

Sandhi

Open Source Visual Programming Software

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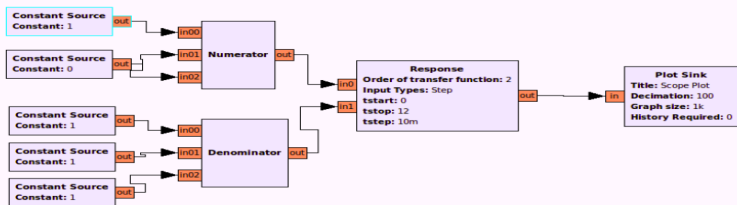
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Introduction

- Sandhi is a visual programming editor based on GNU Radio
- Basic data structure in sandhi is the flowgraph
- It has been named Sandhi as it means connecting and conveys our idea of connecting various blocks to come up with a robust visual program
- Sandhi is aimed to become a visual programming tool for replacing LabVIEW

Flowgraph

- Flowgraph represents the connections of the blocks through which a continuous stream of samples flows
- The concept of a flowgraph is an acyclic directional graph:
 - with one or more source blocks (to insert samples into the flowgraph)
 - one or more sink blocks (to terminate or export samples from the flowgraph) and
 - any functional blocks in between.



Motivation to develop Sandhi

- Lack of proper open source alternative to LabVIEW.
- Expensive proprietary software.
- Being FOSS, it gives you freedom to modify, share and sell your application without any permission.

Development of Sandhi

- GNU Radio
- sciscipy
- GRAS

- GNU Radio is a free and open-source software development toolkit that provides signal processing blocks to implement software radios.
- Supposed to be used by the Electrical Engineering community for the purpose of digital signal processing
- It has a rich module of implemented device drivers and thereby supports a range of devices

Why GNU Radio?

- GNURadio is a very promising visual programming tool as:
 - it make very easy for the developer to abstract his code
 - provides a very easy to use framework to the developer
 - it is open source

- Sciscipy is an Application Programming Interface
- Aimed for Inter Process Communication with scilab when in workspace of Python programming language

Sample Code:

```
from scilab import Scilab  
sci = Scilab()  
x = sci.rand(20, 20)  
y = x*x.transpose()  
y_inv = sci.inv(y)
```


- GRAS stands for GNU Radio Advanced Scheduler
- It was impossible to implement the feedback with GNU Radio, which uses stock application scheduler

Note: Application Scheduler is responsible for threading, controlling the data flow and managing the use of the computer resources like processor time to various processes.

Block in sandhi

- Blocks are the basic building component of flowgraph
- Blocks have the property written in C++ or Python

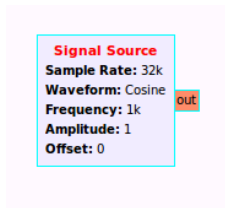


Figure 1 : Source

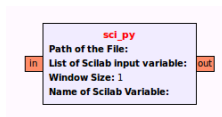


Figure 2 : Process

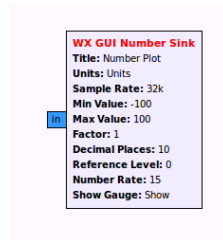
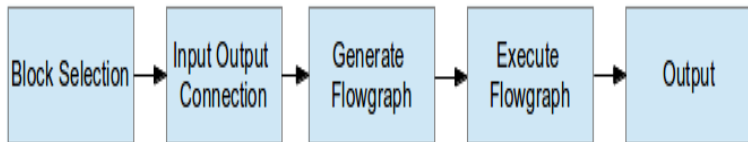


Figure 3 : Sink

How to create a block

- One can create a customized block with knowledge of C++ or Python
- Block developer have access to any library available in Python
- There are two files needed to create a block in sandhi:
 - Functionality written in C++ or Python
 - Properties written in xml file

Work Flow



- **Block:** A functional processing unit with inputs and outputs.
- **port:** A single input or output of a block.
- **Source:** A producer of data.
- **Sink:** A consumer of data.

Experiments on sandhi: Data Aquisition

- Single Board Heater System(SBHS) can controlled using sandhi
- Using Python serial library, one can set the fan,heat value to SBHS and receive temperature value from SBHS

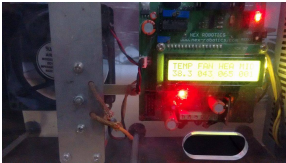


Figure 4 : SBHS setup

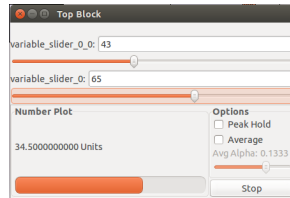


Figure 5 : Output Window with slider



Experiments on sandhi: step response of transfer function

- To perform step response the flowgraph is created as follows
- Flowgraph uses *Numerator*, *Denominator*, *Response* and *plot-sink* block
- These blocks has been written in Python and response of system is calculated in scilab using scipy in Response block

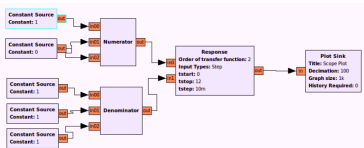


Figure 6 : Flowgraph

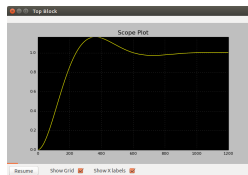


Figure 7 : Output Plot