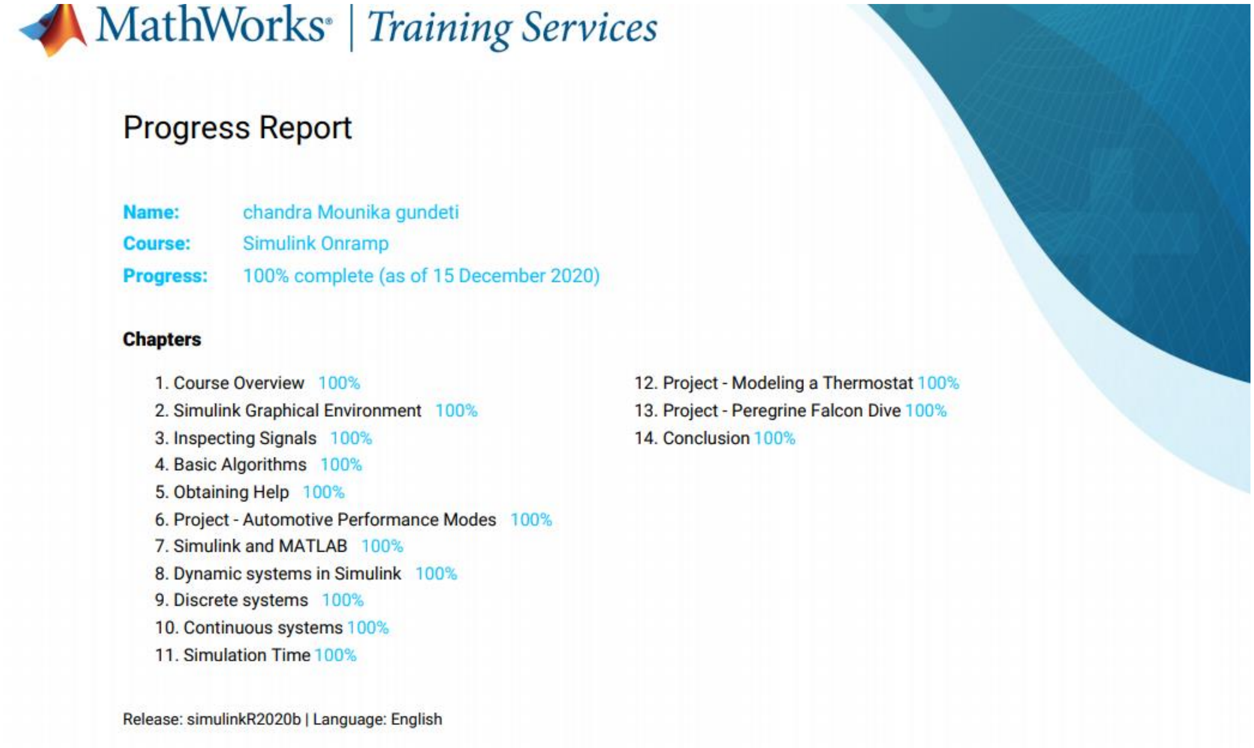
Name: chandra Mounika gundeti
Course: MATLAB Onramp
Progress: 100% complete (as of 15 December 2020)

Chapters

1. Course Overview 100%
2. Commands 100%
3. MATLAB Desktop and Editor 100%
4. Vectors and Matrices 100%
5. Indexing into and Modifying Arrays 100%
6. Array Calculations 100%
7. Calling Functions 100%
8. Obtaining Help 100%
9. Plotting Data 100%
10. Review Problems 100%
11. Importing Data 100%
12. Logical Arrays 100%
13. Programming 100%
14. Final Project 100%
15. Conclusion 100%

Release: R2020b | Language: English

Simulink On Ramp:



MathWorks | *Training Services*

Progress Report

Name: chandra Mounika gundeti
Course: Simulink Onramp
Progress: 100% complete (as of 15 December 2020)

Chapters

1. Course Overview 100%
2. Simulink Graphical Environment 100%
3. Inspecting Signals 100%
4. Basic Algorithms 100%
5. Obtaining Help 100%
6. Project - Automotive Performance Modes 100%
7. Simulink and MATLAB 100%
8. Dynamic systems in Simulink 100%
9. Discrete systems 100%
10. Continuous systems 100%
11. Simulation Time 100%
12. Project - Modeling a Thermostat 100%
13. Project - Peregrine Falcon Dive 100%
14. Conclusion 100%

