

SUMCON in *Mathematica*
suspension odel structor



SUMCON Version:1.32

About SUMCON

Version Info

Refresh

SUMCON User's Manual

Mechanical suspension modeling tool in Mathematica

Contents

❖ Preparation

☐ installation

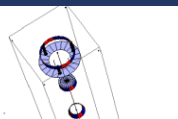
☐ Model Construction

☐ Step 1. Registrare Rigid Bodies

☐ Step 2. Set Connection

☐ Step 3. Start calculation


☐ Calculation Result



❖ Preparation / Installation

1) Install the Modeling tools from the below URL ;

<http://gwdoc.icrr.u-tokyo.ac.jp/cgi-bin/private/DocDB/ShowDocument?docid=3729>



Institute for Cosmic Ray Research
University of Tokyo

JGW-T1503729-v1
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Suspension rigid-body modeling tool in Mathematica

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[Takanori Sekiguchi](#)

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Abstract:
This is a suspension modeling tool built in Wolfram Mathematica. You will need Mathematica later than version 7. To start the program, unzip the attached file and execute 'startSUMCON.nb' in the top directory. The user manual is to be added soon.

Files in Document:

- [sumcon.1.3.2.zip](#) (6.2 MB)

Get all files as [tar.gz](#), [zip](#).

Topics:

- [Detector:Seismic Isolation](#)
- [Activity:KAGRA](#)
- [Detector:Suspensions](#)

Authors:

- [Takanori Sekiguchi](#)

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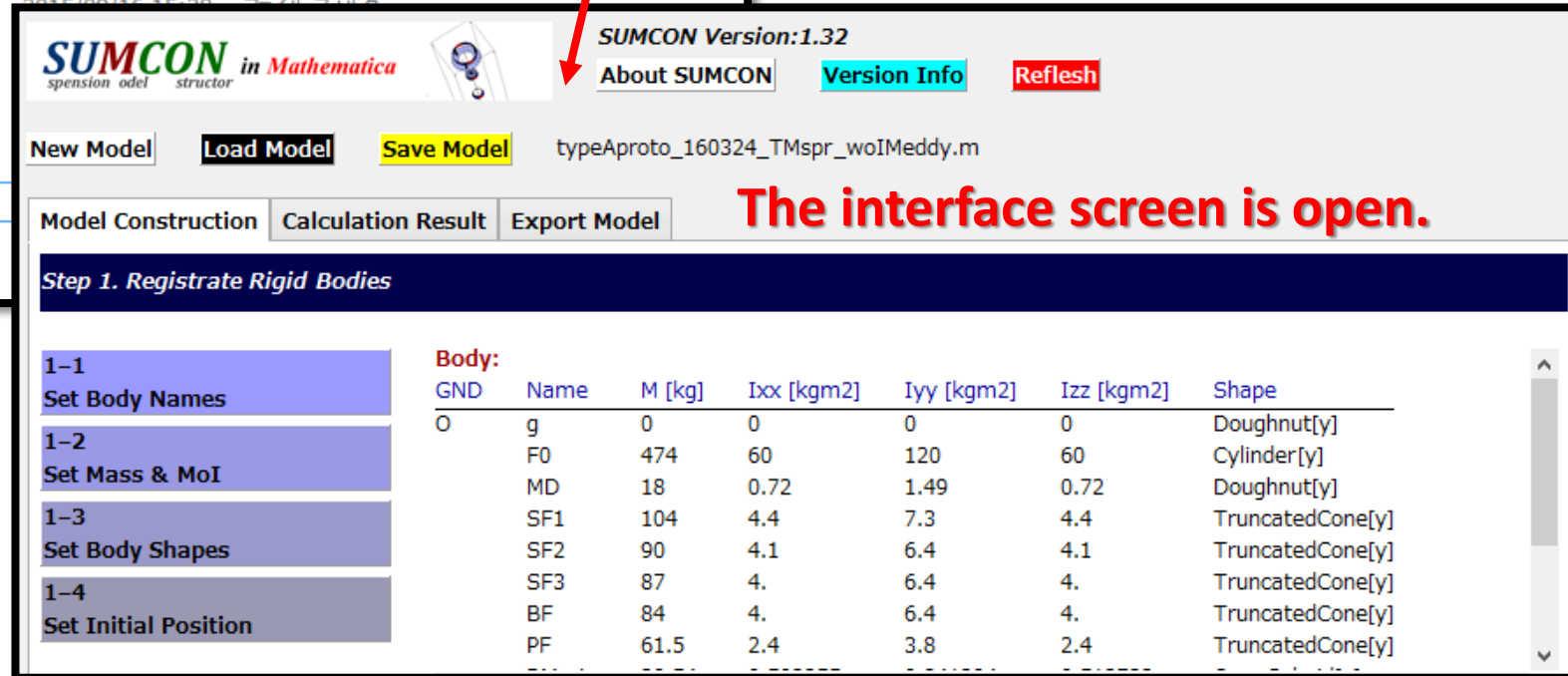
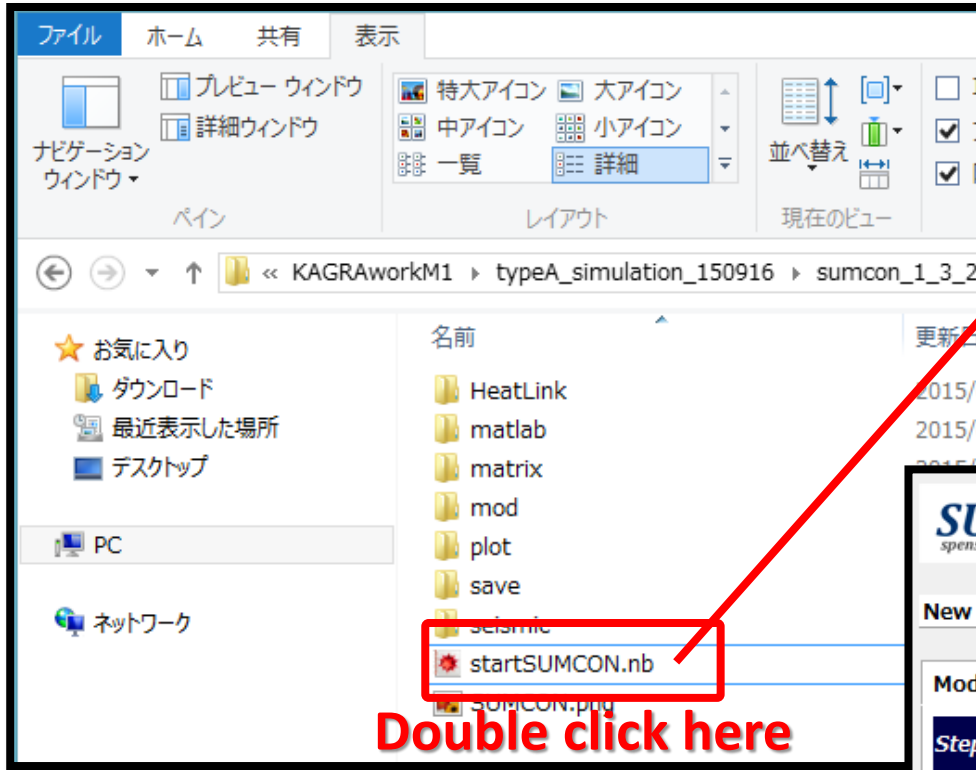
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❖ Preparation / Starting the program

