<Report>

$(BE SCADE Study of the Longitudinal Flight System)

$(Model-Based Systems Engineering with SysML)

Summary:
<This is the SCADE report of the design models of the longitudinal flight system. Validation and verification is performed using the simulation, the Model Test Coverage and formal proof>

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Table Of Contents

1. General Project Description

2. Software Architecture

2.1. Project Architecture

2.2. Call Graph

3. BE2 Project

3.1. Root Elements

3.1.1. Constants

3.1.2. Alarms Operator
3.1.2.1. Interface
3.1.2.2. Operator Hierarchy
3.1.2.3. Graphical and Textual Diagrams

3.1.3. AutoPilot Operator
3.1.3.1. Interface
3.1.3.2. Operator Hierarchy
3.1.3.3. Graphical and Textual Diagrams

3.1.4. CalculAltitude Operator
3.1.4.1. Interface
3.1.4.2. Operator Hierarchy
3.1.4.3. Graphical and Textual Diagrams

3.1.5. CalculDensity Operator
3.1.5.1. Interface
3.1.5.2. Operator Hierarchy
3.1.5.3. Graphical and Textual Diagrams

3.1.6. Calculs Operator
3.1.6.1. Interface
3.1.6.2. Operator Hierarchy
3.1.6.3. Graphical and Textual Diagrams

3.1.7. CalculSlope Operator
3.1.7.1. Interface
3.1.7.2. Operator Hierarchy
3.1.7.3. Graphical and Textual Diagrams

3.1.8. CalculSpeed Operator
3.1.8.1. Interface
3.1.8.2. Operator Hierarchy
3.1.8.3. Graphical and Textual Diagrams

3.1.9. Controls Operator
3.1.9.1. Interface
3.1.9.2. Operator Hierarchy
3.1.9.3. Graphical and Textual Diagrams

3.1.10. Obs_Prop1 Operator
3.1.10.1. Interface
3.1.10.2. Operator Hierarchy
3.1.10.3. Graphical and Textual Diagrams

3.1.11. Prop1 Operator
3.1.11.1. Interface
3.1.11.2. Operator Hierarchy
3.1.11.3. Graphical and Textual Diagrams

3.1.12. Prop2 Operator
3.1.12.1. Interface
3.1.12.2. Operator Hierarchy
3.1.12.3. Graphical and Textual Diagrams

3.1.13. Prop3 Operator
3.1.13.1. Interface
3.1.13.2. Operator Hierarchy
3.1.13.3. Graphical and Textual Diagrams

3.1.14. SystemPA Operator
3.1.14.1. Interface

3.1.14.2. Operator Hierarchy
3.1.14.3. Graphical and Textual Diagrams

List Of Figures

Figure 1: View of Alarms_1 (Alarms)
Figure 2: View of AutoPilot_1 (AutoPilot)
Figure 3: View of CalculAltitude_1 (CalculAltitude)
Figure 4: View of CalculDensity_1 (CalculDensity)
Figure 5: View of Calculs_1 (Calculs)
Figure 6: View of CalculSlope_1 (CalculSlope)
Figure 7: View of CalculSpeed_1 (CalculSpeed)
Figure 8: View of Controls_1 (Controls)
Figure 9: View of Obs_Prop1_1 (Obs_Prop1)
Figure 10: View of Prop1_1 (Prop1)
Figure 11: View of Prop2_1 (Prop2)
Figure 12: View of Prop3_1 (Prop3)
Figure 13: View of SystemPA_1 (SystemPA)

List Of Tables

Table 1: Public Constants of BE2
Table 2: Inputs of Alarms
Table 3: Outputs of Alarms
Table 4: CONF1 (#1) hidden inputs assignment of Alarms_1
Table 5: CONF1 (#2) hidden inputs assignment of Alarms_1
Table 6: CONF1 (#3) hidden inputs assignment of Alarms_1
Table 7: Inputs of AutoPilot
Table 8: Outputs of AutoPilot
Table 9: State Machines of AutoPilot_1
Table 10: States of AutoPilot_1
Table 11: Transitions of AutoPilot_1
Table 12: Inputs of CalculAltitude
Table 13: Outputs of CalculAltitude
Table 14: Inputs of CalculDensity
Table 15: Outputs of CalculDensity
Table 16: Inputs of Calculs
Table 17: Outputs of Calculs
Table 18: Inputs of CalculSlope
Table 19: Outputs of CalculSlope
Table 20: DERIV (#1) hidden inputs assignment of CalculSlope_1
Table 21: Inputs of CalculSpeed
Table 22: Outputs of CalculSpeed
Table 23: Inputs of Controls
Table 24: Outputs of Controls
Table 25: LIM (#1) hidden inputs assignment of Controls_1
Table 26: LIM (#3) hidden inputs assignment of Controls_1
Table 27: RLIM (#1) hidden inputs assignment of Controls_1
Table 28: Inputs of Obs_Prop1
Table 29: Outputs of Obs_Prop1
Table 30: Inputs of Prop1
Table 31: Outputs of Prop1
Table 32: Inputs of Prop2
Table 33: Outputs of Prop2
Table 34: Inputs of Prop3
Table 35: Outputs of Prop3
Table 36: Inputs of SystemPA
Table 37: Outputs of SystemPA

