RAVSim

Run-time Analysis and Visualization Simulator

A quick start user manual,

Current RAVSim Version: v1.1,

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About RAVSim

Run-time Analyzing and Visualization Simulator or RAVSim, is an interactive simulator (multi-core architecture-based) tool for analyzing and simulation of a spiking neural network model. It is developed on a graphical programming language platform called LabVIEW (Laboratory Virtual Instrument Engineering Workbench) [1].

RAVSim offers both deterministic (by solving Ordinary Differential Equations (ODEs)) [2] and

stochastic (using stochastic leaky integrate-and-fire (LIF) neurons algorithm) simulations [3], which allows the users to fully understand the behavior of the spiking neural network from the LIF [4] model in all possible simulation approaches and it differs from other available tools by being able to execute, analyze, extract, and validate the model using wild images-based dataset. RAVSim cannot only analyze or simulate the spiking neural net but also offers users the chance to create their own dataset with their choice of image pixels, quality, and extension.

This short document will teach you how to use RAVSim to perform run-time experiments. The video demo of RAVSim can also be seen in,

1- https://www.youtube.com/watch?v=Ozv0MXXj89Y

Basic Requirements

A graphical programming approach LabVIEW Runtime 2021 or above.
A minimum computer requirement:

- Processor: i3 CPU @ 2.3 GHz
- RAM: 4.0 GB
- System Type: 32/64-bit OS
- Operating System: Mac OS, Window

To install Runtime LabVIEW:

https://www.ni.com/kokr/support/downloads/softwareproducts/download.labview.html#305931

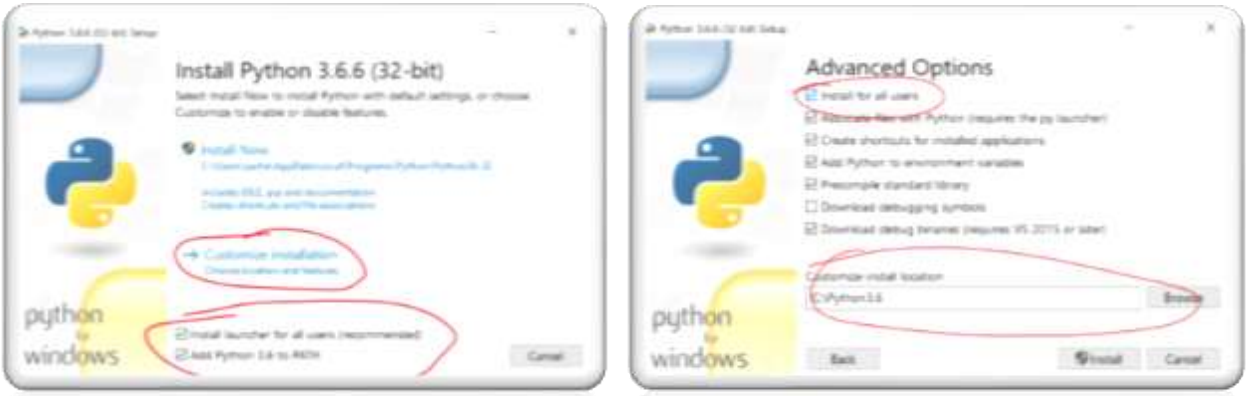
To install Runtime LabVIEW:

Users May also need to install the Python version for image classification VI. As LabVIEW requires a very specific Python Installation and is not compatible with many installers. It requires you to download Python 2.7 or 3.6 from "**Python.org**". Since most individuals polled still use LabVIEW 32-bit that version is referenced.

Version	Operating System	Description	MD5 Sum	File Size	GPG
Zipped source tarball	Source release		9a080a86e1a8d85e45eee4b1cd0a16a2	22930752	SIG
XZ compressed source tarball	Source release		c3f30a0aff425dda77fd19e02f425d6ba	17156744	SIG
macOS 64-bit/32-bit installer	Mac OS X	for Mac OS X 10.6 and later	c58267cab06f6d291d332a2b163edd33	28060853	SIG
macOS 64-bit installer	Mac OS X	for OS X 10.9 and later	3ad13cc51c488182ed21a50050a38ba7	26954940	SIG
Windows help file	Windows		e01b52e24494611221b4a8669325b4123	8139973	SIG
Windows x86-64 embeddable zip file	Windows	for AMD64/EM64T/x64	7149ec14ed5dc13f42e06a14d627c921	7186734	SIG
Windows x86-64 executable installer	Windows	for AMD64/EM64T/x64	767db14ed07b145e24e10785f9d28e29	31930528	SIG
Windows x86-64 web-based installer	Windows	for AMD64/EM64T/x64	f308e4659721a0ef68e29cae09f6ed0f	1319992	SIG
Windows x86 embeddable zip file	Windows		b4c424de0650ad238c71359f3cd71ef2	6401894	SIG
Windows x86 executable installer	Windows		467161f1e894254096f9a69e2db3302c	30878752	SIG
Windows x86 web-based installer	Windows		a940f770b4bc617ab4a308ff1e27abd6	1293456	SIG