2) Start program



❖ Model construction

1) You should registrate suspension parameters as follows.

SUMCON Version:1.32

SUMCON in Mathematica
suspension odel structor

SUMCON Version:1.32
About SUMCON Version Info Refresh

New Model Load Model Save Model typeAproto_160324_TMspr_woIMeddy.m

Model Construction Calculation Result Export Model

Step 1. Registrare Rigid Bodies

1-1 Set Body Names
1-2 Set Mass & MoI
1-3 Set Body Shapes
1-4 Set Initial Position

Body:	GND	Name	M [kg]	Ixx [kgm2]	Iyy [kgm2]	Izz [kgm2]	Shape
	0	g	0	0	0	0	Doughnut[y]
		F0	474	60	120	60	Cylinder[y]
		MD	18	0.72	1.49	0.72	Doughnut[y]
		SF1	104	4.4	7.3	4.4	TruncatedCone[y]
		SF2	90	4.1	6.4	4.1	TruncatedCone[y]
		SF3	87	4.	6.4	4.	TruncatedCone[y]
		BF	84	4.	6.4	4.	TruncatedCone[y]
		PF	61.5	2.4	3.8	2.4	TruncatedCone[y]

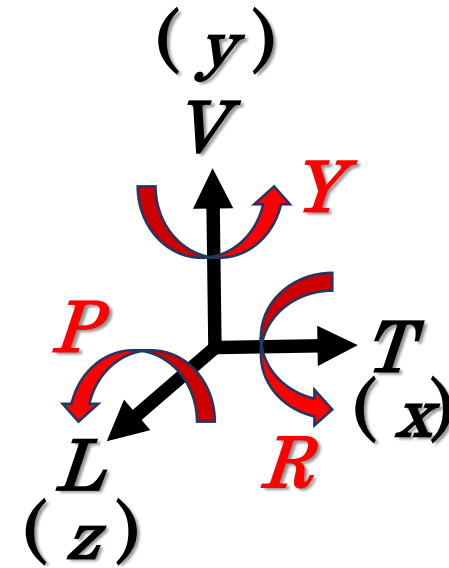
Step 2. Set Connection

Set Material Properties

2-1 Set Wires
2-2 Set Vertical Springs
2-3 Set Material Properties

Wire:	Name	Body1	Body2	Material	L [m]	D [mm]
	F0-MD-1	F0	MD	Maraging Steel	1.9398	2.
	F0-MD-2	F0	MD	Maraging Steel	1.9398	2.
	F0-MD-3	F0	MD	Maraging Steel	1.9398	2.

Axes definition



❖ Model construction / Step 1. / Set Body Names

2) Set suspension names

SUMCON Version:1.32

1-1 Set Body Names

Registrare Body Names

GND	Name	GND	Name	GND	Name	GND	Name	GND	Name
<input checked="" type="checkbox"/>	g	<input type="checkbox"/>	F0	<input type="checkbox"/>	MD	<input type="checkbox"/>	SF1	<input type="checkbox"/>	SF2
<input type="checkbox"/>	SF3	<input type="checkbox"/>	BF	<input type="checkbox"/>	PF	<input type="checkbox"/>	RMario	<input type="checkbox"/>	Mario
<input type="checkbox"/>	IRM	<input type="checkbox"/>	IM	<input type="checkbox"/>	RM	<input type="checkbox"/>	TM	<input type="checkbox"/>	
<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	

Save Cancel

Objects touched on ground should be checked here.