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Stateflow On Ramp:

MathWorks | *Training Services*

Course Completion Certificate

chandra Mounika gundeti

has successfully completed 100% of the self-paced training course

Stateflow Onramp

DIRECTOR, TRAINING SERVICES

17 December 2020

Activity 1

SUBSYSTEMS IN BODY CONTROL MODULE:

1) POWER TRAIN:

Power is produced by the engine and transferred to the wheels to propel the vehicle.
Drive train helps to transfer power produced from the engine to the wheels with the help of intermediate linkages.
The set of linkages in between the engine and the wheels constitute drive train.
It includes the clutch, the gearbox, the universal joints and the drive shaft and differential arrangement.
The function of the clutch is to provide gradually increasing amount of power to the shaft, while engine output remains fixed.
Vehicle requires more power when it just starts to roll (it needs to overcome inertia). But at this point of time the speed is very low. As the engine is connected to the wheels rigidly through gears, the engine also moves slowly. A slow revolving engine produces little power which is not sufficient to accelerate. Engine can produce more power if it runs at high RPMs.
In order to couple an engine running at high speed and a gear system running at low speed, we introduce a clutch which connects the engine and the gear non-rigidly.
The gearbox helps to multiply or divide the available torque at several fixed ratios. This is essential because the vehicle needs more torque while accelerating and less during constant speed cruising. When the vehicle begins to roll from rest, highest amount of torque is required which can be obtained with the help of a set of reduction gear.

2) CHASSIS:

A chassis is defined as the most basic framework for a manmade structure. In structure of a car, truck or sport utility vehicle at the most basic level, the chassis of an automobile consists of only the frame. Sometimes the chassis will include not only the frame, but also the wheels and transmission
Chassis is the load-bearing framework of a vehicle
It supports all the parts of the automobile attached to it.
Chassis offers the opportunity to make dramatic design improvements along with the financial and environmental benefits

3) INFOTAINMENT SYSTEM

Infotainment system is a collection of hardware and software in automobiles that provides audio or video entertainment.
The system initially consisted of radio players, CD players and now it consists of touchscreen inputs, GPS navigator, USB and Bluetooth connectivity, android apps, steering wheel audio controls and overall information about the vehicle.
The main components of an in-vehicle infotainment system are:

Radio: AM and FM radio can be adjusted to auto or manual tuning or can be scanned for available

Radio stations

Connectivity Modules: Infotainment systems consist of Wi-Fi, GPS navigation system, USB and Bluetooth modules to provide connectivity with external networks and devices.
Pairing the smartphone with the system enables the user to access features of the phone like managing calls and other multimedia services

High resolution touch screen: The main infotainment unit is a touch screen based, tablet-like device, mounted on the vehicle's dashboard. It acts as a connected control center. The display ranges from 2 inches to 12 inches

Advanced Vehicular functions: Sensors integrate with infotainment systems to provide safety related information to the driver and passengers

4) SAFETY FEATURES IN CAR

i) Air Bags:

They are one of the key safety features.
In the time of collision, the front air bags inflate to prevent the driver and front passenger from hitting their heads on the dashboard and steering wheel.
Similarly the side air bags protect the passengers sitting on the back from the impact

ii) Traction Control:

In some traction control systems, braking force is applied to selected wheels at the time of acceleration.
It helps to keep the vehicle stable while travelling on wedges and deep curves of roads.
Traction control enhances the stability of a vehicle by controlling the drive that makes wheels' slip when excess power is applied.

iii) Seat belts:

Seat belts are used to prevent the passengers from hitting thier heads to dashboards in case of sudden breaks.

iv) Collision Warning:

