Behavior Pattern: SysML Example v1.1

SysML Examples

The complete SysML example for the flashlight behavior model is available on a teamwork server. Please contact JF Castet or Matt Rozek for access. In the following, the essential diagrams of the SysML model are given for a complete understanding of the SysML implementation.

As a reminder, the flashlight example consists of a simple model of the electrical circuit shown in the image on Figure 1. Three `mission :Component`s are identified:

- a battery;
- a switch;
- and a lamp.

The conceptual equivalent of this model is given here, and provides details about the definition of the behavior model of the flashlight.

The details about the embedding in SysML is explained here, and the reader is referred to that documentation to understand the SysML aspects of the behavior pattern. Only the final result is displayed in this page for high-level reference.
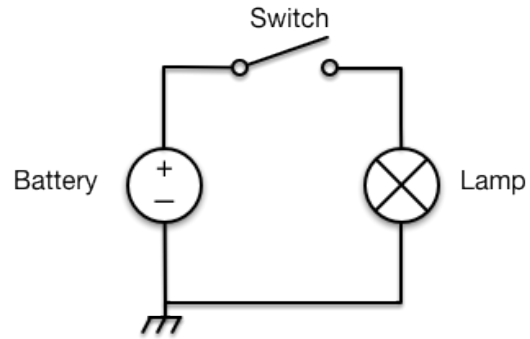
Figure 1. Flashlight electrical model

Figure 2 shows the battery `ElementBehavior` model (derivation and conceptual equivalent in Figure 6 of this page).

Figure 3 shows the switch `ElementBehavior` model (derivation and conceptual equivalent in Figure 7 of this page).

Figure 4 shows the lamp `ElementBehavior` model (derivation and conceptual equivalent in Figure 5 of this page).

Figure 5 shows the model of the `Interaction` between the three components based on a mesh-analysis perspective (the interaction is fully described here).

bdd [Package] Battery ElementBehavior [Battery ElementBehavior]

«mission:Component»
Battery

«analysis:characterizes»   «analysis:characterizes»

«behavior:PropertyGroup»
Battery PropertyGroup
«behavior:StateVariable» VoltageAcrossBattery : batteryVoltageSV
«behavior:StateVariable» CurrentThroughBattery : batteryCurrentSV
«behavior:Parameter» NominalVoltage : batteryNominalVoltage

«behavior:references»

«behavior:ElementBehaviorCharacterization»
Battery ElementBehavior Characterization

«behavior:ElementBehaviorConstraint»
Battery Simple Model
{equals(eb_batteryVoltage,eb_batteryNominalVoltage),
}

parameters
eb_batteryVoltage : batteryVoltageSV
eb_batteryNominalVoltage : batteryNominalVoltage

SysML Parametric Diagram [Battery ElementBehavior Characterization]

«behavior:PropertyGroup»
: Battery PropertyGroup

«behavior:StateVariable»
VoltageAcrossBattery : batteryVoltageSV

«behavior:Parameter»
NominalVoltage : batteryNominalVoltage

«behavior:playsRoleOf»

«behavior:playsRoleOf»

«behavior:ElementBehaviorConstraint»
: Battery Simple Model
{equals(eb_batteryVoltage,eb_batteryNominalVoltage),
}

eb_batteryVoltage : batteryVoltageSV

eb_batteryNominalVoltage : batteryNominalVoltage

Figure 2. Battery `ElementBehavior`

bdd [Package] Switch ElementBehavior [Switch ElementBehavior]

«mission:Component»
Switch

«behavior:StateVariableValueType»
SwitchPositionSV
«behavior:TimeDomain»**domain** : flashlight time
«behavior:Codomain»**codomain** : Switch Position STM

«analysis:characterizes»   «analysis:characterizes»

«behavior:PropertyGroup»
Switch PropertyGroup
«behavior:StateVariable» **VoltageAcrossSwitch** : switchVoltageSV
«behavior:StateVariable» **CurrentThroughSwitch** : switchCurrentSV
«behavior:StateVariable» **SwitchPosition** : SwitchPositionSV

«behavior:references»   «behavior:ElementBehaviorCharacterization»
Switch ElementBehavior Characterization