Body: GND 0

Step 1. Registrare Rigid Bodies

1-1 Set Body Names

1-2 Set Mass & MoI

1-3 Set Body Shapes

1-4 Set Initial Position

Step 2. Set Connection

Set Material Properties

2-1 Set Wires

2-2 Set Vertical Springs

Wire:	Name	Body1	Body2	Material	L [m]	D [mm]
2-1	F0-MD-1	F0	MD	Maraging Steel	1.9398	2.
2-1	F0-MD-2	F0	MD	Maraging Steel	1.9398	2.
2-2	F0-MD-3	F0	MD	Maraging Steel	1.9398	2.

2) Click “save”, otherwise, the registered information is vanished.

❖ Model construction / Step 1. / Set Mass & MoI

3) Set Masses and Moment of inertia

If the inertia has non-diag elements,
Please click the "Off-diag".
Registration page is open.

	Copy	Paste	Mass	Ixx	Iyy	Izz	I Matrix
g	Copy	Paste	0	0	0	0	Off-Diag
F0	Copy	Paste	474	60	120	60	Off-Diag
MD	Copy	Paste	18	0.7199-	1.49	0.7199-	Off-Diag
SF1	Copy	Paste	104	4.4	7.3	4.4	Off-Diag
SF2	Copy	Paste	90	4.1	6.4	4.1	Off-Diag
SF3	Copy	Paste	87	4.	6.4	4.	Off-Diag
BF	Copy	Paste	84	4.	6.4	4.	Off-Diag
PF	Copy	Paste	61.5	2.4	3.8	2.4	Off-Diag
RMario	Copy	Paste	20.54	0.5022-	0.8413-	0.5127-	Off-Diag
Mario	Copy	Paste	21.07	0.1593-	0.3015-	0.1631-	Off-Diag
IRM	Copy	Paste	20.82	0.3353-	0.6379-	0.3279-	Off-Diag
IM	Copy	Paste	20.67	0.0933-	0.1653-	0.1053-	Off-Diag
RM	Copy	Paste	22.91	0.3961-	0.3611-	0.4355-	Off-Diag
TM	Copy	Paste	22.88	0.1115-	0.1135-	0.1399-	Off-Diag

Registered bodies

	x	y	z
x	60	0	0
y	0	120	0
z	0	0	60

2) Click "save", otherwise, the registered information is vanished.

❖ Model construction / Step 1. / Body shape

4) Set suspension body shapes

1-3 Set Body Shapes

Set Appearance of Bodies

	Copy	Paste	Select Shape	Dimension				
g	Copy	Paste	Doughnut[y]	Outer D	Inner D			
				1.5	0.8	0.2	0.2	0.2
F0	Copy	Paste	Cylinder[y]	Diameter	Height			
				1.4	0.2	0.2	0.2	0.2
MD	Copy	Paste	Doughnut[y]	Outer D	Inner D			
				0.7	0.5	0.2	0.2	0.2
SF1	Copy	Paste	TruncatedCone[y]	Upper D	Lower D	Height		
				0.6	0.8	0.2	0.2	0.2
SF2	Copy	Paste	TruncatedCone[y]	Upper D	Lower D	Height		
				0.6	0.8	0.2	0.2	0.2
SF3	Copy	Paste	TruncatedCone[y]	Upper D	Lower D	Height		
				0.6	0.8	0.2	0.2	0.2
BF	Copy	Paste	TruncatedCone[y]	Upper D	Lower D	Height		
				0.5	0.7	0.2	0.2	0.2
PF	Copy	Paste	TruncatedCone[y]	Upper D	Lower D	Height		
				0.4	0.6	0.2	0.2	0.2
RMario	Copy	Paste	OpenCuboid[y]	X-Size	Y-Size	Z-Size		
				0.4	0.1	0.3	0.2	0.2

Choose the shape from options

2) Click “save”, otherwise, the registered information is vanished.

❖ Model construction / Step 1.

5) Set suspension initial positions

The shape, you chose in the step 1-3, should be reflected to this screen.

1-4 Set Initial Position

Set Initial Position of Rigid Bodies

Name	x [mm]	y [mm]	z [mm]
g	0.	0.	0.
F0	0.	500.	0.
MD	0.	-1621.1	0.
SF1	0.	-1771.1	0.
SF2	0.	-4042.1	0.
SF3	0.	-6313.1	0.
BF	0.	-8686.1	0.
PF	0.	-11967.1	0.
RMario	0.	-12386.1	0.
Mario	0.	-12386.1	0.
IRM	0.	-12654.503	0.
IM	0.	-12654.403	0.
RM	0.	-13004.503	0.
TM	0.	-13004.503	0.

Save Cancel

3D Model: A vertical rectangular frame containing several small, colorful mechanical components representing a suspension system. A red arrow points from the text above to this model.

2) Click “save”, otherwise, the registered information is vanished.