Installing Python for LabVIEW:

After downloading the above-specified version, use the following method for installation,



After the successful installation, the windows user might need to set the system path. To set the path, please use the following link,

- https://learn.microsoft.com/en-us/previous-versions/office/developer/sharepoint-2010/ee537574(v=office.14)#to-add-a-path-to-the-path-environment-variable.

1. Analysing the SNN models using RAVSim

In this section, you will learn how to analyze and visualize the SNN models in RAVSim.

1.1. Launching RAVSim

The front interface/welcome page of RAVSim, shown in Figure 1, will appear when you double-click on **RAV*Sim.app*** (for MAC OS) or **RAV*Sim.exe*** (for Windows OS).

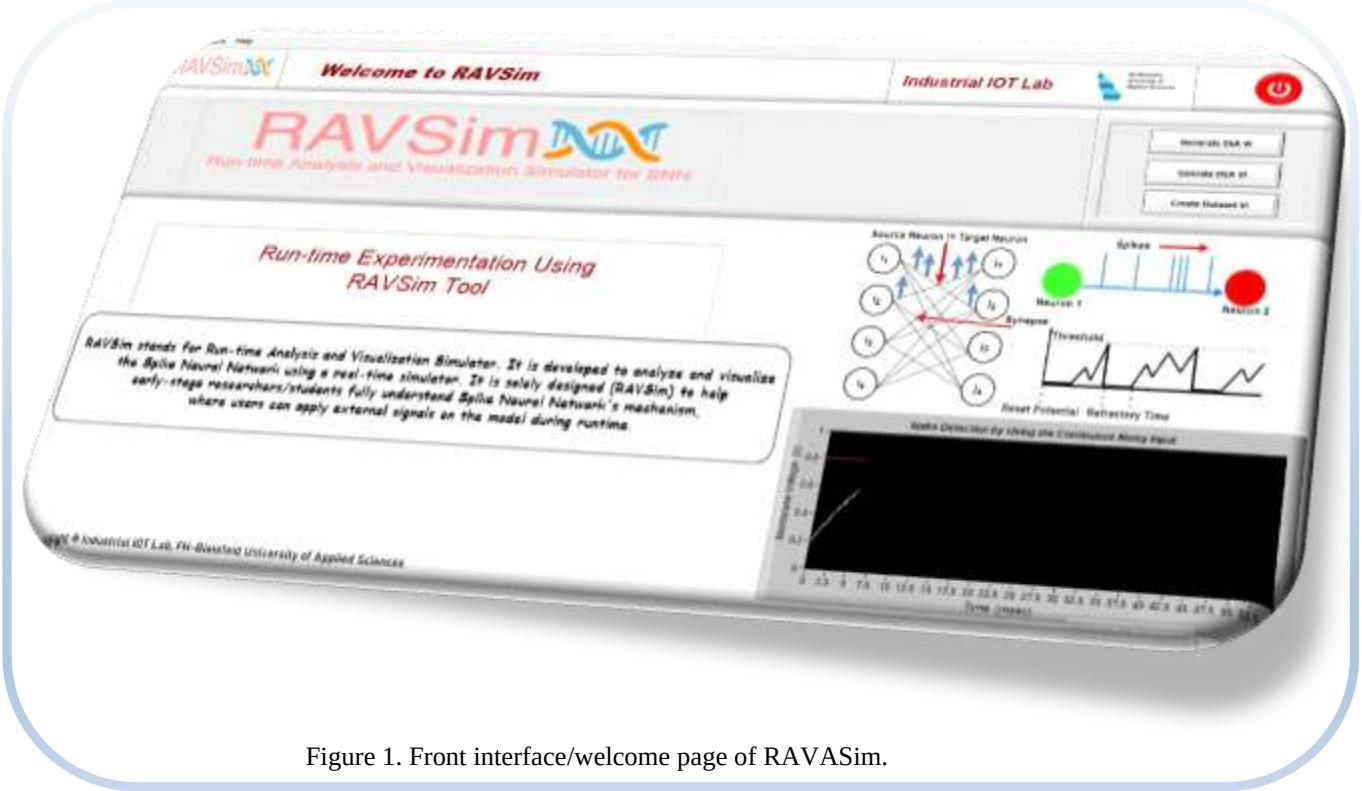


Figure 1. Front interface/welcome page of RAVASim.

