Hierarchical FSM

Lab 4, ESDM

Objective

Using the Stateflow tool in Simulink to model to implement simple design requirements which are very often encountered in practice.

Theoretical aspects

TBD. See the Lectures.

In this lab you will implement:

- Substates and superstates
- History transitions

Exercises

1. Design a FSM in Stateflow to implement a Christmas Lights Control module, according to the following requirements:

    1. We design a control module for blinking Christmas Lights.

    2. The system has 5 leds. We control them by setting the 5 outputs `OUT1`, `OUT2`, `OUT3`, `OUT4` `OUT5` to a certain intensity:

        - `OUTx = number 0 to 100`: set intensity of LED number x to specified number
        - Examples:
            - `OUTx = 0`: turn OFF (intensity 0)
            - `OUTx = 100`: turn completely ON (max intensity)

        - `OUTx = 50`: dimmed LED to 50%

    3. There are 4 blinking patters:

        1. **Mode 1: Flash**: All LEDs flashing ON - OFF together, with 0.200 seconds period
        2. **Mode 2: Slow**: All LEDs intensity slowly increases from 0% to 100% for 3 seconds, then from 100% to 0% in 3 seconds, and so on
        3. **Mode 3: Train**: Train of lights: only first LED on for 250ms, then only second LED on for 250ms, etc. Like the light is moving from one LED to the next, and then repeats circularly.

    4. There is one input `Command`

        1. `Command = 0`: Execute each mode for 10 seconds, then move to next one. Repeat forever.
        2. `Command = 1`: Execute only Mode 1, keep forever.
        3. `Command = 2`: Execute only Mode 2, keep forever.
        4. `Command = 3`: Execute only Mode 3, keep forever.
        5. `Command = 4`: Execute each mode for 10 seconds, then move to next one. Repeat for 20 minutes, then turn system OFF.

    5. There is one additional boolean input `OVERHEATING`. The input `OVERHEATING = TRUE` signals that the temperature is higher than a max threshold.

    6. When `OVERHEATING = TRUE`, the system shall temporarily pause and turn OFF all the LEDs. The operation resumes when `OVERHEATING` becomes `FALSE`, but no sooner than 15 seconds (any pause must last at least 15 seconds). When the system resumes, it shall continue the animation from the same point.

2. Test your design: put appropriate inputs and observe the output signals.

3. Run the Model advisor tool (Analysis -> Model Advisor -> Model Advisor), select and run the “Modeling Standards for MAAB” checks. Observe the warnings/failures and fix some of them.

4. Generate C code from the model (Code -> C/C++ Code -> Build Model). Locate the code files, open them and identify the implementation of the state machine. How is it implemented (with which C instructions)?