❖ Model construction / Step 2. / Set wires

1) Set suspension wire information, by clicking here

Step 2. Set Connection

Set Material Properties

2-1 **Set Wires**

2-2 Set Vertical Springs

2-3 Set Inverted Pendulum

2-4 Set Heat Links

2-5 Set Damper

Wire: Name

F0-MD-1

F0-MD-2

F0-MD-3

SF1-SF2-1

SF2-SF3-1

SF3-BF-1

BF-PF-1

PF-Mario-1

PF-RMario-1

PF-RMario-2

Mario-IM-1

Mario-IM-2

2-1 Set Wires

Set Wires

Create New Wires Set Material Properties

Edit Each Wire Edit Wire Connection

Del	Copy	Name	U Body	U Clamp Pos [mm]			L Body	L Clamp Pos [mm]	
Delete	Copy	F0-MD-1	F0	290.	-80.	0.	MD	290.	17
Delete	Copy	F0-MD-2	F0	-145.	-80.	-251.-	MD	-145.	17
Delete	Copy	F0-MD-3	F0	-145.-	-80.	251.1-	MD	-145.-	17
Delete	Copy	F0-SF1-1	F0	0.	120.	0.	SF1	0.	-1
Delete	Copy	SF1-SF2-1	SF1	0.	-25.	0.	SF2	0.	5.
Delete	Copy	SF2-SF3-1	SF2	0.	-5.	0.	SF3	0.	5.
Delete	Copy	SF3-BF-1	SF3	0.	-5.	0.	BF	0.	5.
Delete	Copy	BF-PF-1	BF	0.	-5.	0.	PF	0.	5.
Delete	Copy	PF-Mario-1	PF	0.	-5.	0.	Mario	0.	5.
Delete	Copy	PF-RMario-1	PF	175.5	-5.	0.	RMario	175.5	5.

100%

Step 3. Start Calculation

Construct Model

In more detail,
please See
p. 12 ~ p. 15

❖ Model construction / Step 2. / Set wires

2 - i) Set suspension wire information

If Suspended by ONE wire

How many wires for suspension?

1

Set attaching bodies

Upper body: g Lower body: F0

Set clamp position

Vertical position of upper SP wrt upper body's CoM [mm] -5.
Vertical position of lower SP wrt lower body's CoM [mm] 5.
200.
50.
0.
0.

New Wire Registration

Select Material

Set Material Properties

Material	Young [GPa]	Poisson	Loss [rad]
Maraging Steel	184	0.32	1. E -4

Wire Dimension

Variable Thickness Wire Length with Tension

Length [m]	Diam [mm]	Neck L[mm]	Neck D[mm]
1.	1.	20.	1.

Stiffness

Calculate from Wire Dimension

Longitudinal Stiffness: 0. N/m
Torsional Stiffness: 0. Nm/rad

Tension on Each Wire

Calculate From Suspended Mass

The number of the wires

Upper & lower body name

Suspension position of the upper & lower body
(From body's Center of Mas)

Wire material (They are registered already. mostly.)

1)Length, 2) diameter, 3) Neck length, 4) Neck dimeter

Wire stiffness

Tension on each wire

❖ Model construction / Step 2. / Set wires

2 - ii) Set suspension wire information

If Suspended by TWO wires

How many wires for suspension?
2

Set attaching bodies
Upper body: g Lower body: F0

Set clamp position
Vertical position of upper SP wrt upper body's CoM [mm] -5.
Vertical position of lower SP wrt lower body's CoM [mm] 5.
X-distance between upper SP & upper body's CoM [mm] 200.
X-distance between lower SP & lower body's CoM [mm] 50.
0.
0.

Select Material

New Wire Registration

Set Material Properties
Material: Maraging Steel Young [GPa]: 184 Poisson: 0.32 Loss [rad]: 1. E -4

Wire Dimension
 Variable Thickness Wire Length with Tension
Length [m]: 1. Diam [mm]: 1. Neck L[mm]: 20. Neck D[mm]: 1.

Stiffness
Calculate from Wire Dimension
Longitudinal Stiffness: 0. N/m
Torsional Stiffness: 0. Nm/rad

Tension on Each Wire
Calculate From Suspended Mass
0. N (0. kgw)

The number of the wires

Upper & lower body name

Suspension position of the upper & lower body
(From body's Center of Mas)

Wire material (They are registered already. mostly.)

1)Length, 2) diameter, 3) Neck length, 4) Neck diameter

Wire stiffness

Tension on each wire

Model construction / Step 2. / Set wires

2 - iii) Set suspension wire information

If Suspended by THREE wires

How many wires for suspension? 3

Set attaching bodies
Upper body: g Lower body: F0

Set clamp position
Vertical position of upper SP wrt upper body's CoM [mm] -5.
Vertical position of lower SP wrt lower body's CoM [mm] 5.
Horizontal radial distance from body's COM [mm] 200.
Rotation angle in the horizontal plane [deg] 50.
0.
0.

New Wire Registration

Material	Young [GPa]	Poisson	Loss [rad]
Maraging Steel	184	0.32	1. E -4

Wire Dimension
 Variable Thickness Wire Length with Tension
Length [m] 1. Diam [mm] 1. Neck L[mm] 20. Neck D[mm] 1.

Stiffness
Calculate from Wire Dimension
Longitudinal Stiffness: 0. N/m
Torsional Stiffness: 0. Nm/rad

Tension on Each Wire
Calculate From Suspended Mass

The number of the wires

Upper & lower body name

Suspension position of the upper & lower body
(From body's Center of Mas)

Wire material (They are registered already. mostly.)

