Tutorial 3

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Demonstration on Scilab.

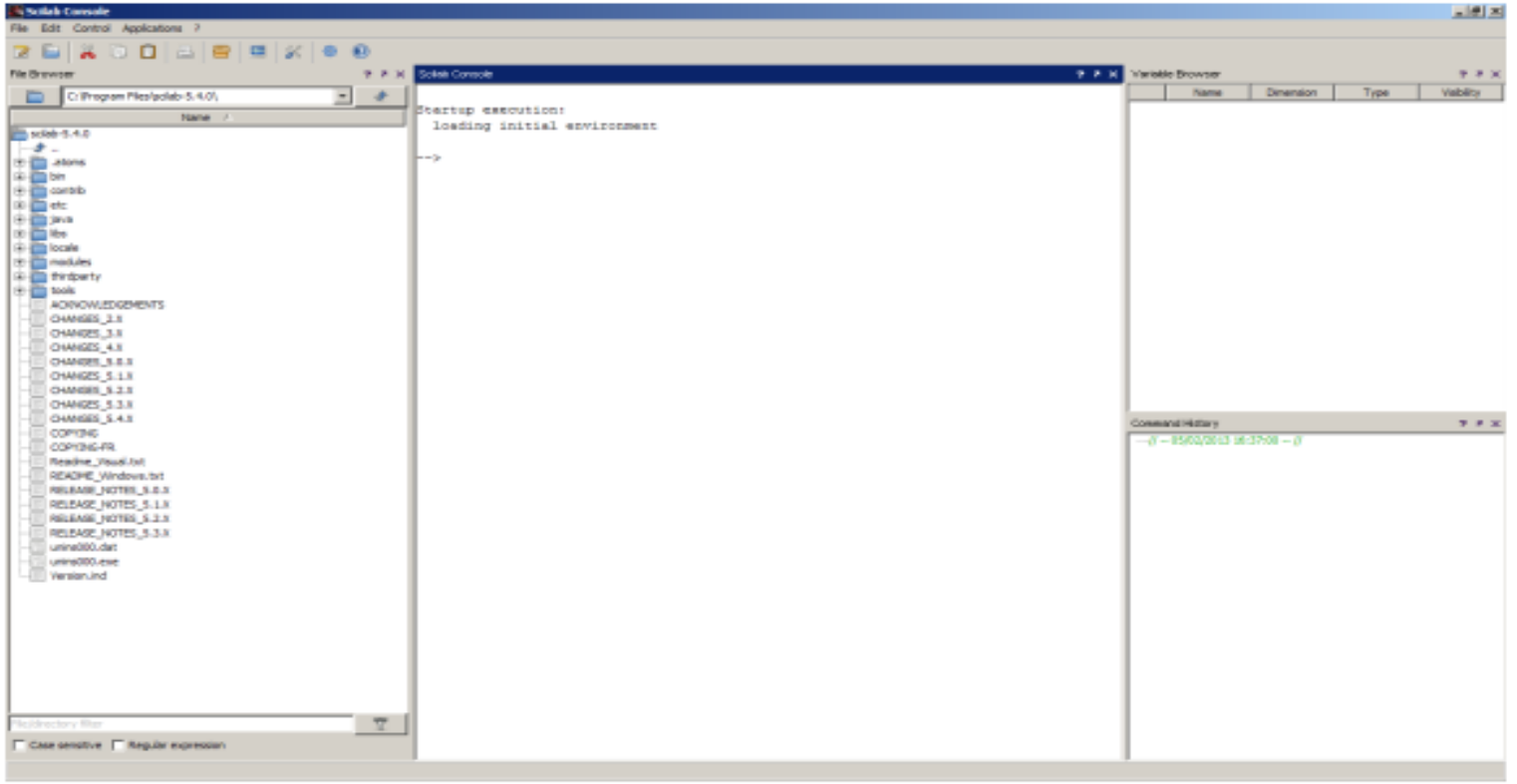
https://www.scilab.org/download/6.1.0

The useful workspace in Scilab consists of several windows:

- The console for making calculations,
- The editor for writing programs,
- The graphics windows for displaying graphics,
- The embedded help.

The general environment and the console

After double-clicking the icon to launch Scilab, Scilab environment by default consists of the following docked windows – console, files and variables browsers, command history (see “Windows management and workspace customization”, page 11):



In the console after the prompt " **-->** ", just type a command and press the Enter key (Windows and Linux) or Return key (Mac OS X) on the keyboard to obtain the corresponding result.

```
--> 57/4

 ans  =

    14.25

--> (2+9)^5

 ans  =

    161051.
```

Mention
Before the result, **ans** is displayed for "answer".

