# Tutorial - BioBricks model generator for electronic simulator.

#### • Requirements

First you need to download the software at these following URLs:

Main repository: https://github.com/igemsoftware/ENSPS-Strasbourg\_2011

Mirror: https://github.com/Dadomba/IGEM\_2011\_ENSPS\_Final\_Folder

For the simulation part, you need Dolphin Smash, mixed-signal multi-level and multi-domain simulation software to use the model files generated by the BioBricks model generator. You can found it at: <u>http://www.dolphin.fr/medal/smash/smash\_overview.php</u>.

#### • Launcher

After downloading the software, go to Launcher folder and double-click on "BBMGS.exe"



Then the launcher opens. You have two choices: "Behavioral model generator" or "Conservative model generator".



• Behavioral model generator

After clicking on "Behavioral model generator" from the launcher, it opens the main window for this generator.

Species	Name	Initial Value	Reactions	Name	Туре	Input Species	Output Species
Add			Add				
Modify			Remove				

On the left panel, you can "Add", "Remove" or "Modify" a species from the available species list.

"Add" button opens the species window, where you can choose the name of the species you want to add and the initial value (absent: LOW, present: HIGH)

🚳 Add Species	? ×
Name	IPTG
Initial Value	LOW - LOW HIGH
Add	Close

"Modify" button allows to change the initial value of the selected species.

When all the species you want to use are added, you can go to the right panel. On this panel, you can "Add" or "Remove" a reaction.

"Add" button opens a selection window to choose between "Inhibition", "Complexation" and "Synthesis" mechanisms.

In this tutorial, we will see the example of GFP synthesis with IPTG as activator and TetR as repressor. To create this mechanism, first you can select a species and then click on the ">>" or "<<" button to move it in the desired box. You obtain the following configuration. To validate, click on "Add".

Synthesis		? <mark>×</mark>
Name	GFP_Synthesis	
Available species		
GFP		Activators IPTG
	>>	
	<<	
		Barrassara
		TetR
	>>	
	<<	
Result	GFP ▼	
Add	Cancel	

This principle is the same for other mechanisms.

You obtain the following main window, where the reaction was added into reaction panel.

🚳 Behavioral Code Ger	nerator						- <b>-</b> X
Add Remove Modify	Name GFP IPTG TetR	Initial Value LOW LOW LOW	Add Remove	Name <sup>®</sup> GFP_Synthesis	Type Synthesis	Input Species Act: IPTG Rep: TetR	Output Species GFP
			➔ Create a system				

Then the last thing to do is to click on "Create a system". This opens the "System creation" window.

System Creat	tion	_	_	-	-	-	-	-	? ×	
		Name		GFP_	System					
Available reactions					Reactions in the system					
Name	Туре	Input Species	Output Speci	25		Name	Туре	Input Species	Output Species	
						GFP_Synthesis	Synthesis	Act: IPTG Re	GFP	
					>>					
					<<					
	Constant	t Species	,	ariable Spec	ies					
	Name		Nan	ne ^						
			IPTG TetR							
			>>				Simulation Time	1000 seconds	5	
			<<				Step Time	0,10 seconds	·	
			_							
				Create	Car	ncel				

After putting the reactions you want into reactions in the system panel, input species will automatically appear in the constant species panel. You can choose if you want that they will stay constant or become variable species. Finally you select the simulation and the step time and you click on "Create".

## • Files obtained

The models and simulation files were now generated in the sub-folder "bin2launch/generated\_files".



## • Simulations

To launch Smash, you can double-click on the file "\*.pat" in the generated files folder. You obtain the following window.

SMASH 5.12.0 - [C:\Users\Yves\Deskto	Nigemsoftware-ENSPS-Strasbourg_2011-0f24396/igemsoftware-ENSPS-Strasbourg_2011-0f24396/ibinaries/bin2launch/generated_file]	- 0 <b>- X</b> -
<u> </u>	s Debug Waveforms Processing Results Iools Windows Help	_ 5 ×
💰 💰 🦑 🗎 🖻 💋 🍻 🕼 🗐 💭	è) ở ∿ 🗈 🐧 🛪 🙈 🕼 ( <)	In
成 哉   🗲 啄   🗿 🕘 🔍 🔍 🔍	泰泰蓉  今  夏永賀陽栗  ノル個  西西西西  小  加本奈  山浩  早	
Cruit files GPP system.pat GPP system.vhd GPP system.vhd GPP cort GPP c	.VHDI SET KIND-AMS .VHDI COMPILE LIBRARY-WORK SOURCE-GFP_synthesis.vhd .VHDI COMPILE LIBRARY-WORK SOURCE-GFP_system.vhd .VHDI elaborate WORK GFP_system .Tran 0.ls 1000s	
K Browser Briles Circuit	<	+
Output GFP_system.rpt		
4 Output logic driv 	rer (s)	ŕ
		-
Load completed.		Ln 1, Col 0

To launch the simulation, you just have to tap the "ctrl+T" keyboard shortcut. You obtain the following window, in which you can select the species you want to see, and click on "Add" button to see them in the scope.

😓 SMASH 5.12.0 - [Transient]											_	_				
Note: File Edit Setup Probes Analysis Debu	ug Waveforms Pr	ocessing Result	s Tools W	indows He	lp											_ 5 ×
🤞 🦸 👔 📄 🍻 🗋 🖬 🌧 👉	0 1 × 68 8	8 B 🕼 🐴	P 0 0	0 5 5	e # 🖬	→  ?	2									10-
₩ #  ≠ &  0 0 0 \$ \$ \$ 8	a 🗠   💠   🎢 /	0 17 10 10 1	1 13 12	Dec Bin Hex		Щфф		-								
Craft fies Craft fies Craft Seystem.pat Crep_system.ya	SYSTEM.S_GFP SYSTEM.S_IPTG SYSTEM.S_TETR Add traces	50 10	0 150	200 250	300	350 400	450	500	550 ×	600	650 7	700 75	0 800	850	900 95	0 VHDL vhdl.leee std VHDL vhdl.leee std VHDL vhdl.leee.std ■
GPP_system.rpt     GPP_system.rpt	Fiter signals Crout Fiter signals CNO FLITER > Case sensitive Bus Radix @ Binary Decimal	INTERN - GPP_SYSTE GPP_SYNTHEESES - C GPP TPTO TETER N Show Benedictional Signed decimal	EM SFP_SYNTHESI: P Apply bus elements Octal ASCII	5	Create B	IS Spedal	lose	Add								,-
Select a command															Ln	1, Col 0

## • Conservative model generator

The conservative model generator works in the same way as behavioral model generator. But some differences are listed below:

The initial value of a species is now a real number and is a concentration.

Add Species		? ×
Name	IPTG	
Initial Value	о, 5þ	×
Add	Close	

The "Inhibition" mechanism has disappeared from the suggested mechanisms list because it is not useful in conservative model and can be simulated with a complexation mechanism.

Finally the main modification is the adding of BioBricks parameters in the mechanism window.

Synthesis	A REAL PROPERTY.		? <b>X</b>
Name	GFP_Synthesys		
Available species GFP	Activators          IPTG         <	Synthesis constants Hill's constant for activator: Ka: Hill's constant for repressor: Kr: Hill's coefficient for activator: na: Hill's coefficient for repressor: nr: Kinetic constant of transcription: ktr: Kinetic constant of translation: ktl: Degradation's coefficient of mRNA: dmRNA: Degradation's coefficient of synthesized protein: dP:	0,20 x 0,02 x 2,0 x -2,0 x 0,10 x 0,10 x 0,10 x 0,10 x 0,10 x
Result	GFP		