1)Length, 2) diameter, 3) Neck length, 4) Neck diameter

Wire stiffness

Tension on each wire

❖ Model construction / Step 2. / Set wires

2 - iv) Set suspension wire information

If Suspended by FOUR wires

How many wires for suspension?

4

Set attaching bodies

Upper body: IRM Lower body: RM

Set clamp position

Vertical position of upper SP wrt upper body's CoM [mm] -5

Vertical position of lower SP wrt lower body's CoM [mm] 5

X-distance from body's COM [mm] 200

Z-distance from body's COM [mm] 50

Upper SP Z-translation from COM [mm] 0

The number of the wires

Upper & lower body name

Suspension position of the upper & lower body
(From body's Center of Mas)

New Wire Registration

Material	Young [GPa]	Poisson	Loss [rad]
Maraging Steel	184	0.32	1. E -4

Wire Dimension

Variable Thickness Wire Length with Tension

Length [m]	Diam [mm]	Neck L [mm]	Neck D [mm]
0.5	1	20	1

Stiffness

Calculate from Wire Dimension

Longitudinal Stiffness: 0 N/m

Torsional Stiffness: 0 Nm/rad

Wire material (They are registered already. mostly.)

1) Length, 2) diameter, 3) Neck length, 4) Neck diameter

Wire stiffness

Tension on each wire

Model construction / Step 2. / Set wires

This sheet is output automatically.

2-1 Set Wires						2-1 Set Wires						2-1 Set Wires												
Edit Each Wire		Edit Wire Connection																						
Del	Copy	Name	U Body	U Clamp Pos [mm]		L Body	L Clamp Pos [mm]			Mat	E [GPa]	Poisson R	Loss [rad]	L [m]	D [mm]	NL [mm]	ND [mm]	T [N]	Upper Clamp Direction			Low		
Delete	Copy	F0-MD-1	F0	290.	-80.	0.	MD	290.	17.	0.	C-70 Steel	200	0.3	3.	E -4	1.6211	4.5000-	26.5	2.	294.3	0	-1	0	0
Delete	Copy	F0-MD-2	F0	-145.	-80.	-251.-	MD	-145.	17.	-251.-	C-70 Steel	200	0.3	3.	E -4	1.6211	4.5000-	26.5	2.	294.3	0	-1	0	0
Delete	Copy	F0-MD-3	F0	-145.-	-80.	251.1-	MD	-145.-	17.	251.1-	C-70 Steel	200	0.3	3.	E -4	1.6211	4.5000-	26.5	2.	294.3	0	-1	0	0
Delete	Copy	F0-SF1-1	F0	0.	120.	0.	SF1	0.	2.5	0.	Maraging Steel	184	0.32	1.	E -4	2.2711	4.5000-	30.5	3.	6652.16	0	-1	0	0
Delete	Copy	SF1-SF2-1	SF1	0.	-44.	0.	SF2	0.	2.5	0.	Maraging Steel	184	0.32	1.	E -4	2.271	4.5000-	30.5	3.	5546.5-	0	-1	0	0
Delete	Copy	SF2-SF3-1	SF2	0.	-44.	0.	SF3	0.	2.5	0.	Maraging Steel	184	0.32	1.	E -4	2.271	4.5000-	30.5	3.	4440.99	0	-1	0	0
Delete	Copy	SF3-BF-1	SF3	0.	-44.	0.	BF	0.	2.5	0.	Maraging Steel	184	0.32	1.	E -4	2.373	4.5000-	30.5	3.	3335.4	0	-1	0	0
Delete	Copy	BF-PF-1	BF	0.	-54.5	0.	PF	0.	1.5	0.	Maraging Steel	184	0.32	1.	E -4	3.281	4.5000-	30.5	3.	2354.4	0	-1	0	0