1. General Project Description

$(This is the SCADE report of the design models of the longitudinal flight system. Validation and verification is performed using the simulation, the Model Test Coverage and formal proof)

2. Software Architecture

2.1. Project Architecture

This section displays the package hierarchy of projects.

Project BE2

2.2. Call Graph

This Call Graph displays the dependency tree of model operators.

1. Obs_Prop1
   1.1. Prop1
      1.1.1. verif::Implies
   1.2. Prop2
      1.2.1. verif::Implies
   1.3. Prop3
      1.3.1. verif::Implies
   1.4. SystemPA
      1.4.1. Alarms
         1.4.1.1. CONF1 [3]
         1.4.1.2. INITIALISATION
      1.4.2. AutoPilot
      1.4.3. Calculs
         1.4.3.1. CalculAltitude
         1.4.3.2. CalculDensity
         1.4.3.3. CalculSlope
            1.4.3.3.1. ASIN
            1.4.3.3.2. DERIV
            1.4.3.3.3. INITIALISATION
         1.4.3.4. CalculSpeed
            1.4.3.4.1. SQRT
      1.4.4. Controls
         1.4.4.1. INITIALISATION
         1.4.4.2. LIM [2]
         1.4.4.3. RLIM

3. BE2 Project

3.1. Root Elements

3.1.1. Constants

Table 1: Public Constants of BE2

Name	Type	Value	Comments and Information
altitudeThreshold	float32	300.0	
incidenceThreshold	float32	12.0	
speedVerticalThreshold	float32	100.0	

3.1.2. Alarms Operator

Declared as **`public node`**

3.1.2.1. Interface

Table 2: Inputs of Alarms

Name	Type	Comments and Information
incidence	float32	
altitude	float32	
speedVertical	float32	
ldgExt	bool	

Table 3: Outputs of Alarms

Name	Type	Comments and Information
stall	bool	
crash	bool	
descent	bool	

3.1.2.2. Operator Hierarchy

diagram : Alarms_1

3.1.2.3. Graphical and Textual Diagrams

3.1.2.3.1. View of Alarms_1 (Alarms)

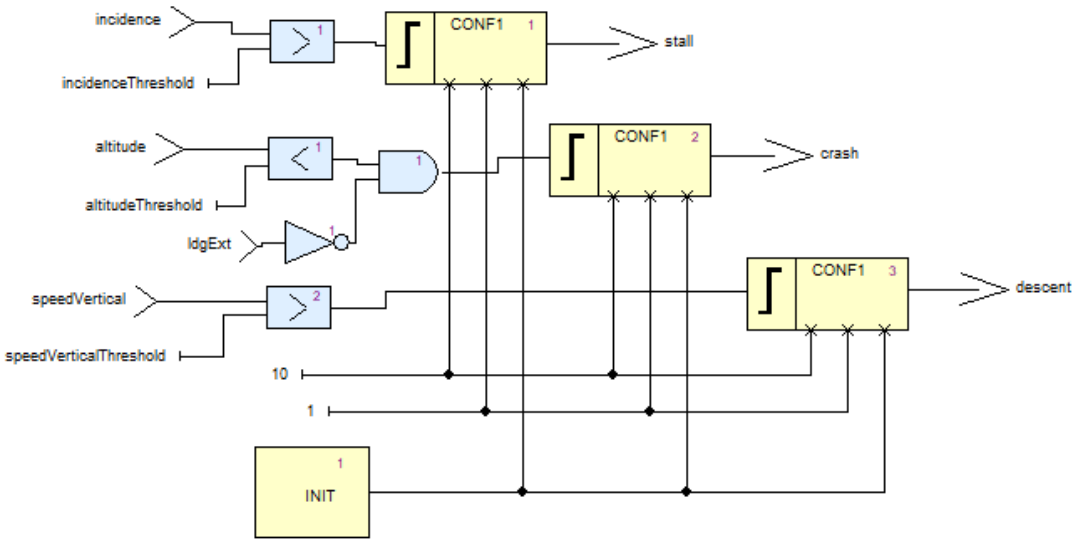

Figure 1: View of Alarms_1 (Alarms)