«behavior:ElementBehaviorConstraint»
SP_OPEN Constraint
{equals(eb_switchCurrent,0),
}
parameters
eb_switchCurrent : switchCurrentSV

«behavior:AttributeAutomatonConstraint»
Switch Position STM

stm [State Machine] Switch Position STM [Switch Position STM]

●

«behavior:AutomatonState»
OPEN

«behavior:AutomatonState»
CLOSED

analysis:characterizes relationship
from the constraint block to the
OPEN state of the STM

«behavior:ElementBehaviorConstraint»
SP_CLOSED Constraint
{equals(eb_switchVoltage,0),
}
parameters
eb_switchVoltage : switchVoltageSV

analysis:characterizes relationship
from the constraint block to the
CLOSED state of the STM

relationMap [Package] Switch ElementBehavior [OPEN constraint-state]
SP_OPEN Constraint ⊖ ——► OPEN

relationMap [Package] Switch ElementBehavior [CLOSED constraint-state]
SP_CLOSED Constraint ⊖ ——► CLOSED

SysML Parametric Diagram [Switch ElementBehavior Characterization]

«behavior:PropertyGroup»
: Switch PropertyGroup

«behavior:StateVariable»
CurrentThroughSwitch : switchCurrentSV

«behavior:StateVariable»
VoltageAcrossSwitch : switchVoltageSV

«behavior:playsRoleOf»

«behavior:ElementBehaviorConstraint»
: **SP_OPEN Constraint**
{equals(eb_switchCurrent,0),
}
eb_switchCurrent : switchCurrentSV

«behavior:playsRoleOf»

«behavior:ElementBehaviorConstraint»
: **SP_CLOSED Constraint**
{equals(eb_switchVoltage,0),
}
eb_switchVoltage : switchVoltageSV

Figure 3. Switch `ElementBehavior`

bdd [Package] Lamp ElementBehavior [Lamp ElementBehavior]

«mission:Component»
Lamp

«analysis:characterizes»   «analysis:characterizes»   «analysis:characterizes»

«behavior:PropertyGroup»
Lamp StateVariables
«behavior:StateVariable» VoltageAcrossLamp : lampVoltageSV
«behavior:StateVariable» CurrentThroughLamp : lampCurrentSV
«behavior:StateVariable» LumenOutput : lampLuminousFluxSV

«behavior:references»

«behavior:ElementBehaviorCharacterization»
Lamp ElementBehavior Characterization

«behavior:references»

«behavior:PropertyGroup»
Lamp Parameters
«behavior:Parameter» OhmicResistance : lampElectricResistance
«behavior:Parameter» LuminousEfficacy : lampLuminousEfficacy

«behavior:ElementBehaviorConstraint»
Ohm's Law
{equals(eb_lampVoltage,multiply(eb_resistance,eb_lampCurrent)),
}
parameters
eb_lampVoltage : lampVoltageSV
eb_lampCurrent : lampCurrentSV
eb_resistance : lampElectricResistance

«behavior:ElementBehaviorConstraint»
Light Production
{equals(eb_lumenOutput,multiply3(eb_lampVoltage,eb_lampCurrent,eb_luminousEfficacy)),
}
parameters
eb_lumenOutput : lampLuminousFluxSV
eb_lampVoltage : lampVoltageSV
eb_lampCurrent : lampCurrentSV
eb_luminousEfficacy : lampLuminousEfficacy

SysML Parametric Diagram [Lamp ElementBehavior Characterization]

«behavior:PropertyGroup»
: Lamp StateVariables

«behavior:ElementBehaviorConstraint»
: Ohm's Law
{equals(eb_lampVoltage,multiply(eb_resistance,eb_lampCurrent)),
}
eb_lampVoltage : lampVoltageSV
eb_lampCurrent : lampCurrentSV
eb_resistance : lampElectricResistance

«behavior:playsRoleOf»

«behavior:StateVariable»
VoltageAcrossLamp : lampVoltageSV

«behavior:playsRoleOf»

«behavior:StateVariable»
CurrentThroughLamp : lampCurrentSV

«behavior:playsRoleOf»

«behavior:StateVariable»
LumenOutput : lampLuminousFluxSV

«behavior:playsRoleOf»