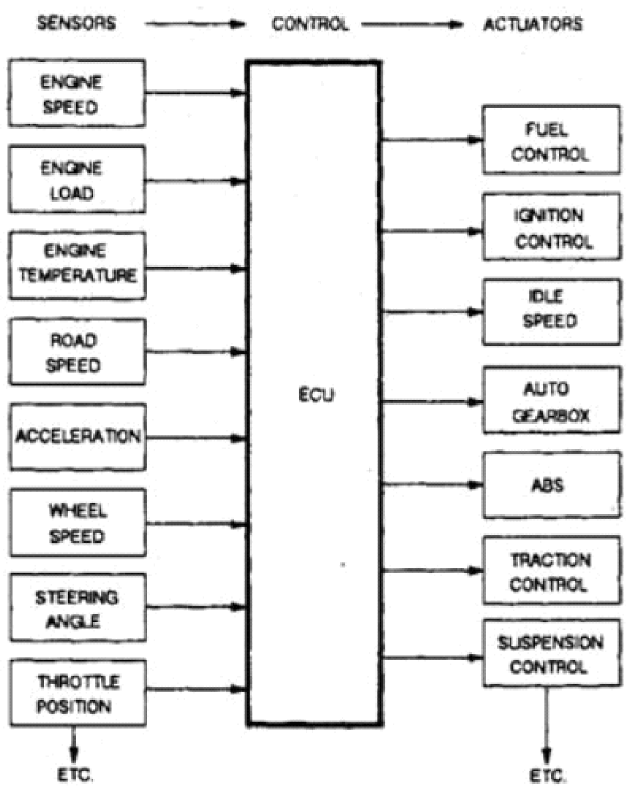
This safety technology alerts about cars or objects that are in the driver's blind spot while driving or parking the car.
So having a camera on back of the car while reversing it is a part of blind spot detection system.

v) Antilock Braking System:

This allows the driver to have a proper steering control which can effectively avoid a collision rather than sudden breaks.
Some ABS also come with brake assist system, which offers greater protection by detecting the force or speed of applied brakes and activates the ABS more rapidly.

5) BODY CONTROL MODULE

In principle, a complete vehicle control system involves one ECU, which controls all aspects of the vehicle. Figure shows a representation of a full vehicle control system.



Advantages of Central Control

The advantages of central control are predominant into main areas, i.e. inputs and outputs. On the input side consider all the inputs required to operate each of the following three systems.

1. Ignition system
2. Fuel system
3. Transmission system

Ignition Fuel Transmission:

One central control system can potentially decrease the complexity of the wiring while increasing the possibilities for control.

If each system is operating independently it is possible that each may not react to some extent in the best way with respect to the other timing.

During the transmission stage, this causes a decrease in efficiency and an increase in emissions.

With single control units or at least with communication between these three systems, all correct actions can take place at the most appropriate times.

However, the complexity of the programming requires much increased computing power. This is particularly apparent if other vehicle systems such as traction control, ABS active suspension and steering are considered.

REFERENCES:

[1] https://www.youtube.com/watch?v=98DXe3uKwfc
[2] https://www.youtube.com/watch?v=FfopczTnFAY
[3] https://www.youtube.com/watch?v=nGPbZ2LdzCA
[4] https://www.youtube.com/watch?v=EI8m61Dal5Q

Activity 2

A BCM can perform multiple control-related operations simultaneously. One of the major objectives of this module is to detect malfunctions in the work of electrical system components. All the output devices are managed by data received from input devices via CAN (Controller Area Network), LIN (Local Interconnect Network), or Ethernet as the means of communication with modules and systems.

The systems that are integrated and controlled by BCM are:

- Energy management systems
- Alarms
- Immobilizers
- Access/driver authorization systems
- Advanced driver assistance systems
- Power windows

The major objective of BCM is to detect malfunctions in an electrical system. It ensures safety, testing, and control of electrical loads, lights, immobilizers, air conditioning systems, locking systems, and windscreen wipers e.t.c.

The advantages of use of BCM are:

- Less number of electronic modules and cables
- Reduced vehicle weight
- Increase in fuel efficiency
- Low manufacturing costs

By using BCM two types of architectures are developed:

1) Centralized BCM architecture
2) Distributed BCM architecture

Centralized BCM architecture:

It requires less number of modules with high functionality and built with a smaller number of modules and more communication interfaces.

Distributed BCM architecture:

It is more flexible and not possible to reach the level of optimization of an ECU with a centralized structure.

Challenges in developing BCM:

1) Increased performance needs
2) Increased number of input/output processors and channels

3) Need to develop a cycle of more complex modules

BCM increases safety and comfort, uncovering brand-new opportunities for self-driving technology development. BCM programming is based on complex embedded software solutions.

Input/output processors can be used to offload interrupt handling. Increased performance is met by applying AUTOSAR. To reduce number of input/output processors and channels and e-switches with a Serial Peripheral Interface (SPI) saving Pulse-Width Modulation (PWM) channels can be used. Cost-effective Quad Flat Packages (QFPs) help to resolve the issues of power consumption in run and sleep modes.