Table 4: CONF1 (#1) hidden inputs assignment of Alarms_1

Rank	Name	Value
1	Cycle	*wired (_L6)*
2	Init	*wired (_L5)*

3	B_Init	*wired (_L4)*

Table 5: CONF1 (#2) hidden inputs assignment of Alarms_1

Rank	Name	Value
1	Cycle	*wired (_L6)*
2	Init	*wired (_L5)*
3	B_Init	*wired (_L4)*

Table 6: CONF1 (#3) hidden inputs assignment of Alarms_1

Rank	Name	Value
1	Cycle	*wired (_L6)*
2	Init	*wired (_L5)*
3	B_Init	*wired (_L4)*

3.1.3. AutoPilot Operator

Declared as **`public node`**

3.1.3.1. Interface

Table 7: Inputs of AutoPilot

Name	Type	Comments and Information
button	bool	
altitude	float32	
stickPos	float32	

Table 8: Outputs of AutoPilot

Name	Type	Comments and Information
stick	float32	

3.1.3.2. Operator Hierarchy

diagram : AutoPilot_1
  state-machine : SM1
    state : ClimbMode
    state : CruiseMode
    state : CTRL
    state : DescentMode
    state : IDLE

3.1.3.3. Graphical and Textual Diagrams

3.1.3.3.1. View of AutoPilot_1 (AutoPilot)

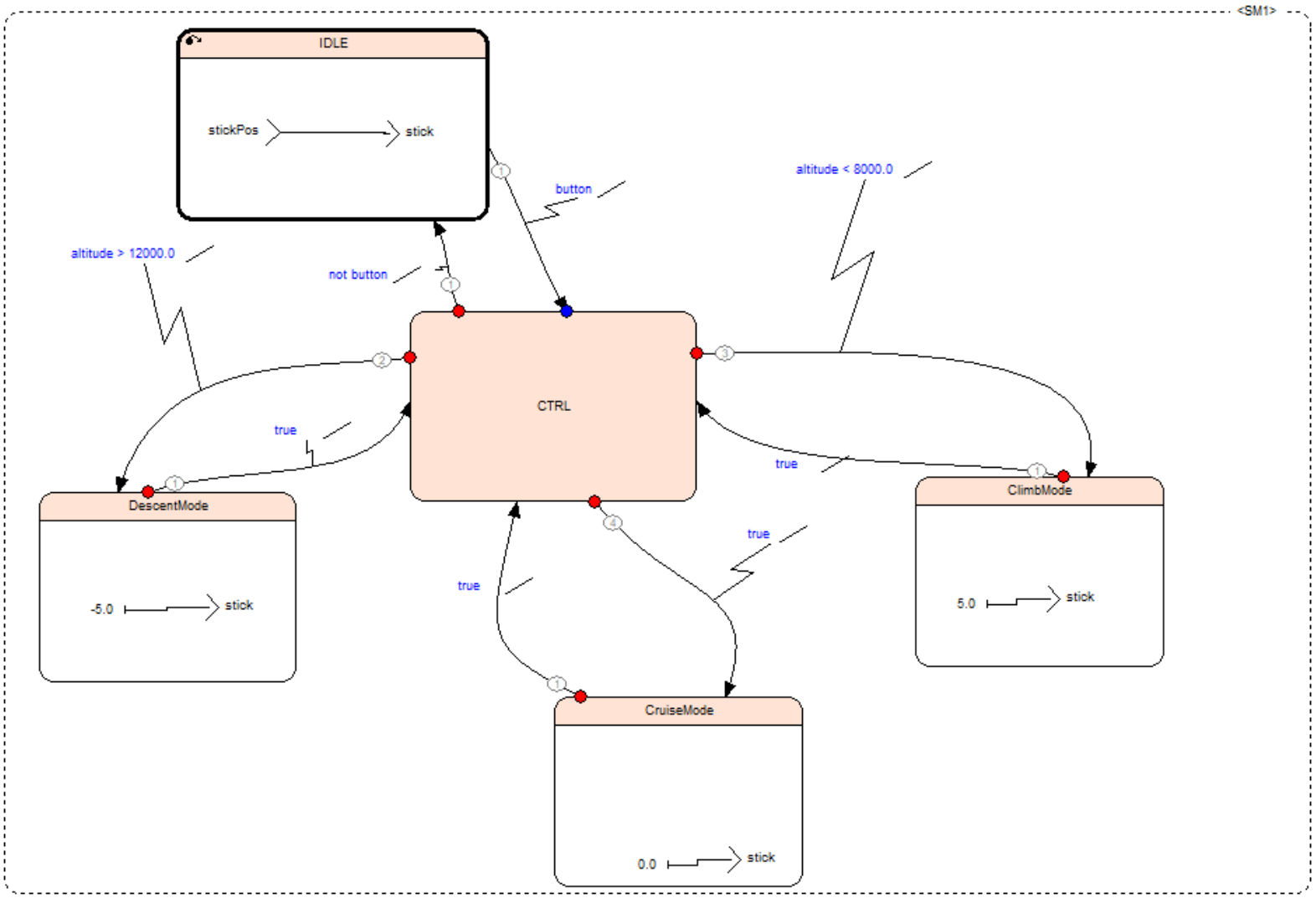

Figure 2: View of AutoPilot_1 (AutoPilot)