«behavior:ElementBehaviorConstraint»
: Light Production
{equals(eb_lumenOutput,multiply3(eb_lampVoltage,eb_lampCurrent,eb_luminousEfficacy)),
}
eb_lumenOutput : lampLuminousFluxSV
eb_lampVoltage : lampVoltageSV
eb_lampCurrent : lampCurrentSV
eb_luminousEfficacy : lampLuminousEfficacy

«behavior:playsRoleOf»

«behavior:playsRoleOf»

«behavior:PropertyGroup»
: Lamp Parameters

«behavior:Parameter»
OhmicResistance : lampElectricResistance

«behavior:Parameter»
LuminousEfficacy : lampLuminousEfficacy

«behavior:playsRoleOf»

«behavior:playsRoleOf»
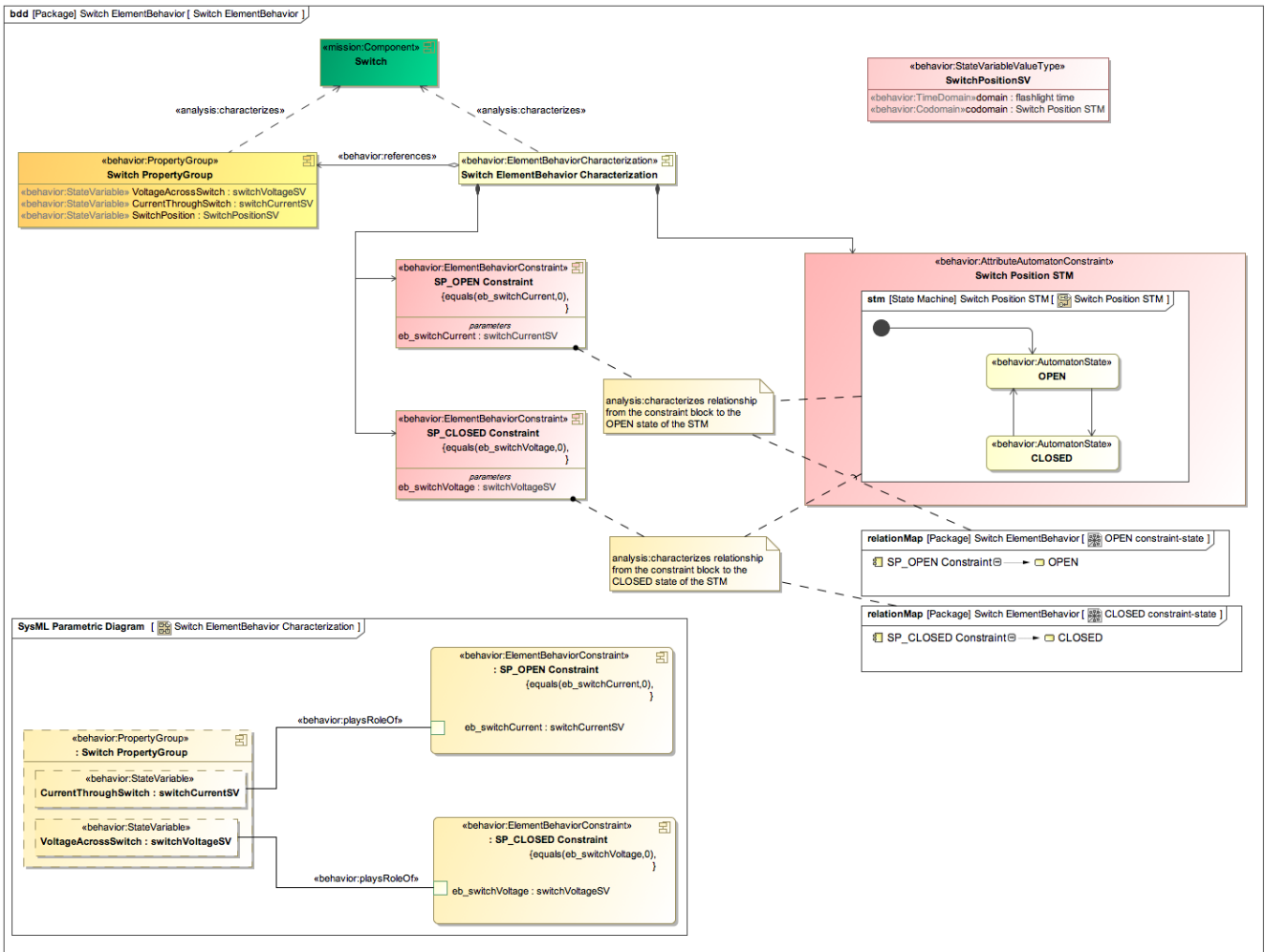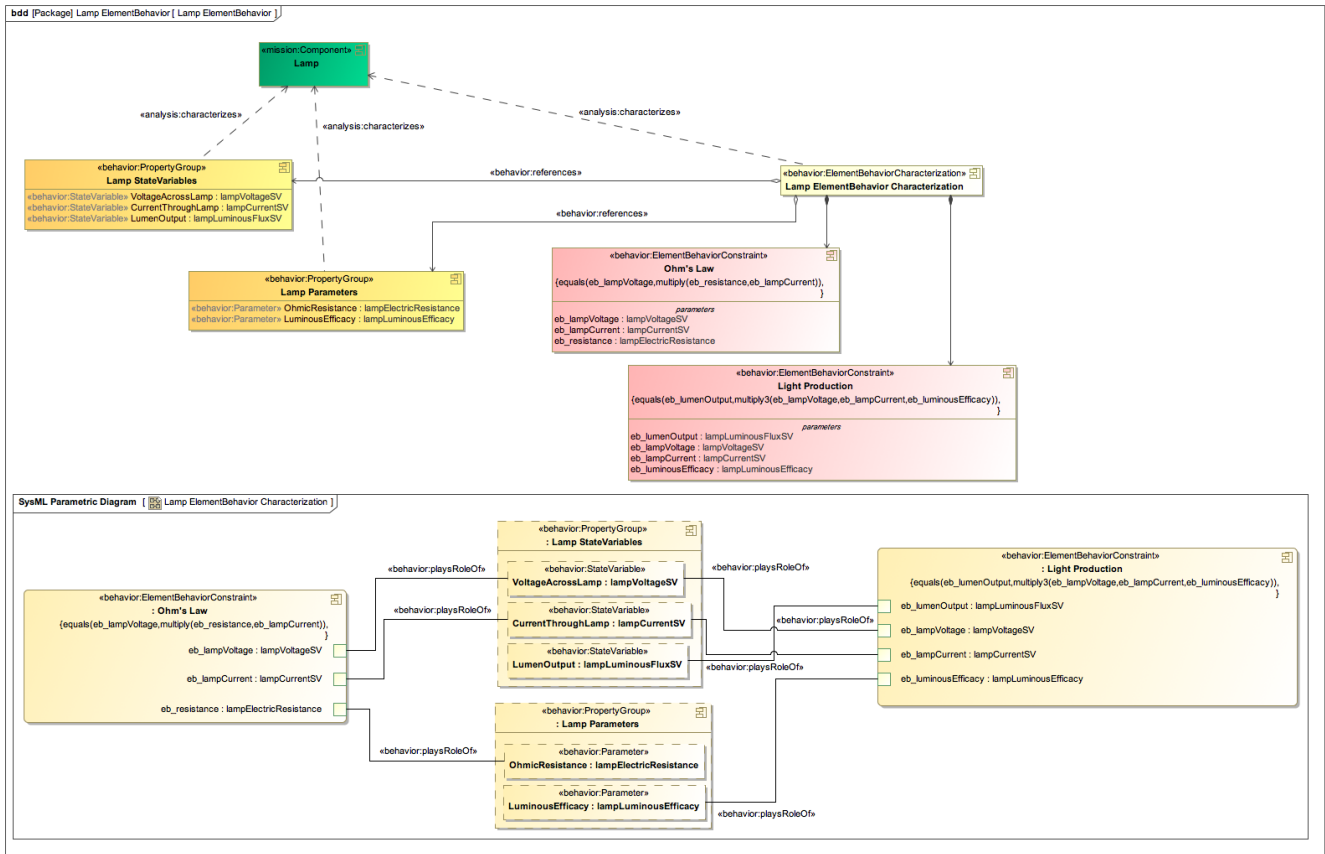
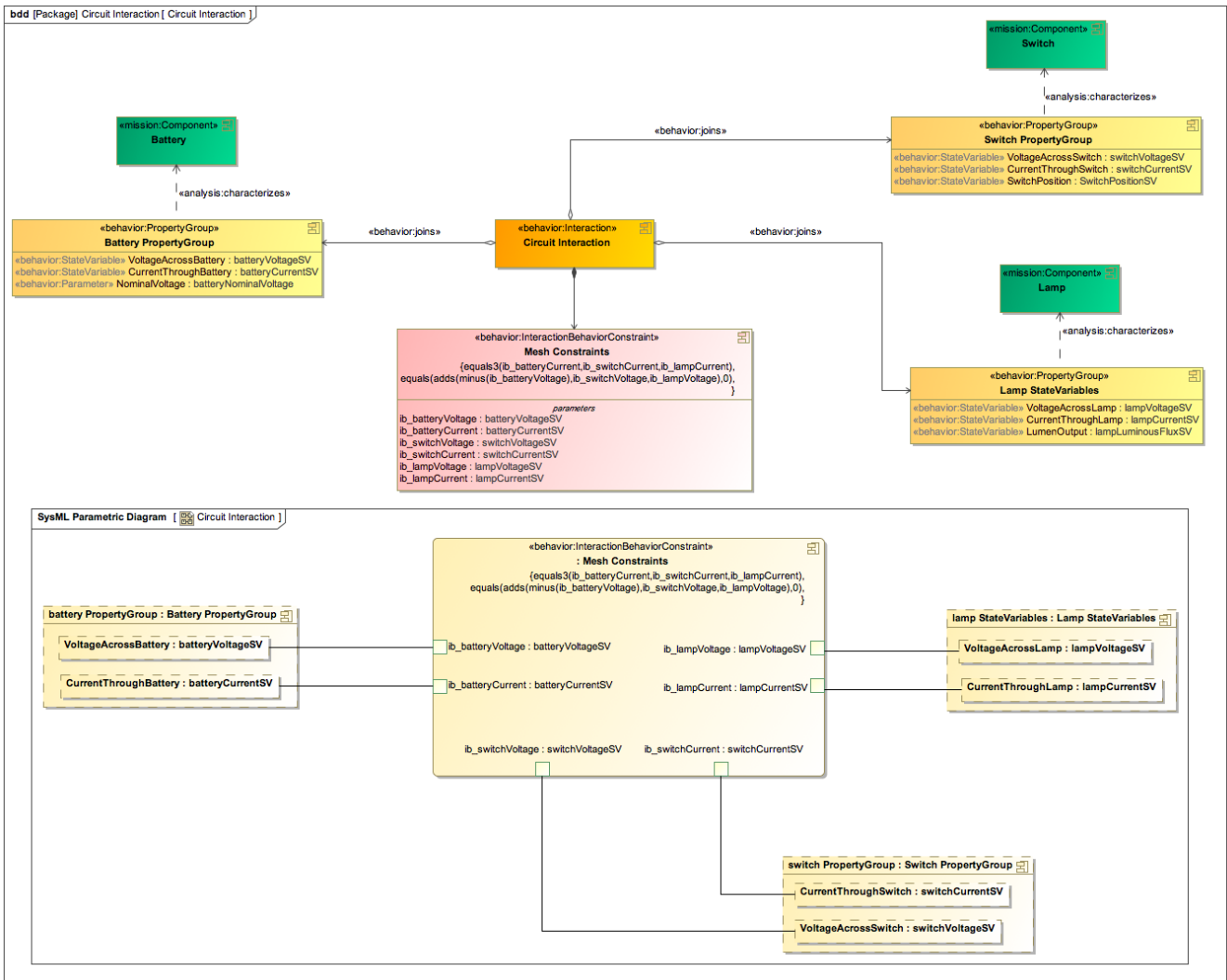Figure 4. Lamp `ElementBehavior`

Figure 5. Flashlight circuit `Interaction`

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