magicdraw™
Architecture Made Simple

ParaMagic™ - SysML Parametrics for MagicDraw

ParaMagic plugin makes MagicDraw SysML models come alive! Using the quantitative information and constraint relationships displayed in SysML diagrams, model-builders can run simulations from the earliest stages of system design. In traditional domains of system engineering like aerospace and transportation, users can explore system performance, estimate cost and allocate resources. Developers leveraging MagicDraw's DoDAF and business modeling capabilities can add parametric simulation using SysML submodels for defense planning, business process analysis and computational finance. Download the ParaMagic plugin demo version at http://www.magicdraw.com/paramagic

ParaMagic uses Mathematica™ (Wolfram Research) as the mathematical solver for the parametric relationship. ParaMagic is packaged as a plugin to the MagicDraw UML/SysML tool and is available for separate purchase by new and existing MagicDraw customers. Price is $999/€669.

Constraint Relationships

Mathematical relationships handled by Mathematica include basis arithmetic and exponentiation, trigonometric, exponential, and logarithmic expressions, and MINIMUM, MAXIMUM, SUM and AVERAGE functions. Because many equations can be solved non-causally, i.e. in any direction, ParaMagic-based models can be explored fully, with easy exchange of inputs and outputs. Mathematica can be installed on the local computer, or ParaMagic can support server-based licenses or web services.
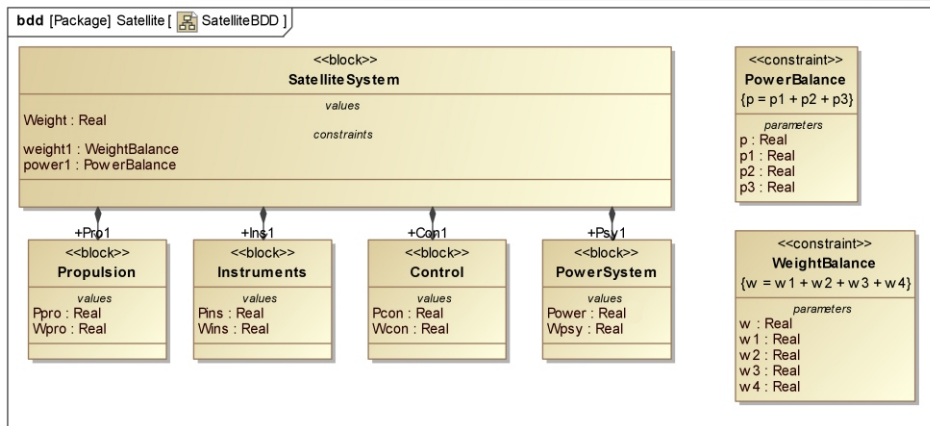
SysML Parametrics

The SysML 1.0 specification supports properties, constraint blocks and parametric diagrams, but until ParaMagic, this information couldn't be put to use beyond documentation. Collaborative modeling and simulation becomes easier with a visual representation of model structure and partitioning complex models into subsystems encourages object-oriented discipline in model design. The MagicDraw TeamServer implementation lets specialists share the model while providing a governance mechanism in collaborative environments.

Functionality	SysML	MagicDraw SysML + ParaMagic
Structure Diagrams	✓	✓
Behavior Diagrams	✓	✓
Requirements Diagrams	✓	✓
Parametric Diagrams	✓	✓
Model Simulation		✓
Trade Studies		✓
"What If" Scenarios		✓

Examples of SysML Diagrams and Parametric Results

Block Definition Diagram with System Components, Properties and Constraints

bdd [Package] Satellite [SatelliteBDD]

<<block>> Satellite System
values
Weight : Real
constraints
weight1 : WeightBalance
power1 : PowerBalance

<<constraint>> PowerBalance
$\{p = p1 + p2 + p3\}$
parameters
p : Real
p1 : Real
p2 : Real
p3 : Real