On the bottom right side of the corner, the simulation is only for demonstration purposes by using the NLIF model. However, the same model is also used in the run-time simulation VI, where a user can analyze and visualize the model by increasing/decreasing the parameters, all during runtime.

1.2. RAVSim Menu Bar

A menu bar is **a graphical control element that contains drop-down menus**.

The menu bar's purpose is to supply a common housing for window- or application-specific menus which provide access to such functions as closing the RAVSim tool, interacting with a WTA network model manually, and looking at the default parametric values of the LIF model and image classification model simulation or displaying help or contact information.

Figure 2. Menu tab showing the drop-down listed features of a RAVSim tool.

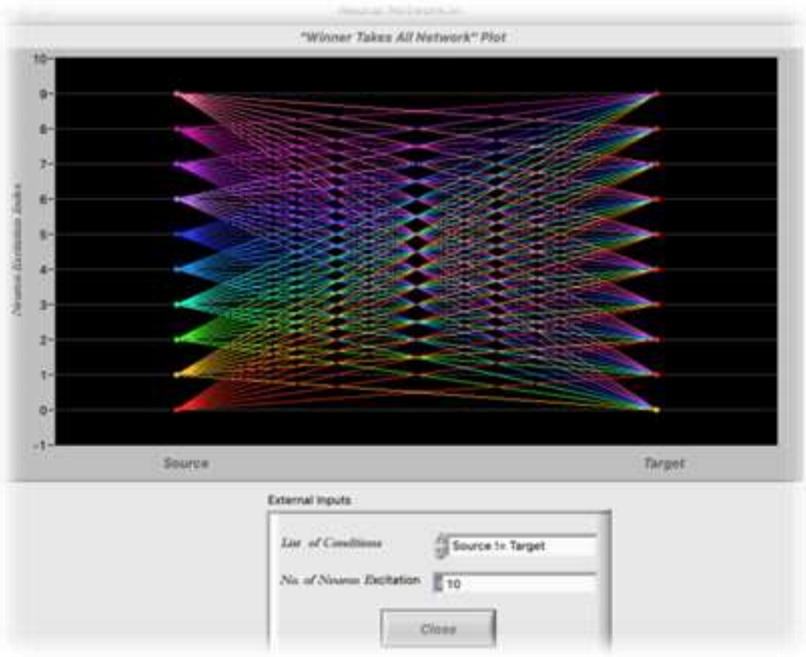


Figure 3. By using the drop-down menu, users can use a manually generated WTA network.

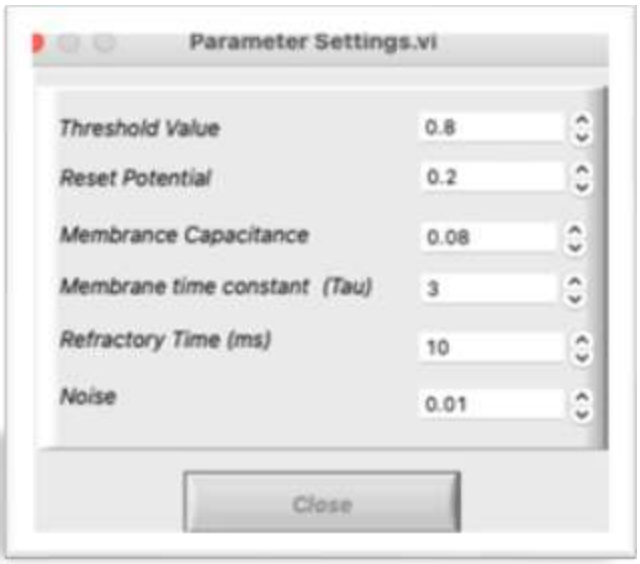


Figure 4. By using the drop-down menu,
users can see the default parametric values of a Runtime Interaction VI.