Delete	Copy	PF-Mario-1	PF	0.	-79.0-	0.	Mario	0.	1.5	0.	Maraging Steel	184	0.32	1.	E -4	0.169	4.5000-	40.5	2.	712.206	0	-1	0	0
Delete	Copy	PF-RMario-1	PF	0.	20.	-175.5	RMario	0.	17.	-175.5	Copper Beryllium	134	0.3	5.	E -6	0.287	4.5000-	40.5	2.	857.394	0	-1	0	0
Delete	Copy	PF-RMario-2	PF	151.9-	20.	87.75	RMario	151.9-	17.	87.75	Copper Beryllium	134	0.3	5.	E -6	0.287	4.5000-	40.5	2.	857.394	0	-1	0	0
Delete	Copy	PF-RMario-3	PF	-151.-	20.	87.75	RMario	-151.-	17.	87.75	Copper Beryllium	134	0.3	5.	E -6	0.287	4.5000-	40.5	2.	857.394	0	-1	0	0
Delete	Copy	Mario-IM-1	Mario	94.	-5.	110.	IM	94.	5.	110.	Copper Beryllium	134	0.3	5.	E -6	0.2684-	0.6	0.	0.6	464.994	0	-1	0	0
Delete	Copy	Mario-IM-3	Mario	-94.	-5.	110.	IM	-94.	5.	110.	Copper Beryllium	134	0.3	5.	E -6	0.2684-	0.6	0.	0.6	464.994	0	-1	0	0
Delete	Copy	Mario-IM-4	Mario	-94.	-5.	-110.	IM	-94.	5.	-110.	Copper Beryllium	134	0.3	5.	E -6	0.2684-	0.6	0.	0.6	464.994	0	-1	0	0
Delete	Copy	RMario-IRM-1	RMario	171.7	5.	161.	IRM	171.7	30.	161.	Copper Beryllium	134	0.3	5.	E -6	0.2425-	0.6	0.	0.6	610.182	0	-1	0	0
Delete	Copy	RMario-IRM-2	RMario	171.7	5.	-161.	IRM	171.7	30.	-161.	Copper Beryllium	134	0.3	5.	E -6	0.2425-	0.6	0.	0.6	610.182	0	-1	0	0
Delete	Copy	RMario-IRM-3	RMario	-171.7	5.	161.	IRM	-171.7	30.	161.	Copper Beryllium	134	0.3	5.	E -6	0.2425-	0.6	0.	0.6	610.182	0.	-1.	0.	0.
Delete	Copy	RMario-IRM-4	RMario	-171.7	5.	-161.	IRM	-171.7	30.	-161.	Copper Beryllium	134	0.3	5.	E -6	0.2425-	0.6	0.	0.6	610.182	0.	-1.	0.	0.
Delete	Copy	IM-TM-1	IM	114.2	-40.	29.2	TM	114.2	-30.	29.2	Sapphire	345	0.3	2.	E -7	0.33	1.6	0.	1.6	221.706	0	-1	0	0
Delete	Copy	IM-TM-2	IM	114.2	-40.	-29.2	TM	114.2	-30.	-29.2	Sapphire	345	0.3	2.	E -7	0.33	1.6	0.	1.6	221.706	0	-1	0	0
Delete	Copy	IM-TM-3	IM	-114.2	-40.	29.2	TM	-114.2	-30.	29.2	Sapphire	345	0.3	2.	E -7	0.33	1.6	0.	1.6	221.706	0	-1	0	0
Delete	Copy	IM-TM-4	IM	-114.2	-40.	-29.2	TM	-114.2	-30.	-29.2	Sapphire	345	0.3	2.	E -7	0.33	1.6	0.	1.6	221.706	0	-1	0	0
Delete	Copy	IRM-RM-1	IRM	153.1-	50.	44.70-	RM	153.1-	50.	44.70-	Copper Beryllium	134	0.3	5.	E -6	0.3308-	0.6	0.	1.	362.97-	0	-1	0	0
Delete	Copy	IRM-RM-2	IRM	153.1-	50.	-44.7-	RM	153.1-	50.	-44.7-	Copper Beryllium	134	0.3	5.	E -6	0.3308-	0.6	0.	1.	362.97-	0	-1	0	0
Delete	Copy	IRM-RM-3	IRM	-153.-	50.	44.70-	RM	-153.-	50.	44.70-	Copper Beryllium	134	0.3	5.	E -6	0.3308-	0.6	0.	1.	362.97-	0	-1	0	0
Delete	Copy	IRM-RM-4	IRM	-153.-	50.	-44.7-	RM	-153.-	50.	-44.7-	Copper Beryllium	134	0.3	5.	E -6	0.3308-	0.6	0.	1.	362.97-	0	-1	0	0

