# **Evaluation with causality**

As described in the section Mathematical equation, the parametric evaluator is capable of solving expressions in the mathematical equation to find the value of the target from the value of the given. We could say that the target is an unknown value that you want to find and the given is a known input value. Normally, a target is a variable on the left-hand side of an equation and a given is a variable on the right-hand side.

Sometimes, however, you know the value of the variable on the left-hand side of an equation and need to find the value of the variable on the right-hand side. You can use Cameo Simulation Toolkit to obtain the given variable if you integrate an external evaluator, which supports solving symbolic equations, to Cameo Simulation Toolkit. MATLAB with Symbolic Math Toolbox is one of the external evaluators you can use.

As a prerequisite, you must integrate MATLAB with Symbolic Math Toolbox successfully. See also Integration with MATLAB.

If the language that defines an expression of a constraint block needs to be solved by an external evaluator that is capable of solving symbolic equations, you can specify what property is the target and the given through the **Causality** column in the **Variables** pane.

Variables		
B Variables ×		
		Ø -
Name	Value	Causality
⊡· <b>□</b> A	a : A@136aa52	None 👻
🛛 🔽 a : Real	1.2500	Given 👻
	0.2800	Given 👻
V c : Real	3.1416	Given 👻
🔽 d : Real	2.0000	Given 👻
v e : Real	1.9983	Target 🗸 🗸
	Sum@134d187	None 👻
s2: trigonometry {z=sin(x + y) * cos(y)}	trigonometry@60d4ca	None 👻
. S3: Multiply {z=x*y}	Multiply@183f0a5	None 👻

## Using MATLAB to evaluate mathematical equations.

The preceding figure shows the block object **Circle** in the **Variables** pane. It has a constraint property typed by the constraint block **Circle Area**. The expression of the constraint block is **{area = 3.14159 \*\*\* (radius ^ 2)}**. The default causality of **area** and **radius** will be **target** and **given** respectively. However, you can click the drop-down list box in the **Causality** column to change the causality of **area** and **radius** to be **given** and **target**. Cameo Simulation Toolkit will then evaluate the value of **radius** from the given value of **area**.

The expression of the constraint block **Circle Area** in the figure shows two roots: (i) a positive value 2.8209 and (ii) a negative value -2.8209. The parametric evaluator needs only one root to evaluate the value of a radius from the given value of an area. Therefore, the **Roots selection** dialog will open for you to select which root you want as shown in the following figure.

X	Roots selection	×
Roots select Number of with the mu select the e	ction roots, returned from math engine, is incompatible ultiplicity of the constraint parameter(s). Please expected roots available in the list.	×;
Please select Press Ctrl key [area = 3. radius =	1 root. for multiple selections. 14159 * (radius^2)]	
2.8209		
-2.8209		
Show all 2	? root(s).	
		ОК

#### Roots Selection dialog.

The number of roots varies according to the expression and the multiplicity of a property, which is the target. Therefore, it is possible to select more than one root. The following scenarios show you how to work with multiple roots.

#### Scenario 1

The following figure shows the constraint Test Multiple Root 1 is applied to block A.

bdd	[Package] Sample [ Samp	ile ]
	«block»	
	Α	
	constraints c2 : Test Multiple Root 1	
	values x : Real = 0.0	
	y : Real = 0.0	
	«constraint»	
	<b>Test Multiple Root 1</b>	
	constraints {y=(x^3)+4*(x^2)-5*x-2}	
	<i>parameters</i> x : Real	
	y : rteai	

The Constraint Test Multiple Root 1 is Applied to Block A

#### Scenario 2

The given types of causality of y and x are given and target respectively. Once Cameo Simulation Toolkit finished executing block **A** and performing a parametric simulation to satisfy the constraint **Test Multiple Root 1**, the equation would result in three values of x and all are the possible roots for the equation. Therefore, the **Roots selection** dialog would open, allowing you to select one of these three values as the root (see the following figure).

	Roots selection	×	음 Vari	ables × o <sup>©</sup> Br	reakpoints 🗙		
Posts selection		2 ¥ ¥					
Number of roots, returned from math engine, is incompatible with the multiplicity of the constraint parameter(s). Please select the expected roots available in the list	Name		Value	Causality			
	X	E- 🗖 A		A@60434655	None	4	
			Ē ⊡ c2:	Test Multiple Ro	Test Multiple Root1@13bbdab8	None	Ý
Please select 1	root.		💷 x : l	Real	0.0000	Target	~
Press Ctrl key [y=(x^3)+ x =	for multiple selections. 4*(x^2)-5*x-2]		γ:	Real	0.0000	Given	¥
1.2548							
-0.3232 -4.9316			-				
Show all 3	root(s).						
		ОК					

### The Roots Selection Dialog.

## Scenario 3

However, you may select more than one value as the root. But, the number of values you can select cannot be more than the upper multiplicity. Otherwise, an error will occur and an **Error** message dialog will open. The following figure shows that *two* values were selected as the roots when in fact, the upper multiplicity of x value property was *one*. Therefore, an error occurred and the **Error** dialog would open.

	Roots selection	×	🗄 Variables 🗙 💍 Breakpoir	nts X		
Roots selection Number of roots, returned from math engine, is incompatible		Z ≧ ≧ Image: Second				
with the multiplicity of the constraint parameter(s). Please select the expected roots available in the list.	X	⊡· ☐ A ⊕· ☑ c2 : Test Multiple Root1 {y=(x	A@73562eeb ^3) Test Multiple Root1@79d71265	None v		
Please select 1 ro Press Ctrl key for [y=(x^3)+4*( x =	iot. multiple selections. (x^2)-5*x-2]		💷 x : Real	0.0000	Target ↓ Given ↓	
1.2548 -0.3232 -4.9316				Error	×	
Show all 3 roc	ot(s).	ОК	The number of seleceter	d roots must be less than the multiplicity!	( multiplicity = 1). <u>Need Help? &gt;&gt;</u> OK	

Error Occurs when the Number of Roots Selected is Greater than the Upper Multiplicity.

## **Related pages**

- Specifying the language for the expression
- Value binding
- Evaluating expressions
- Dynamic constraint
- Manual value updates using the Parametric Evaluator
- Communicating with evaluators through simulation console
- Exchanging values between Cameo Simulation Toolkit and Parametric Evaluator
- Built-in Math
- Integration with external Evaluators
- Trade study analysisSample project