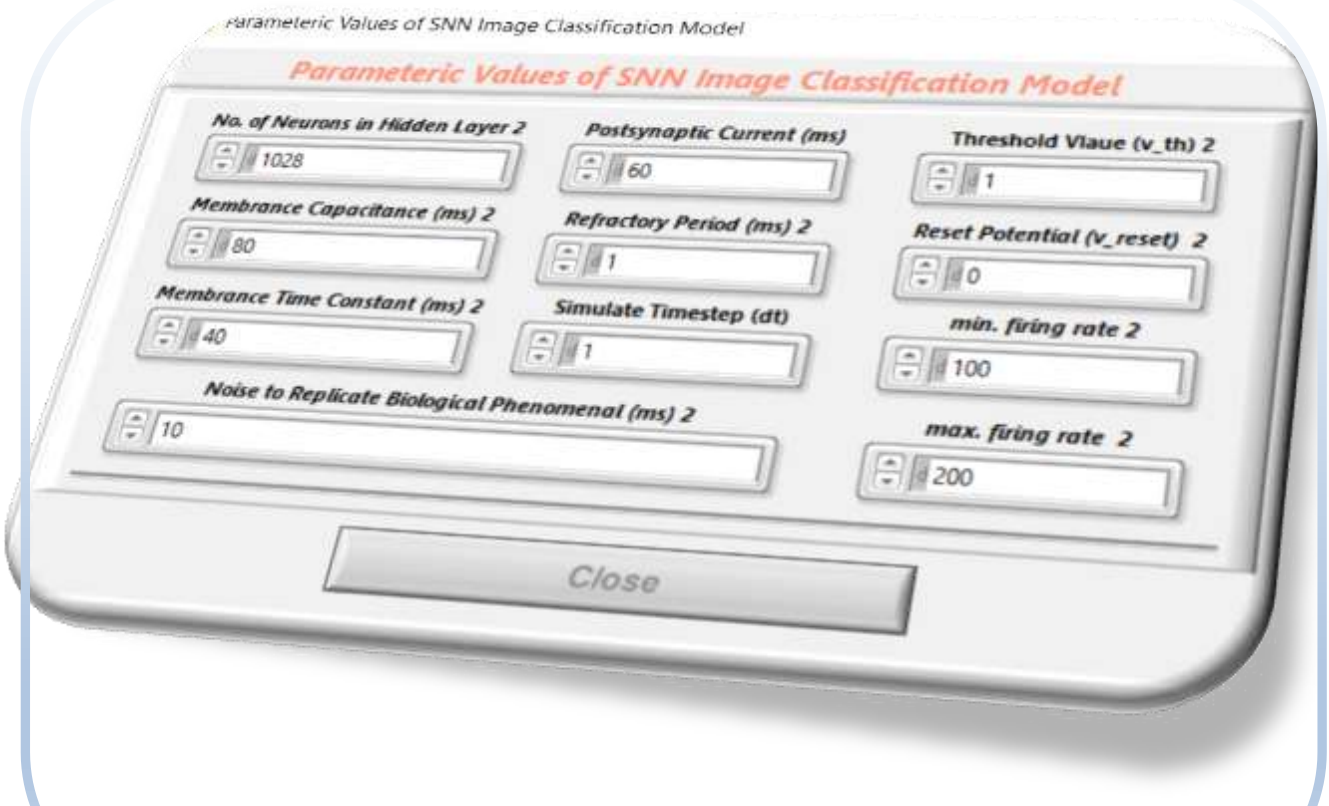


Figure 5. By using the drop-down menu,
users can see the default parametric values of an Image classification VI.

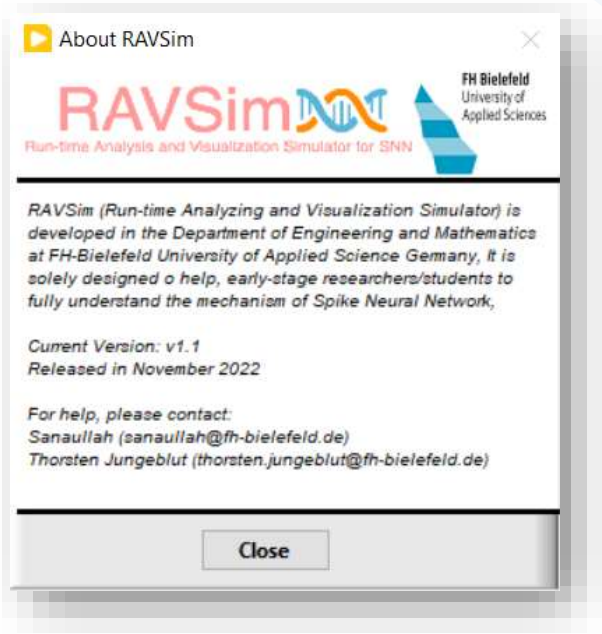


Figure 6. By using the drop-down menu from a **Help list**,
users can see the relevant information.