Save Cancel

❖ Model construction / Step 2. / Set Vertical springs (GAS)

1) Set GAS filter, by

Step 2. Set Connection

Set Material Properties

2-1

Set Wires

2-2

Set Vertical Springs

2-3

Set Inverted Pendulum

2-4

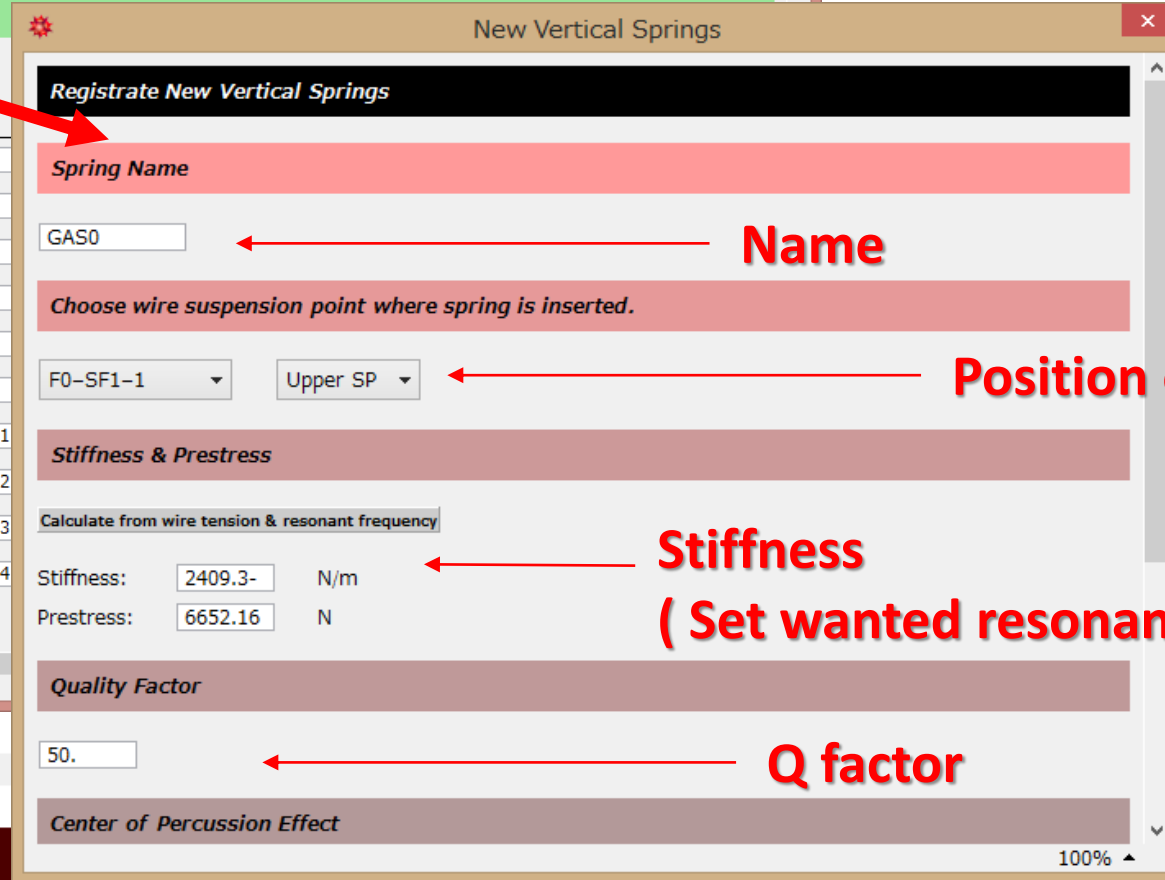
Set Heat Links

2-5

Set Damper

Step 3. Start Calculation

Construct Model



Name

Position of the GAS

Stiffness
(Set wanted resonance frequency)

Q factor

❖ Model construction / Step 2. / Set IP

1) Set Inverted Pendulum, by clicking here

Step 2. Set Connection

Set Material Properties

- 2-1 Set Wires
- 2-2 Set Vertical Springs
- 2-3 Set Inverted Pendulum**
- 2-4 Set Heat Links
- 2-5 Set Damper

Wire:

Name	Body1	Body2	Material	L [m]	D [mm]
F0-MD-1	F0	MD	Maraging Steel	1.9398	2.
F0-MD-2	F0	MD	Maraging Steel	1.9398	2.
F0-MD-3	F0	MD	Maraging Steel	1.9398	2.
F0-SF1-1	F0	SF1	Maraging Steel	2.26566	4.5
SF1-SF2-1	SF1	SF2	Maraging Steel	2.26644	4.5
SF2-SF3-1	SF2	SF3	Maraging Steel	2.26711	4.5
SF3-BF-1	SF3	BF	Maraging Steel	2.36766	4.5
BF-PF-1	BF	PF	Maraging Steel	3.3877	4.5
PF-Mario-1	PF	Mario	Maraging Steel	0.406237	4.5
PF-RMario-1	PF	RMario	Maraging Steel	0.227468	4.5
PF-RMario-2	PF	RMario	Maraging Steel	0.227468	4.5
PF-RMario-3	PF	RMario	Maraging Steel	0.227468	4.5
Mario-IM-1	Mario	IM	Copper Beryllium	0.267643	0.6
Mario-IM-2	Mario	IM	Copper Beryllium	0.267643	0.6

Step 3. Start Calculation

Construct Model

❖ Model construction / Step 2. / Damper

1) Set Eddy current damper, by clicking here

Step 2. Set Connection

Set Material Properties

- 2-1 Set Wires
- 2-2 Set Vertical Springs
- 2-3 Set Inverted Pendulum
- 2-4 Set Heat Links
- 2-5 Set Damper**

Wire:

Name	Body1	Body2	Material	L [m]	D [mm]
F0-MD-1	F0	MD	Maraging Steel	1.9398	2.
F0-MD-2	F0	MD	Maraging Steel	1.9398	2.
F0-MD-3	F0	MD	Maraging Steel	1.9398	2.
F0-SF1-1	F0	SF1	Maraging Steel	2.26566	4.5
SF1-SF2-1	SF1	SF2	Maraging Steel	2.26644	4.5
SF2-SF3-1	SF2	SF3	Maraging Steel	2.26711	4.5
SF3-BF-1	SF3	BF	Maraging Steel	2.36766	4.5
BF-PF-1	BF	PF	Maraging Steel	3.3877	4.5
PF-Mario-1	PF	Mario	Maraging Steel	0.406237	4.5
PF-RMario-1	PF	RMario	Maraging Steel	0.227468	4.5
PF-RMario-2	PF	RMario	Maraging Steel	0.227468	4.5
PF-RMario-3	PF	RMario	Maraging Steel	0.227468	4.5
Mario-IM-1	Mario	IM	Copper Beryllium	0.267643	0.6
Mario-IM-2	Mario	IM	Copper Beryllium	0.267643	0.6

Step 3. Start Calculation

Construct Model

❖ Model construction / Step 3.