Operations are written with " **+** " for addition, " **−** " for subtraction, " ***** " for multiplication, " **/** " for division, " **^** " for exponents. For example:

```
-->2+3.4
 ans  =
    5.4
```

The case is sensitive. It is thus necessary to respect uppercase and lowercase for the calculations to be performed properly. For example, with **sqrt** command (which calculates the square root):

```
-->sqrt(9)
 ans  =
    3.
```

while:

```
-->SQRT(9)
          !--error 4
Undefined variable: SQRT
```

Particular numbers

%e and **%pi** represent respectively e and π:

```
--> %e
 %e  =
    2.7182818
```

```
--> %pi
 %pi  =
    3.1415927
```

```
--> exp(10)/factorial(10)

 ans  =

    0.0060699
```

What is the relationship between period and frequency?

Frequency and period are the inverse of each other.

$T = 1/f$

and

$f = 1/T$

What does the amplitude of a signal measure?

What does the frequency of a signal measure?

What does the phase of a signal measure?

- “ Frequency is rate of change with respect to time. Change in short span of time means Low Frequency & Change in a long span of time means High Frequency”

- Is the above statement true or not?

- THINK:
- Assume a case where there is no rate of change at all. i.e A signal maintains a constant voltage level the entire time it is active. What will be the frequency in this case.
- If a signal does not change at all, it never completes a cycle, so it’s frequency is Zero.
- Now what if the signal changes instantaneously, Then what will be it’s frequency

- Not True

- True:- Change in a short span of time means high frequency and change in a long time of span means low frequency.

The power we used by one of the application has a frequency of 32 KHz. The period for the same is----------.

T= 1/f

= 1/32*10^3

= 1/32000

=0.00003125 sec

= 31.25 microsecond

Table : Units of period and frequency

Unit	*Equivalent*	*Unit*	*Equivalent*
Seconds (s)	1 s	Hertz (Hz)	1 Hz
Milliseconds (ms)	10^{-3} s	Kilohertz (kHz)	10^{3} Hz
Microseconds (μs)	10^{-6} s	Megahertz (MHz)	10^{6} Hz
Nanoseconds (ns)	10^{-9} s	Gigahertz (GHz)	10^{9} Hz
Picoseconds (ps)	10^{-12} s	Terahertz (THz)	10^{12} Hz

A sine wave is offset 1/3 cycle with respect to time 0. What is its phase in degrees and radians?

= 1/3 *360

=120 degree

In Radian:

= 120*(2*3.142/360)

= 2.094 radian

The period of a signal is 100 ms. What is its frequency in kilohertz?

$$100\ \text{ms} = 100 \times 10^{-3}\ \text{s} = 10^{-1}\ \text{s}$$

$$f = \frac{1}{T} = \frac{1}{10^{-1}}\text{Hz} = 10\ \text{Hz} = 10 \times 10^{-3}\ \text{kHz} = 10^{-2}\ \text{kHz}$$

Represent 100 milliseconds in terms of seconds, microseconds, nanoseconds and pico-seconds.

Represent 14MHz in Hz, KHz, GHz, THz

Ans:

- 100 ms = 100 * 10^-3 s = 0.1 s
- 100 ms = 10^5 micro seconds

- 100ms = 10^8 nano seconds
- 100ms = 10^11 pico-seconds

- 14 MHz = 14 * 10^6 Hz
- 14MHz = 14 * 10^3 KHz
- 14 MHz = 14* 10^-3 GHz
- 14MHz = 14* 10^-6 THz

1. How can a composite signal be decomposed into its individual frequencies?

Using Fourier analysis. ***Fourier series*** gives the frequency domain of a periodic signal; ***Fourier analysis*** gives the frequency domain of a nonperiodic signal.

2. Name three types of transmission impairment.

Three types of transmission impairment are ***attenuation***, ***distortion***, and ***noise***.

3. Distinguish between baseband transmission and broadband transmission.

Baseband transmission means sending a digital or an analog signal without modulation using a low-pass channel. ***Broadband transmission*** means modulating a digital or an analog signal using a band-pass channel.

4. What does the Nyquist theorem have to do with communications?

The *Nyquist theorem* defines the maximum bit rate of a noiseless channel.

