Basic control blocks in Simulink

Lab 1, DSP

Objective

Introducing students to the Simulink environment

Theoretical aspects

Blocks often used:

- In and Out ports
- Switch
- Constant / values from Workspace
- Logical operators
- Relational operators
- Sum / Product
- Enabled subsystems
- If / Action / Merge blocks
- Model configuration parameters: solver step size

Exercises

1. Create a Vehicle Speed Adapter system that satisfies the following requirements.

   Implement the conditions in the requirements in two ways:

   - with Switch blocks
   - with If / Action / Merge blocks

   Implement the Suggested Gear functionality with a lookup table block.

Requirements

1. Inputs:
   - `UserRequest`: enum (USERREQ_NONE=0, USERREQ_ACC=1, USERREQ_DECC=2)
   - `CurrentSpeed`: double (0 - 200 km/h)
2. Outputs:
   - `TargetSpeed`: double (0 - 200 km/h)
   - `SuggestedGear`: int (0 - 6)
3. Functional requirements
   1. When input `UserRequest` is USERREQ_ACC, the output `TargetSpeed` shall be computed from the input `CurrentSpeed`, increased according to acceleration value `PARAM_MaxAccel`.
   2. When input `UserRequest` is USERREQ_DECC, the output `TargetSpeed` shall be computed from the input `CurrentSpeed`, decreased according to decceleration value `PARAM_MaxDeccel`.
   3. When input `UserRequest` is USERREQ_NONE, the output `TargetSpeed` shall computed
      from the input `CurrentSpeed`, with no acceleration nor decceleration.
   4. The output `TargetSpeed` shall be below maximum value `PARAM_MaxSpeed` at all times.
   5. The output `SuggestedGear` shall be computed based on the `TargetSpeed` as follows:

Speed Range	Suggested Gear
0 - 20 km/h	1
20 - 40 km/h	2
40 - 60 km/h	3
60 - 90 km/h	4
90 - 120 km/h	5
over 120 km/h	6

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2. Create a testbench model and test the Speed Adapter module in some simple scenarios:
   - test that all user requests work
   - test that all suggested gear values are output
   - test that PARAM_MaxSpeed is not exceeded

3. Implement the following new requirement as well, and then update the test module to test them:
    1. The speed adaption module can be enabled or disabled with parameter `PARAM_EnableSpeedAdapt`.
    2. When `PARAM_EnableSpeedAdapt` is FALSE, the output `TargetSpeed` shall have the value of the input `CurrentSpeed`, without any modification
    3. When `PARAM_EnableSpeedAdapt` is TRUE, the output `TargetSpeed` shall be computed according to the previous requirements.

Final questions

1. TBD