2. Generating a Run-time Interaction VI:

As soon as the “Generate SSA VI” button (This will bring up a virtual instrument shown in Figure 7) is clicked the user will enter the run-time simulation environment. And a “Run_Spikes.vi“ dialogue box will pop up, where the user can enter the desired values of the parameters for analyzing and visualizing the simulations. The users can enter these values immediately or they can go with the default values and can also change the values accordingly during the time of the simulation,

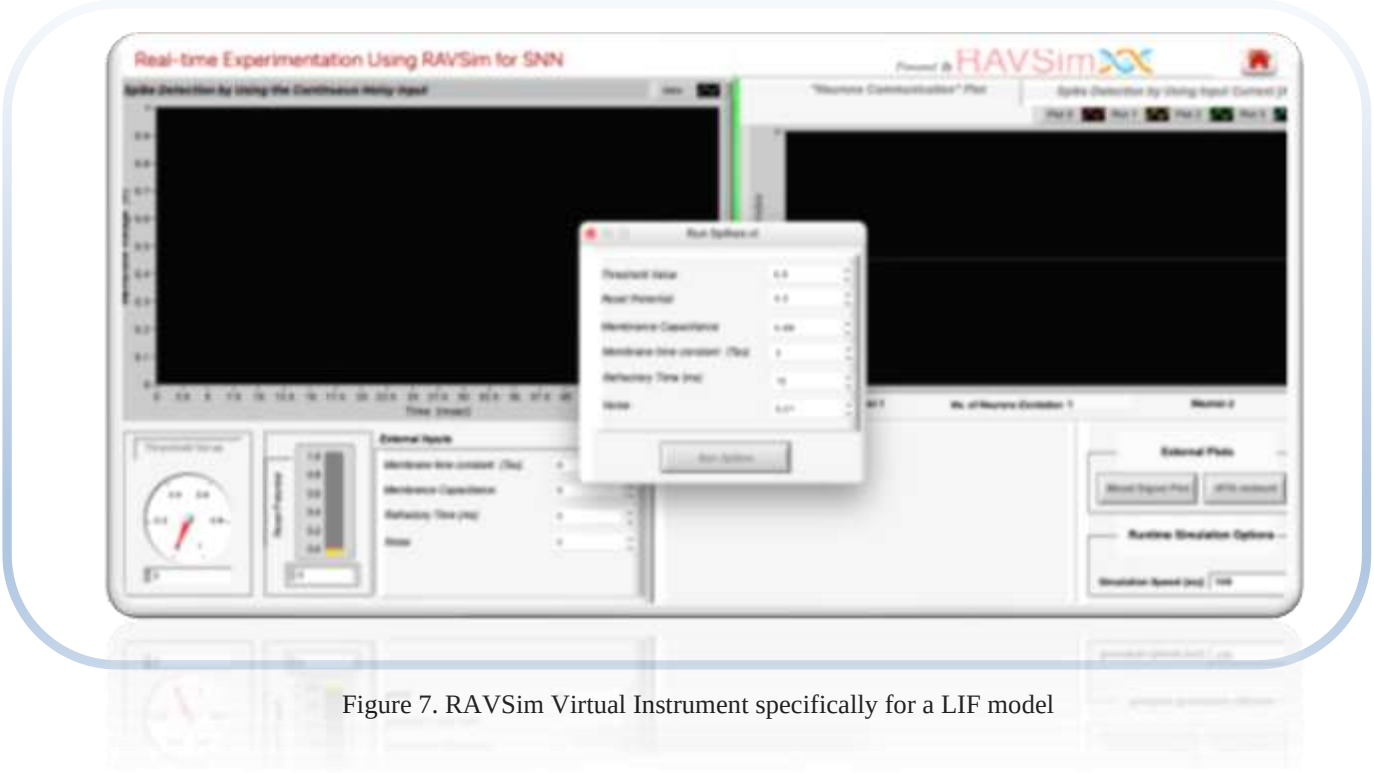


Figure 7. RAVSim Virtual Instrument specifically for a LIF model

2.1. Runtime Experimentation VI

Run-time experimentation of the RAV-Simulator provides a lot of flexibility for the user to interact with the SNN model at any point in time. Figure 7 shows the simulator's screen overview after hitting the “Run Spike” button.