5. What does the Shannon capacity have to do with communications?

The ***Shannon capacity*** determines the theoretical maximum bit rate of a noisy channel.

6. Is the frequency domain plot of a voice signal discrete or continuous?

The frequency domain of a voice signal is normally *continuous* because voice is a *nonperiodic* signal.

7. We send a voice signal from a microphone to a recorder. Is this baseband or broadband transmission?

This is *baseband transmission* because no modulation is involved.

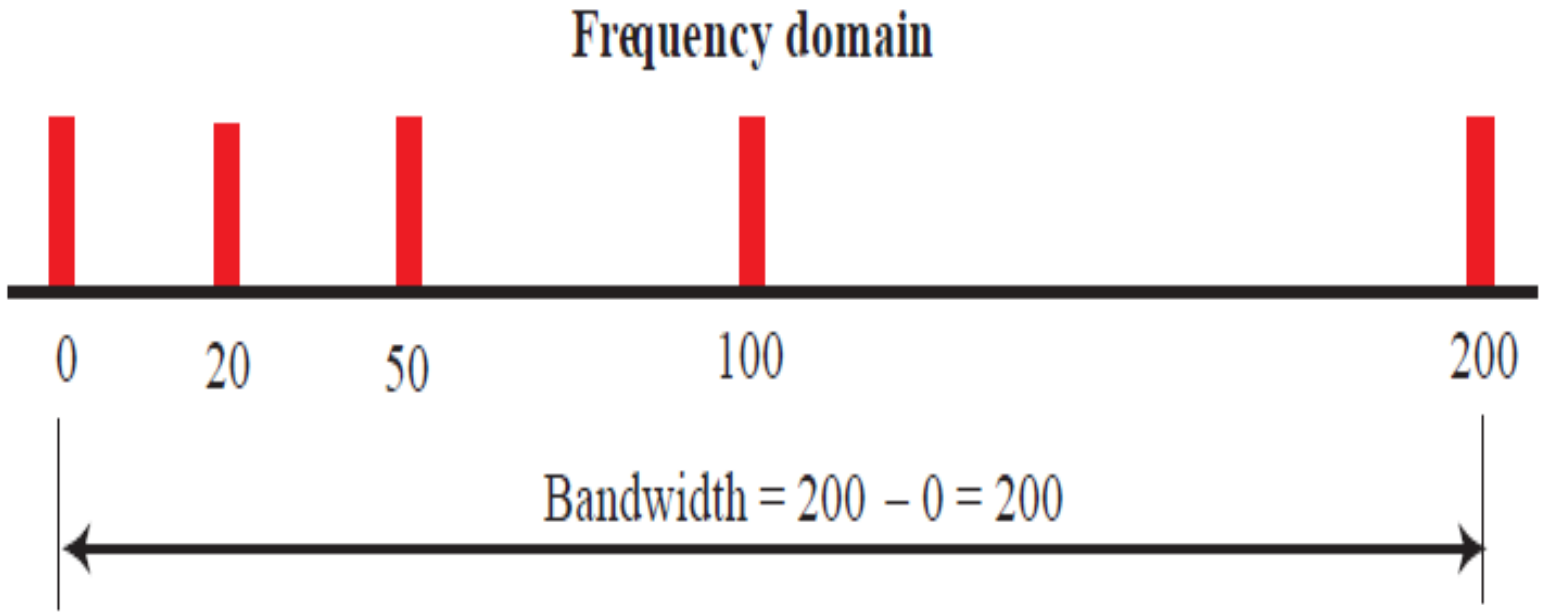
8. We send a digital signal from one station on a LAN to another station. Is this baseband or broadband transmission?

This is *baseband transmission* because no modulation is involved.

9. We modulate several voice signals and send them through the air. Is this baseband or broadband transmission?

This is ***broadband transmission*** because it involves modulation.

What is the bandwidth of a signal that can be decomposed into five sine waves with frequencies at 0, 20, 50, 100, and 200 Hz? All peak amplitudes are the same. Draw the spectrum.


Frequency domain
0
20
50
100
200
Bandwidth = 200 – 0 = 200

1. Introduction to Scilab Tool.

Objective: Getting acquaintance with Scilab environment. (basic commands and functions)

2. Hands on practice of signals and their properties in Scilab: Amplitude, Phase, Frequency, Composite Signals, Frequency Spectrum. Objective: Understanding properties of signal

Thank you!!!
End of the Tutorial 3