Table 9: State Machines of AutoPilot_1

State Machine	Comments and Information
SM1	

Table 10: States of AutoPilot_1

State	Comments and Information
SM1:ClimbMode	
SM1:CruiseMode	
SM1:CTRL	
SM1:DescentMode	
SM1:IDLE	

Table 11: Transitions of AutoPilot_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: SM1:ClimbMode **Target:** SM1:CTRL	1	**Condition:** true	
Source: SM1:CruiseMode **Target:** SM1:CTRL	1	**Condition:** true	
Source: SM1:CTRL **Target:** SM1:IDLE	1	**Condition:** not button	
Source: SM1:CTRL **Target:**	2	**Condition:** altitude > 12000.0 **Actions:**	

SM1:DescentMode			
Source: SM1:CTRL **Target:** SM1:ClimbMode	3	**Condition:** altitude < 8000.0 **Actions:**	
Source: SM1:CTRL **Target:** SM1:CruiseMode	4	**Condition:** true **Actions:**	
Source: SM1:DescentMode **Target:** SM1:CTRL	1	**Condition:** true	
Source: SM1:IDLE **Target:** SM1:CTRL	1	**Condition:** button **Actions:**	

3.1.4. CalculAltitude Operator

Declared as **`public function`**

3.1.4.1. Interface

Table 12: Inputs of CalculAltitude

Name	Type	Comments and Information
P0	float32	

Table 13: Outputs of CalculAltitude

Name	Type	Comments and Information
altitute	float32	

3.1.4.2. Operator Hierarchy

diagram : CalculAltitude_1

3.1.4.3. Graphical and Textual Diagrams

3.1.4.3.1. View of CalculAltitude_1 (CalculAltitude)

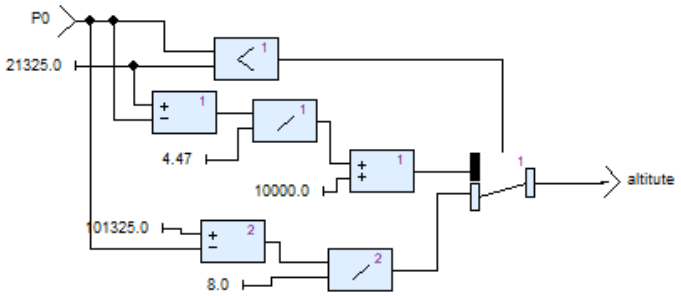

Figure 3: View of CalculAltitude_1 (CalculAltitude)

3.1.5. CalculDensity Operator

Declared as **`public function`**

3.1.5.1. Interface

Table 14: Inputs of CalculDensity

Name	Type	Comments and Information
altitude	float32	

Table 15: Outputs of CalculDensity

Name	Type	Comments and Information
density	float32	

3.1.5.2. Operator Hierarchy

diagram : CalculDensity_1

3.1.5.3. Graphical and Textual Diagrams

3.1.5.3.1. View of CalculDensity_1 (CalculDensity)

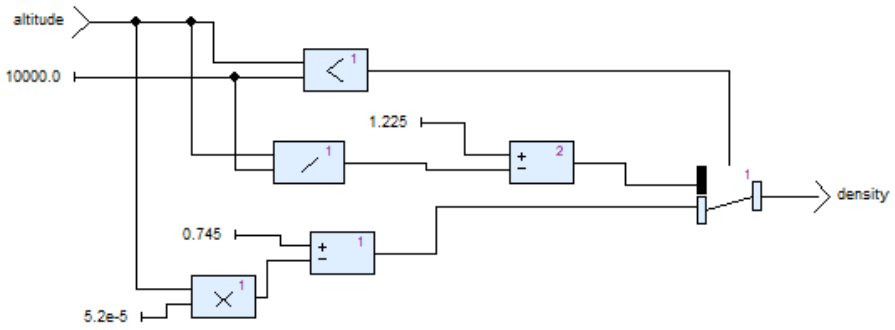

Figure 4: View of CalculDensity_1 (CalculDensity)

3.1.6. Calculs Operator

Declared as **`public node`**

3.1.6.1. Interface

Table 16: Inputs of Calculs

Name	Type	Comments and Information
P0	float32	
Pa	float32	

Table 17: Outputs of Calculs

Name	Type	Comments and Information
slope	float32	
speed	float32	
altitute	float32	
speedVertical	float32	