+Pro1 — **<<block>> Propulsion**
values
Ppro : Real
Wpro : Real

+Ins1 — **<<block>> Instruments**
values
Pins : Real
Wins : Real

+Con1 — **<<block>> Control**
values
Pcon : Real
Wcon : Real

+Psy1 — **<<block>> PowerSystem**
values
Power : Real
Wpsy : Real

<<constraint>> WeightBalance
$\{w = w1 + w2 + w3 + w4\}$
parameters
w : Real
w1 : Real
w2 : Real
w3 : Real
w4 : Real

In a simple example, a satellite with four subsystems needs to meet weight and power budget requirements. Constraint blocks, which may be re-used from previous projects, are added to the model and parametric diagrams provide the wiring between the component attributes, like propulsion system weight and the analysis equations, like WeightBalance. The ParaMagic browser summarizes the model parameters, assigns them as givens or unknowns, and prepares the system of equations for export to the mathematical solver. Results appear in the browser and can be uploaded into the SysML model.

Parametric Diagram

par [Block] SatelliteSystem[SatelliteSystem]

<<constraint>> weight1 : WeightBalance
$\{w = w1 + w2 + w3 + w4\}$
w : Real   w1 : Real   w2 : Real   w3 : Real   w4 : Real

e1   e2   e3   e4   e5

<<ValueType>> Weight : Real

<<block>> Pro1 : Propulsion
<<ValueType>> Wpro : Real
<<ValueType>> Ppro : Real

<<block>> Ins1 : Instruments
<<ValueType>> Wins : Real
<<ValueType>> Pins : Real

<<block>> Con1 : Control
<<ValueType>> Wcon : Real
<<ValueType>> Pcon : Real

<<block>> Psy1 : PowerSystem
<<ValueType>> Wpsy : Real
<<ValueType>> Power : Real

e6   e7   e8   e9

p1 : Real   p2 : Real   p3 : Real   p : Real

<<constraint>> power1 : PowerBalance
$\{p = p1 + p2 + p3\}$

ParaMagic Browser

ParaMagic(TM) 15.1a2 - Data
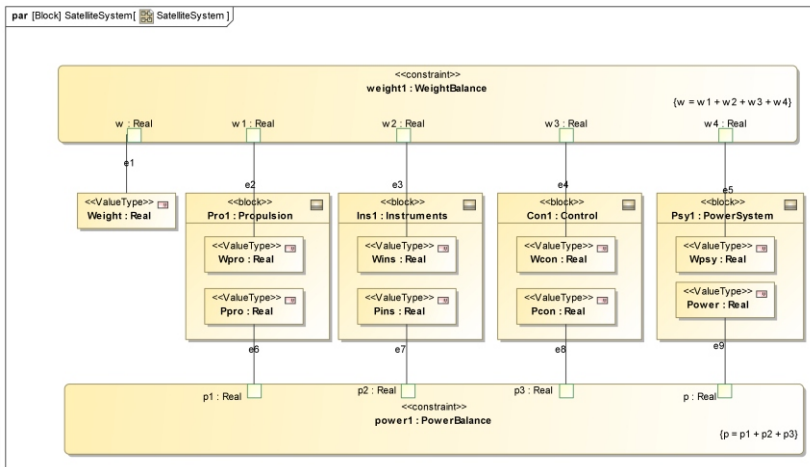
Name	Symbol	Type	Causality	Values
SatelliteSystem		SatelliteSystem		
Con1		Control		
Pcon		REAL	given	1,500
Wcon		REAL	given	500
Ins1		Instruments		
Pins		REAL	given	2,000
Wins		REAL	given	2,000
Pro1		Propulsion		
Ppro		REAL	given	5,000
Wpro		REAL	given	5,000
Psy1		PowerSystem		
Power		REAL	target	?????
Wpsy		REAL	given	2,000
Weight		REAL	target	?????

Expand   Collapse All   Solve   Update to SysML

root (SatelliteSystem)

Name	Lo...	O...	Relation	Active
weight1	Y		<Weight>==<Pro1.Wpro>+<Ins1.Wins>+<...	✓
power1	Y		<Psy1.Power>==<Pro1.Ppro>+<Ins1.Pins>...	✓

Questions?

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