Plots in Figure 8, visualize the spikes generated with the values which the user has inserted. And they can change the values of the parameters like the threshold, reset potential, etc during the run-time. The right plot, show the spike detection by using continuous noisy input and the left plot shows the users, how neurons are communicating with each other, and how many times one neuron is interacting with the other, also the right plot menu option 2nd, visualize the plot that shows the detection of spikes using the input current. Once the simulation is started, the user can increase or decrease the parametric values of a model by using the left bottom “external

Parameter Values" table and observing their effects on the SNN model during run time.

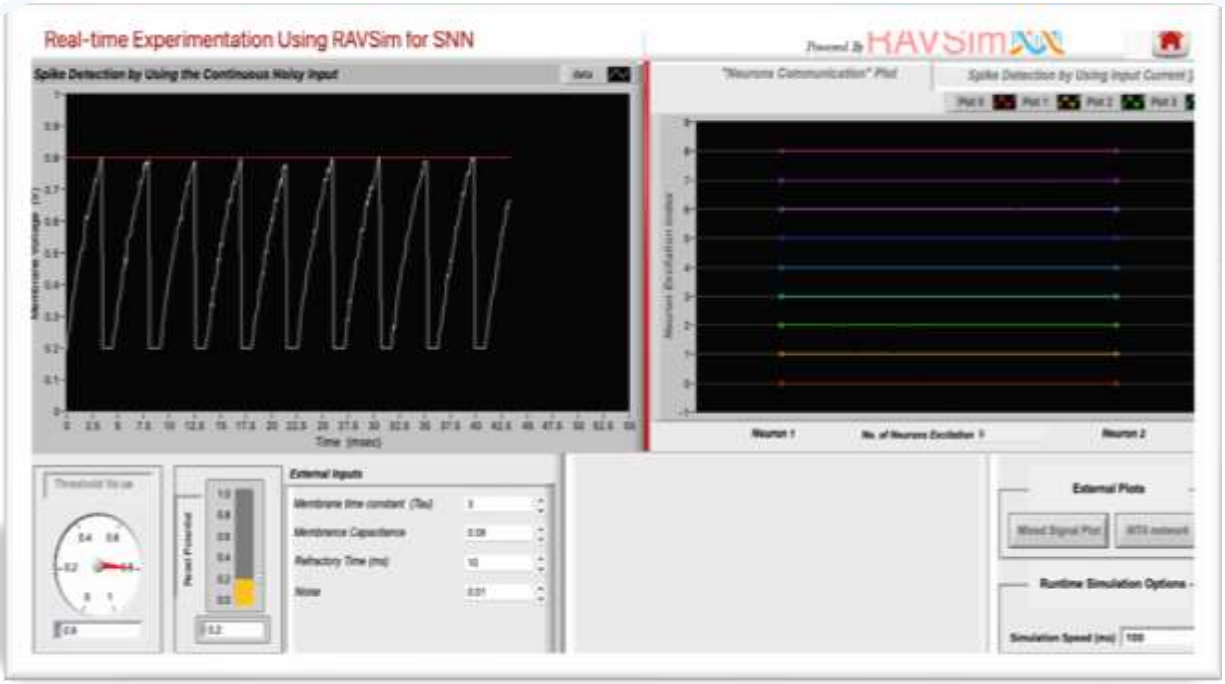


Figure 8. Run time Experimentation of RAV-Simulator for SNN

Figure 7 also shows the screenshot of the run-time simulation of a LIF by using continuous noisy input and neuron communication plot taken randomly. This figure shows that unlike NLIF events with default parametric values, users can interact with the model and change the concentration of model input to any level and at any instant of time. In case the concentrations of the input model are required to be triggered to threshold level instantly, the neuron communication plot displays the runtime graphically neuron excitation results.

3. Generating an Image Classification VI:

As soon as the "Generate DSA VI" button (This will bring up a virtual instrument shown in Figure 9) is clicked the user will enter the image classification simulation environment, where the user can enter the desired values of the parameters for analyzing and visualizing the image classification with using different datasets (RGB-based dataset only). Once the user hit the start analysis button, the green lights will turn red and the status will change in in-progress, which indicates to the user that the simulation is still in progress.