3.1.6.2. Operator Hierarchy

diagram : Calculs_1

3.1.6.3. Graphical and Textual Diagrams

3.1.6.3.1. View of Calculs_1 (Calculs)

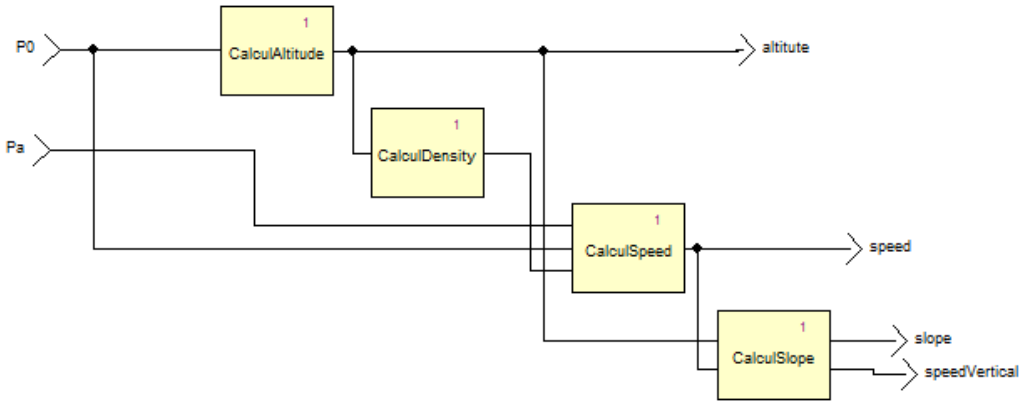

Figure 5: View of Calculs_1 (Calculs)

3.1.7. CalculSlope Operator

Declared as **`public node`**

3.1.7.1. Interface

Table 18: Inputs of CalculSlope

Name	Type	Comments and Information
altitude	float32	
speed	float32	

Table 19: Outputs of CalculSlope

Name	Type	Comments and Information
slope	float32	
speedVertical	float32	

3.1.7.2. Operator Hierarchy

diagram : CalculSlope_1

3.1.7.3. Graphical and Textual Diagrams

3.1.7.3.1. View of CalculSlope_1 (CalculSlope)

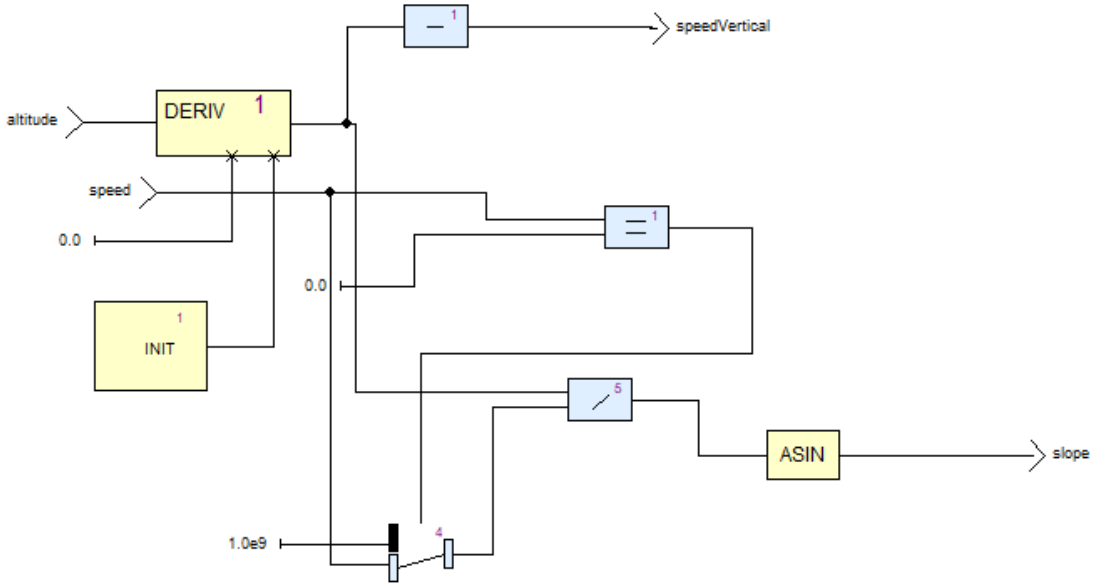

Figure 6: View of CalculSlope_1 (CalculSlope)