Application notes of Infinion:

PROPOTIONAL LOAD CURRENT SENSOR (UPD166034T1U):
FEATURES:
- 3.3V compatible logic interface
- Low standby current
- Loss of ground protection
- Under voltage lock out
- Active clamp operation at inductive load switches off
- Cross current protection in case of H-bridge high side usage

PARKING SENSOR (FM24CL16):
FEATURES:
- Power Supply Voltage with respect to VSS is -1.0V to +5.0V
- Voltage on any pin with respect to VSS is -1.0V to +5.0V and VIN < VDD+1.0V
- Storage Temperature is -40°C to + 125°C
- Electrostatic Discharge Voltage - Human Body Model is 4kV and Machine Mode is 300V

ACTUATORS:
FEATURES:
- One full bridge for 6A load (RDSON = 150 mΩ)
- Three half bridges for 1.6A load (RDSON = 800 mΩ)
- One high-side driver for 6A load (RDSON = 100 mΩ)
- Very low current consumption in standby mode
- Open load diagnostic for all outputs
- Overload diagnostic for all outputs
- Separated half bridges for door lock motor

MPXY8000 Series Tire Pressure Monitoring Sensor: AN1954/D

- The MPXY8000 Series sensor is a fully integrated sensor targeted specifically for tire pressure monitoring systems (TPMS)
- Capacitive absolute pressure sensor with a range from 0 kpa to 637.5 kpa
- Temperature sensor capable of measuring temperature in the range of -40°C to 125°C

- Optimized for low-voltage and low-power draw suitable for powering with a single 3-volt lithium battery
- Media compatible with fluids and media and media that are commonly found within the tire environment
- Operates in four modes namely Standby/Reset (Idle), Measure Pressure, Measure Temperature and Output Read mode

Automotive dedicated door-actuator drivers: L9953 and L9954

- It is the leading automotive door actuator driver family
- They meet the requirements for centralized or de-centralized door-lock topologies
- Temperature warning indication and thermal shutdown protection
- Very low current consumption in standby mode
- Standard serial peripheral interface

Comparison Analysis of Sensors:

UPD166025T1J and UPD166033T1U

	UPD166025T1J	UPD166033T1U
Light bulb switching	40W to 55W	55W to 75W
Over current detection current	114 A	130 A
Power limitation thermal shutdown temperature	50 °C	40 °C
Current limitation trigger threshold during turn-on	2V	1V

Current sensor:

	TLI4970-D050T5	TLI4971-A120T5-U-E0001
Accuracy	3.5 %	3.45 %
Current Range	50.0 A	120.0 A
Interfaces	SPI	Analog
Isolation U_{IORM}	330.0 V	1150.0 V

Mass airflow sensor:

Specification	AWM2100V	AWM2150V
Power consumption	30mW	30mW
Output voltage trim point	30mV	2.5mV
Null voltage	0.00 ± 1.0 mV	0.00 ± 1.0 mV
Output voltage shift	-2.5% - +2.5%	-5% - +5%
Response time	3.0 ms	3.0 ms
Weight	10.8 gms	10.8 gms
Resistance	5KOhm	5KOhm
Current	0.3 mA	0.3 mA

Transmission speed sensor:

Sl No	Parameter	TLE4953X	TLE4959C(-FX)
1	Supply voltage (volts)	4.5 - 20	4 - 16
2	Supply current (mA)	5.9 – 16.8	8 – 13.4
3	Temperature range (degree centigrade)	-10 to 150	-40 to 185
4	Frequency for accurate speed measurement (kHz)	0 – 12	0 - 10
5	Application	Industrial speed sensor	automatic transmission system

Pressure sensor:

Sl.No	Parameter	KP25X	KP21
1	Pressure Range (Pa)	40 - 165	10-150
2	Temperature Range (degree centigrade)	-40 to 125	-40 to 140
3	Accuracy (kPa)	1	1
4	Maximum operating temperature (degree centigrade)	115	140
5	Supply voltage (volts)	3.3 - 5	4.5 – 5.5
6	Sensitivity (mV/kPa)	9.8 - 39	40 - 88
7	Application	Automotive engine management	Automotive engine control

Activity 3

FUNCTIONAL REQUIREMENTS:

- The entire process starts with the analysis of the functional requirements
- It is the main step in development process because it defines what is required for the control software in terms of functionality o Usually the requirement engineering group will list the entire requirements that are required by the process
- The function requirements describe what the software should do from the functional point of view:
- MUST: This word, or the terms "REQUIRED" or "SHALL", mean that the definition is an absolute requirement of the specification.
- MUST NOT: This phrase, or the phrase "SHALL NOT", mean that the definition is an absolute prohibition of the specification.
- SHOULD: This word, or the adjective "RECOMMENDED", mean that there may exist valid reasons circumstances to ignore a item, but the full implications must be understood and carefully weighed before choosing a different course.
- SHOULD NOT: This phrase, or the phrase "NOT RECOMMENDED" mean that there may exist valid reasons circumstances when the behavior is acceptable.
- MAY: This word, or the adjective "OPTIONAL", means that an item is truly optional.
- A function requirement, most of the time, describes what should happen and doesn't necessarily give details regarding the exact implementation. o When defining requirements, the requirement engineer must work closely with the function developer to make sure that the requirements are clearly defined and implementable.

FUNCTION DEVELOPMENT:

- The function development is performed by the function developer
- A model based development (MBD) environment is used to design and test the required functionality
- Tools like Malab/Simulink or Scilab/Xcos are used to implement control functions
- The control function is developed as a block diagram which has the capability to be simulated and highlight potential errors of the design
- The function developer will then run a series of tests called Model in the Loop (MiL) tests where models (block diagrams) are used to simulate the required functionality
- Testing an embedded system on MiL level means that the model and its environment are interpreted in the modeling framework without any physical components which allows testing at early stages of the development cycle

SOFTWARE INTEGRATION:

- It is the process of combining together all software modules required for a particular project.
- A single function can have impact on several modules made by different developers. It links all files having different extensions of an application and changes them to a single machine code file. It is done at system level to verify the interaction between software modules. It is done mostly by using Hardware In Loop (HIL) techniques.
- HIL environment contains simulator which have all the electrical connections required by an ECU. It also simulates the dynamic behavior of the vehicle and tests closed loop control scenarios.

- It replicates the behavior of a vehicle in an indoor environment, so that ECU can be tested without the need of a real vehicle.
- HIL is a verification test and ensures that developed software met all the specified requirements.
- HIL techniques can be used at both component level and vehicle level.
- HIL in vehicle level connects to a network of simulators and ECUs. It can even test a distributed function.

FUNCTIONAL INTEGRATION:

- The function integration is usually performed by the function developer or by a **test engineer**. The purpose is to test the developed function at the **vehicle level** (production model or a prototype).
- The purpose of the vehicle test is to validate the correct implementation of the requirements and the **integration with the other control modules** (e.g. Transmission Control Module, Anti-lock Braking System control module, etc.).
- The function integration is performed with a computer connected at the target ECU. The target electronic control unit can be the Powertrain Control Module (PCM), Transmission Control Module (TCM), Body Control Module (BCM), etc.

- The laptop must be equipped with proper tools for **accessing software variables** (INCA, Canape) and **network bus messages** (Canalyzer). These tools connect to the target ECU using different communication standards (ETK, CAN, etc.)
- Vehicle testing is performed after a defined **test scenario**. The test engineer will drive the vehicle in certain operating condition suitable for the activation of the function subject to test. For example, in order to test the engine speed limit, the engine needs to be accelerated until it reaches the maximum speed. For this particular example it is recommended that this function is tested on a simulation environment (HiL) before vehicle testing.

- The function integration tests are **validation tests**. Validation confirms that the product, as provided, will fulfill its intended use. In other words, validation ensures that ”you built the right thing.

FUNCTIONAL CALIBERATION:

- The last step in software development is the function calibration. This task is performed by a **calibration/tuning engineer**.
- Most of the software control functions are generic; they are suitable for different vehicle applications (variants). The role of the calibration engineer is to **set the right parameters for the software functions**. For our example, the calibration is the value of the maximum speed limit. Depending on the engine type, it can have different values (e.g. 6500 rpm for gasoline engines, 4500 rpm for diesel engines).
- The **calibration engineer** will tune the software parameters so that it achieves best performances in terms of drivability, performance, emissions, etc.
- The function calibration activities, most of the time, are performed on a vehicle with the same setup as for a function integration.