

# 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 deceleration value **PARAM\_MaxDeccel**.
3. When input **UserRequest** is USERREQ\_NONE, the output **TargetSpeed** shall be computed from the input **CurrentSpeed**, with no acceleration nor deceleration.
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

### 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