Table 20: DERIV (#1) hidden inputs assignment of CalculSlope_1

Rank	Name	Value
1	Init	*wired (_L41)*
2	B_Init	*wired (_L40)*

3.1.8. CalculSpeed Operator

Declared as **`public function`**

3.1.8.1. Interface

Table 21: Inputs of CalculSpeed

Name	Type	Comments and Information
Pa	float32	
P0	float32	
density	float32	

Table 22: Outputs of CalculSpeed

Name	Type	Comments and Information
speed	float32	

3.1.8.2. Operator Hierarchy

diagram : CalculSpeed_1

3.1.8.3. Graphical and Textual Diagrams

3.1.8.3.1. View of CalculSpeed_1 (CalculSpeed)

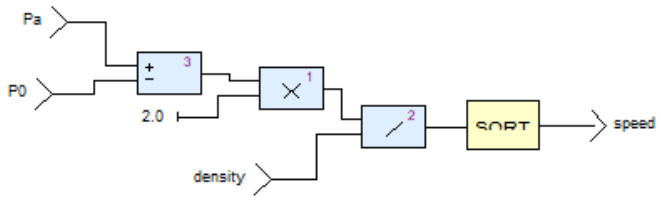

Figure 7: View of CalculSpeed_1 (CalculSpeed)

3.1.9. Controls Operator

Declared as **`public node`**

3.1.9.1. Interface

Table 23: Inputs of Controls

Name	Type	Comments and Information
stickPos	float32	
stall	bool	

Table 24: Outputs of Controls

Name	Type	Comments and Information
elevators	float32	

3.1.9.2. Operator Hierarchy

diagram : Controls_1

3.1.9.3. Graphical and Textual Diagrams

3.1.9.3.1. View of Controls_1 (Controls)

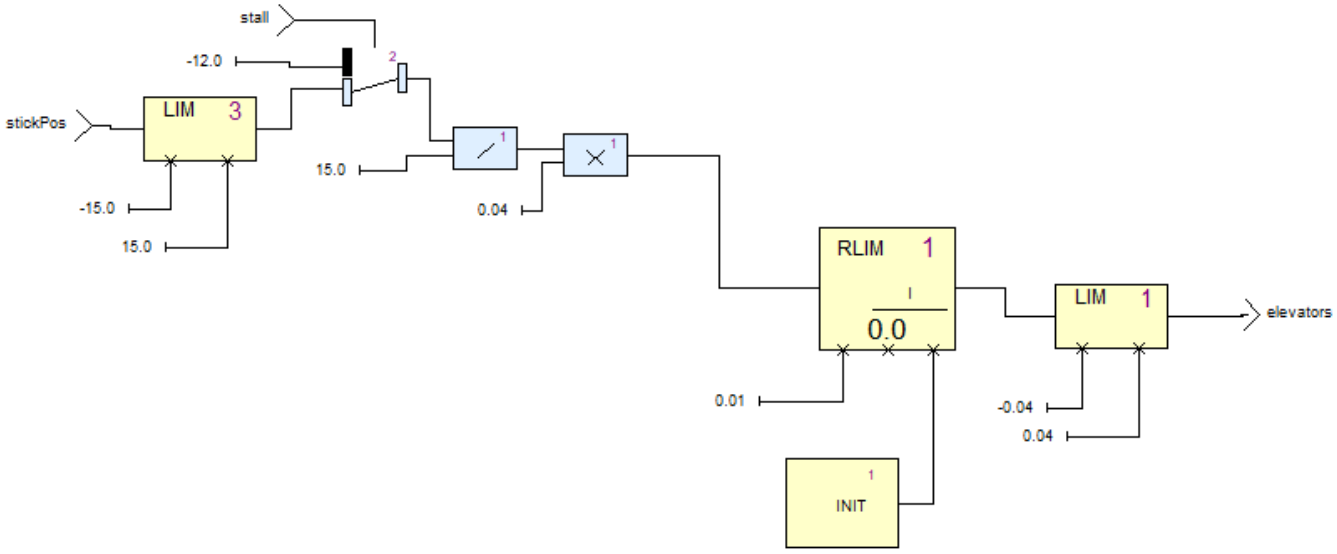

Figure 8: View of Controls_1 (Controls)

Table 25: LIM (#1) hidden inputs assignment of Controls_1

Rank	Name	Value
1	Min	*wired (_L12)*
2	Max	*wired (_L13)*

Table 26: LIM (#3) hidden inputs assignment of Controls_1

Rank	Name	Value
1	Min	*wired (_L25)*
2	Max	*wired (_L26)*

Table 27: RLIM (#1) hidden inputs assignment of Controls_1

Rank	Name	Value

1	Lim	*wired (_L7)*
2	Init	0.0
3	B_Init	*wired (_L9)*

3.1.10. Obs_Prop1 Operator

Declared as **`public node`**

3.1.10.1. Interface

Table 28: Inputs of Obs_Prop1

Name	Type	Comments and Information
P0	float32	
Pa	float32	
incidence	float32	
ldgExt	bool	
stickPos	float32	
autoPilot	bool	