1) Start the calculation, by clicking here

Step 2. Set Connection

Set Material Properties

- 2-1 **Set Wires**
- 2-2 **Set Vertical Springs**
- 2-3 **Set Inverted Pendulum**
- 2-4 **Set Heat Links**
- 2-5 **Set Damper**

Wire:

Name	Body1	Body2	Material	L [m]	D [mm]
F0-MD-1	F0	MD	Maraging Steel	1.9398	2.
F0-MD-2	F0	MD	Maraging Steel	1.9398	2.
F0-MD-3	F0	MD	Maraging Steel	1.9398	2.
F0-SF1-1	F0	SF1	Maraging Steel	2.26566	4.5
SF1-SF2-1	SF1	SF2	Maraging Steel	2.26644	4.5
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BF-PF-1	BF	PF	Maraging Steel	3.3877	4.5
PF-Mario-1	PF	Mario	Maraging Steel	0.406237	4.5
PF-RMario-1	PF	RMario	Maraging Steel	0.227468	4.5
PF-RMario-2	PF	RMario	Maraging Steel	0.227468	4.5
PF-RMario-3	PF	RMario	Maraging Steel	0.227468	4.5
Mario-IM-1	Mario	IM	Copper Beryllium	0.267643	0.6
Mario-IM-2	Mario	IM	Copper Beryllium	0.267643	0.6

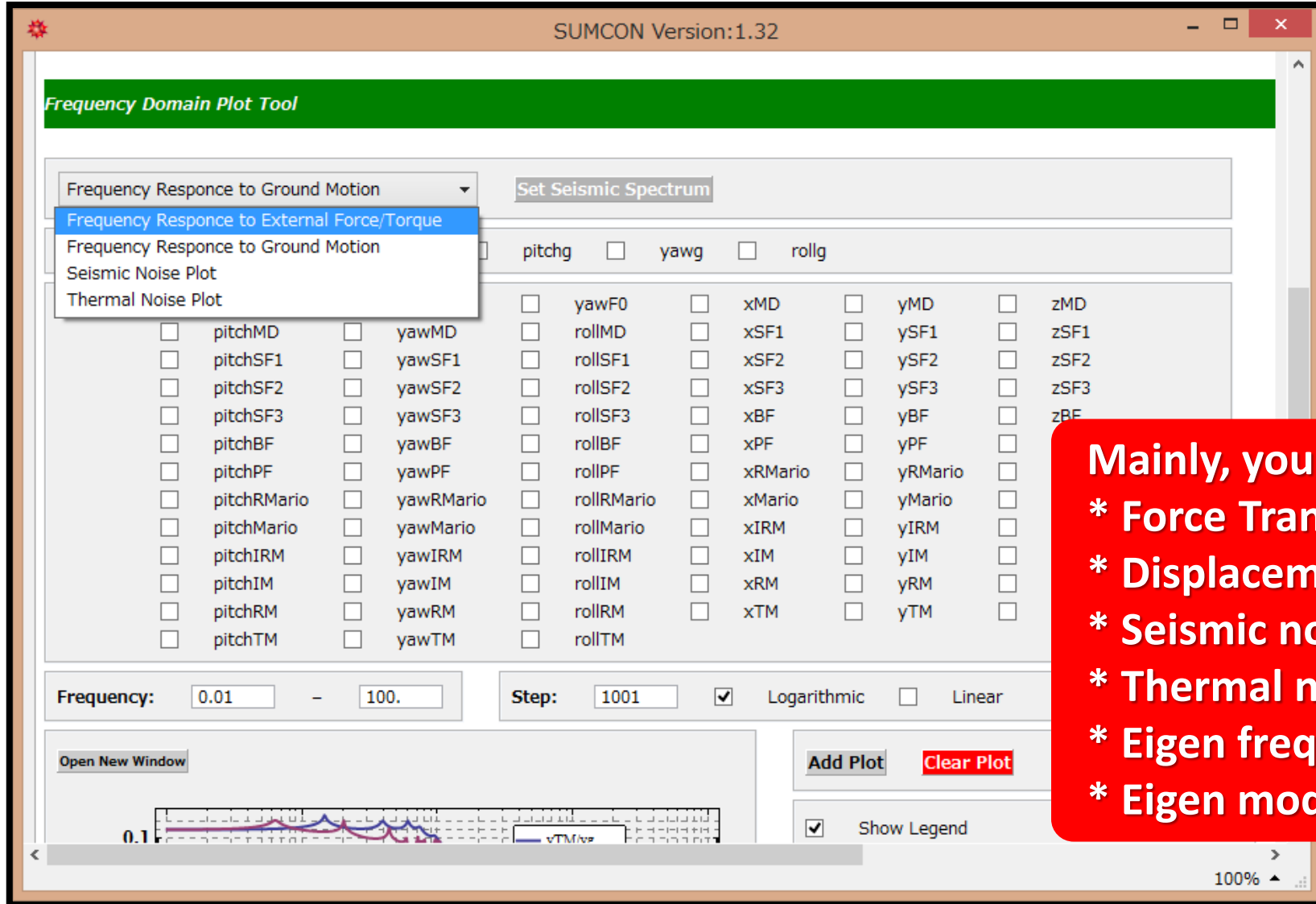
Step 3. Start Calculation

Construct Model

Start the run, by pushing here!

❖ Model construction / Step 3.

1) In the end, you can get the frequency response, and its eigen mode shapes!



You can click anywhere!
Please play with this tool!

(Some stuffs are to be added.)

Mainly, you can plot(get) ;

- * Force Transfer function
- * Displacement Transfer function
- * Seismic noise
- * Thermal noise
- * Eigen frequency
- * Eigen mode shape