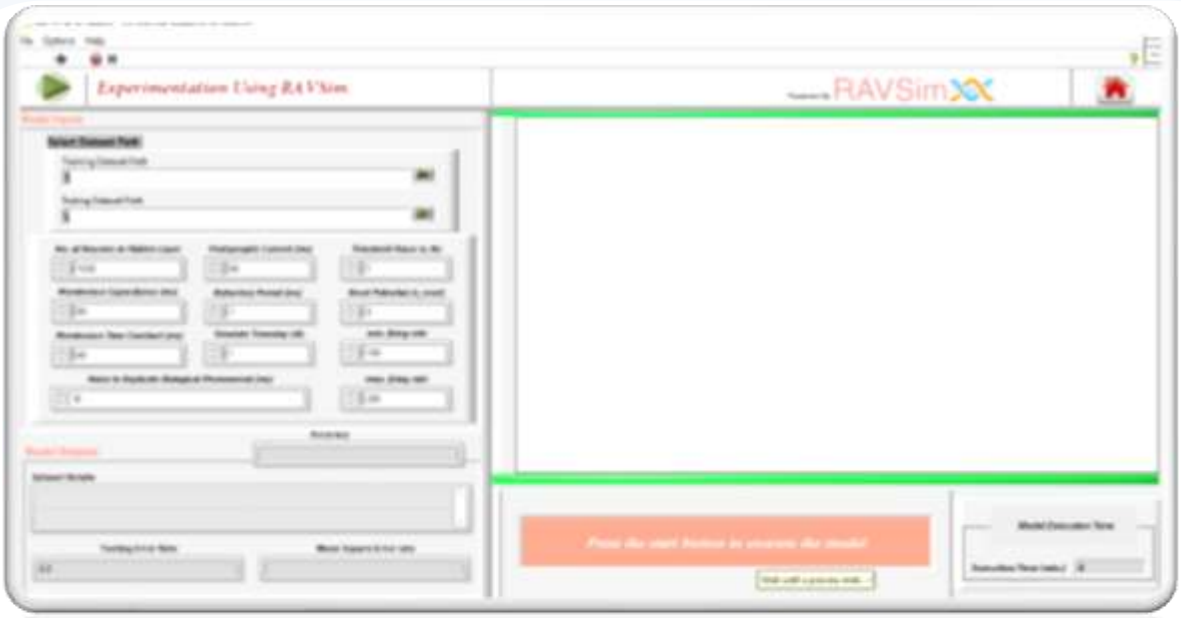


Figure 9. Image classification VI of RAVSim

Once the analysis is completed the following details will display to the user, Model accuracy using plot visualization, Dataset details, Testing error rate with MSE rate, and model execution time. The randomly generated results can be seen in Figure 10.

Figure 10. Image classification VI after analysis

Users can simulate the image classification model with any other dataset (only RGB images based), but the default parameter values can only be used for the specific dataset which is mentioned in the paper.

4. Create Dataset VI:

As soon as the “Create Dataset VI” button (This will bring up a virtual instrument shown in Figure 11) is clicked the user will enter the dataset creation VI, where the user can use any downloaded images for creating a scalable dataset with any extension, size, and quality of images.