Table 29: Outputs of Obs_Prop1

Name	Type	Comments and Information
elevators	float32	
stall	bool	
crash	bool	
descent	bool	
speed	float32	
slope	float32	
altitute	float32	
property1	bool	
property2	bool	
property3	bool	

3.1.10.2. Operator Hierarchy

diagram : Obs_Prop1_1

3.1.10.3. Graphical and Textual Diagrams

3.1.10.3.1. View of Obs_Prop1_1 (Obs_Prop1)

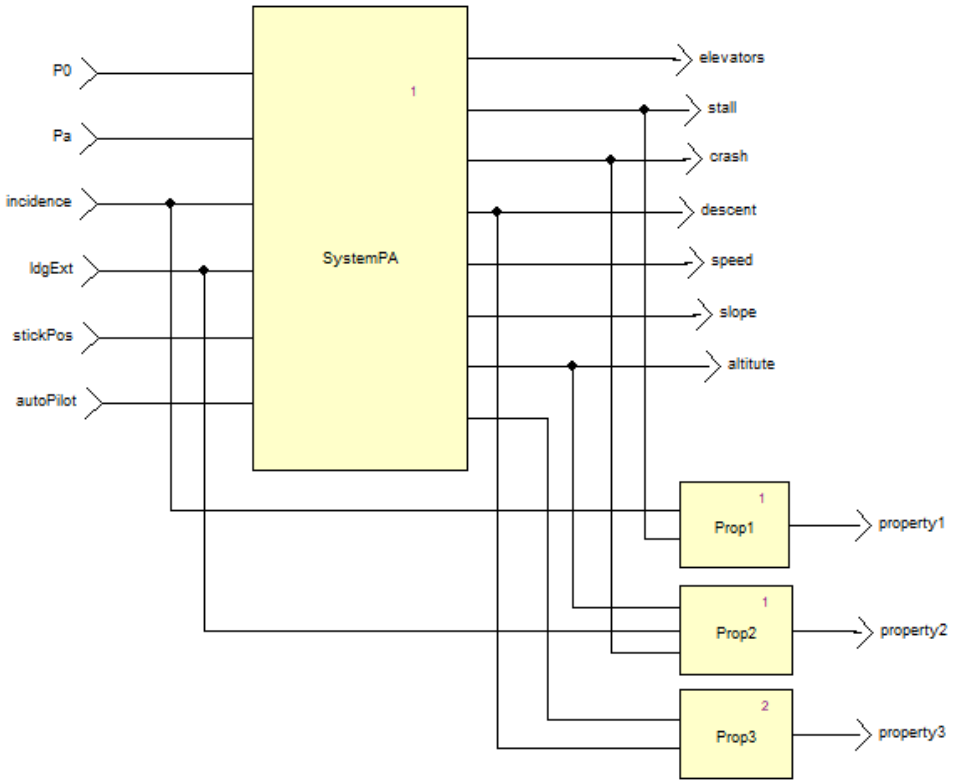

Figure 9: View of Obs_Prop1_1 (Obs_Prop1)

3.1.11. Prop1 Operator

Declared as **`public function`**

3.1.11.1. Interface

Table 30: Inputs of Prop1

Name	Type	Comments and Information
incidence	float32	
stall	bool	

Table 31: Outputs of Prop1

Name	Type	Comments and Information
OutObserver	bool	

3.1.11.2. Operator Hierarchy

diagram : Prop1_1

3.1.11.3. Graphical and Textual Diagrams

3.1.11.3.1. View of Prop1_1 (Prop1)

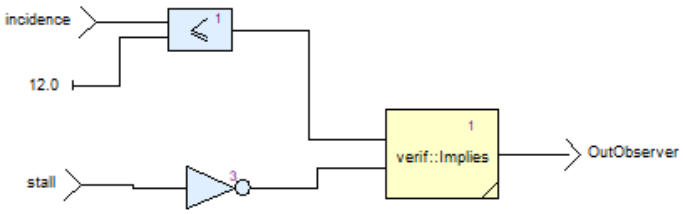

Figure 10: View of Prop1_1 (Prop1)

3.1.12. Prop2 Operator

Declared as **`public function`**

3.1.12.1. Interface

Table 32: Inputs of Prop2

Name	Type	Comments and Information
altitude	float32	
ldgExt	bool	
crash	bool	

Table 33: Outputs of Prop2

Name	Type	Comments and Information
OutObserver	bool	

3.1.12.2. Operator Hierarchy

diagram : Prop2_1

3.1.12.3. Graphical and Textual Diagrams

3.1.12.3.1. View of Prop2_1 (Prop2)

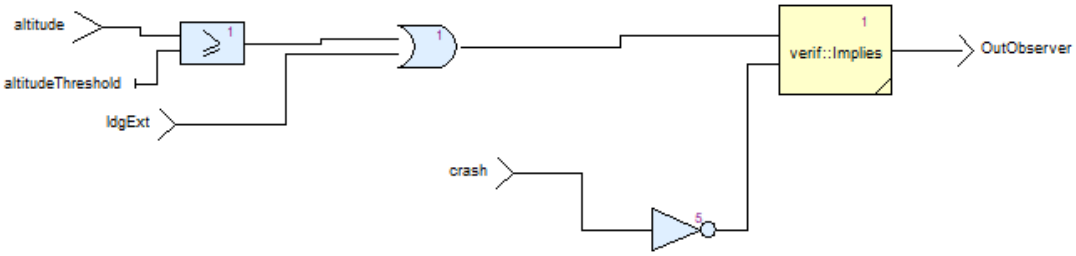

Figure 11: View of Prop2_1 (Prop2)

3.1.13. Prop3 Operator

Declared as **`public function`**

3.1.13.1. Interface

Table 34: Inputs of Prop3

Name	Type	Comments and Information
speedVertical	float32	
descent	bool	

Table 35: Outputs of Prop3

Name	Type	Comments and Information
OutObserver	bool	

3.1.13.2. Operator Hierarchy

diagram : Prop3_1

3.1.13.3. Graphical and Textual Diagrams

3.1.13.3.1. View of Prop3_1 (Prop3)

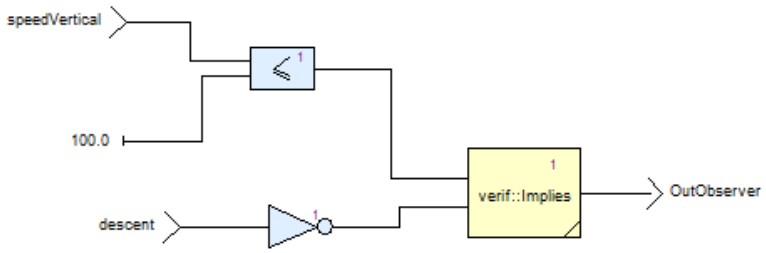

Figure 12: View of Prop3_1 (Prop3)

3.1.14. SystemPA Operator

Declared as **`public node`**

3.1.14.1. Interface

Table 36: Inputs of SystemPA

Name	Type	Comments and Information
P0	float32	
Pa	float32	
incidence	float32	
ldgExt	bool	
stickPos	float32	
autoPilot	bool	

Table 37: Outputs of SystemPA

Name	Type	Comments and Information
elevators	float32	
stall	bool	
crash	bool	
descent	bool	
speed	float32	
slope	float32	
altitute	float32	
speedVertical	float32	

3.1.14.2. Operator Hierarchy

diagram : SystemPA_1

3.1.14.3. Graphical and Textual Diagrams

3.1.14.3.1. View of SystemPA_1 (SystemPA)

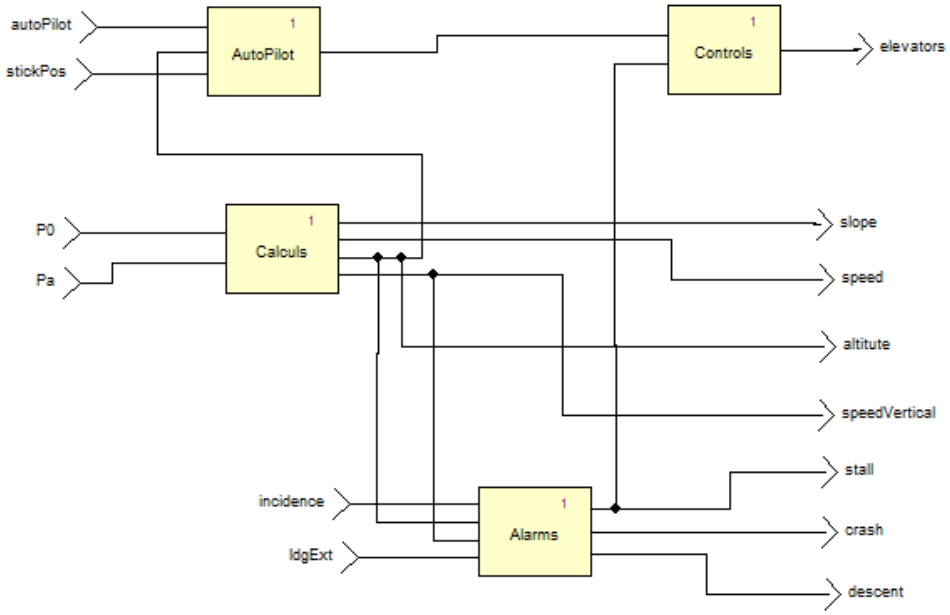

Figure 13: View of SystemPA_1 (SystemPA)

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