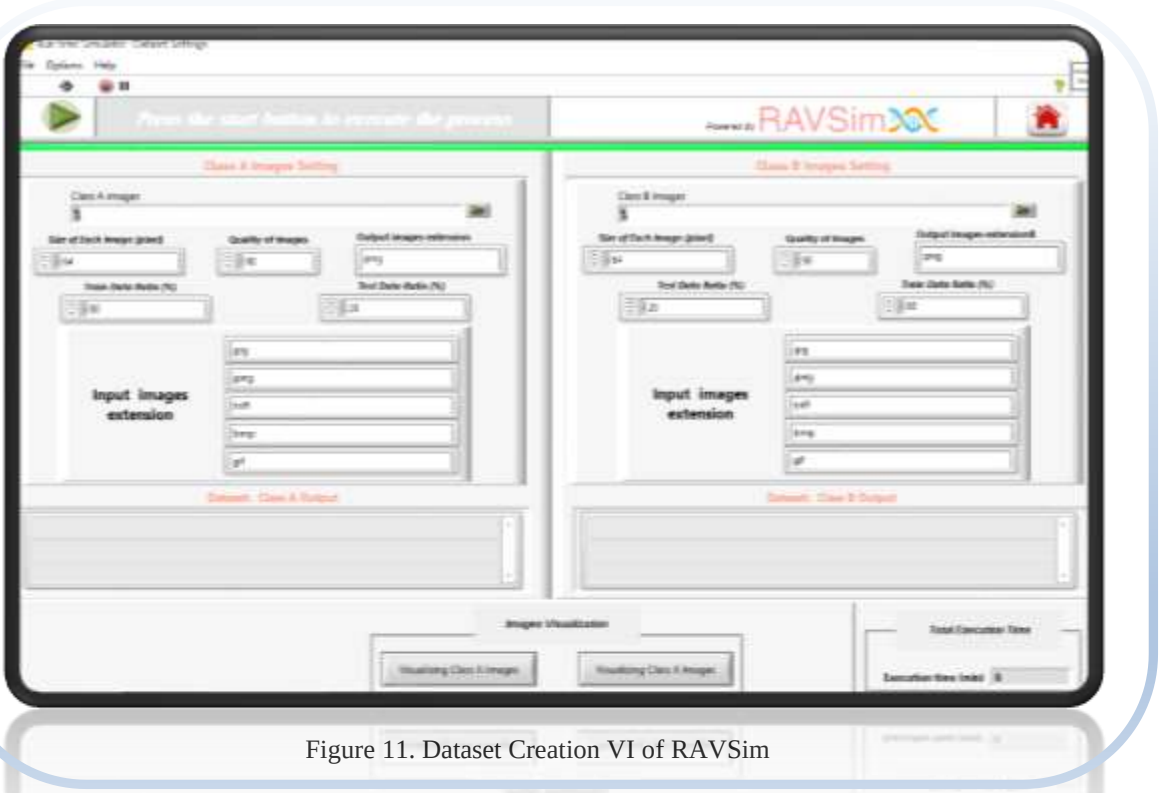


Figure 11. Dataset Creation VI of RAVSim

RAVSim also provides a feature where users can view the images before and after creating a dataset, just to be sure what the images look like, so they don’t need to go back and open one-by-one each image.

Figure 12. Image Visualization of Dataset Creation VI

5. Additional features in RAVSim

If a **STOP** button (icon located at the top right corner in Figure 7.) is pressed, "RAVSim VI" navigates the user back to the home screen.

In Figure 7, the bottom right we have provided the selection of the external plots, mixed-signal plots, and WTA network for the ease of the user and also change the runtime simulation values. With the mixed-signal plot, one can visualize the graphs of the input currents and the continuous signals values which are depicted in figure 8. It also allows the user to capture the graphs for documentation or reporting purposes which will be saved in the relative path of the simulator. In order to go back to the run-time environment, the user needs to click on the "Continue Simulation" button.

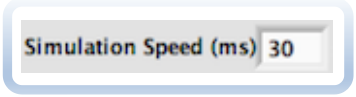
And for navigating to the network connectivity mechanism the user must click on the "WTA Network" in external plots and a window will pop up, where we can visualize the neuron communication graph. Two types of communication graphs can be analyzed at this moment with two different conditions. The first one is the source index equal to the target index and the second one is the source index of the neuron is not equal to the target index. We can select the required graph from the "list of conditions" dropdown. We also capture the graphs or we can continue back to the simulation.

Each screenshot is saved at the location, where "Documents/Screenshot/Screenshot_name".

Alert – When the **STOP** button is pressed, the user navigates to the home page and the stop button on the home page can be used to terminate the RAVSim tool immediately.

Tip – The functionality of graphical plots, including simulation colors, can be changed by using a left-click on the plot legend and selecting the desired drip-down option.

The runtime simulation option, available in RAVSim v1.1, is shown at the bottom right corner of a VI in Figure 7. The option is described below:



- **Simulation Speed**: This option allows the user to increase or decrease the simulation speed by entering the numerical values which are considered as milliseconds values.

Alert – Make sure the triggered threshold value is always greater than the membrane reset potential.

References

[1]. NI LabVIEW, https://www.ni.com/de-de/shop/labview.html.

[2]. Gardner, B., Gr¨uning, A.: Supervised learning in spiking neural networks for precise temporal encoding. PloS one 11(8), e0161335 (2016)

[3]. Morro, A., Canals, V., Oliver, A., Alomar, M.L., Gal´an-Prado, F., Ballester, P.J., Rossell´o, J.L.: A stochastic spiking neural network for virtual screening. IEEE transactions on neural networks and learning systems 29(4), 1371–1375 (2017)

[4]. Gr gory Dumont, Jacques Henry, and Carmen Oana Tarniceriu. Noisy threshold in neuronal models: connections with the noisy leaky integrate-and-fire model. Journal of mathematical biology, 73(6):1413–1436, 2016.