

Installation Guide for



**L_SU,
a graphical user interface
for Seismic Unix (John Stockwell)**

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1 Installation Background and Prerequisites

1.1 Tested operating systems

All the installation steps have been tested on new, blank systems and have worked without any errors and are the recommended simplest paths to installing the software.

Particular users have their own specialized software installations and we would like to hear from you if you have any difficulties with the installation (gllore@lsu.edu Subject: L_SU)

We have used the following instructions to install L_SU under several different operating systems -- sometimes with a little apprehension-- but without any ensuing difficulties.

Linux operating system	Version tested
CentOS	7.7.2003. *.2.2004 and 8
Debian	10 (buster)
Ubuntu	18.04.3 and 20.x
RedHat	6.9
Cygwin/Microsoft Windows	10 with cygwin-3.1.7

Across all OS's, most installation problems occur when either (1) the environment variables are not properly set and (2) when the necessary Perl CPAN modules do not load correctly. The following installation guide may seem extensive because we try to include several of the available operating systems.

One issue you may note is that 'end-of-line termination indicators' differ between Linux systems and Windows. These codes are invisible to the user when editing, but cause errors. If you see errors like that contain confusing messages which include "\r" then you have encountered the issue. A solution is to open the text file in an editor. **Notepad++**, or **vim**, are two examples of text editors that can change the codes for you. In Notepad++ there is a menu option to perform the change using a mouse click or two. In **vim** manually set the file format to "unix: with the following command:

```
:set ff=unix
```

Special NOTE: Do not simply cut and paste from this document into your linux environment without paying special attention that you do not introduce invisible character (e.g., spaces) which will generate execution errors.

1.2 Definition of system variables in your computer work environment

In order for Perl to find all the programs that it needs at run time, it will look in pre-defined areas of your hard drive. These pre-defined directories, whether known to the user or not, exist in all or most operating systems. Your system manager usually adds special file locations as needed. Local users can even override the special file locations although that is not a safe practice.

Note for example, that **CWPROOT** is a directory path where the C programs that belong to Seismic Unix are usually installed. In the next Linux example, this path = `"/usr/local/pl/cwp_su_all_44R22"`

If you do not have permission to change your local `".bashrc"` file then ask your systems manager to make some arrangement that will allow your local `".bashrc"` file to pointing to a system-wide file that only the administrator control, in which case you can add the following line to your local `".bashrc"` file:

```
source /PATH/bashrc_system
```

But, you will need to know what 'PATH' is and what 'bashrc_system' means. If this sounds confusing, see your administrator or write to me at gllore@lsu.edu.

1.2.1 Linux

For my linux example, I usually place Perl programs under `"/usr/local/pl"`. Then, in order for all the Perl scripts and other programs to run, I have to add several new lines of instructions within my file `".bashrc"` file, which is located in my home directory:

```
# for L_SU
# for general perl directories
export LOCAL=/usr/local
export PL=$LOCAL/pl

# Also for L_SU
export L_SU=$PL/L_SU
export PERL5LIB=PERL5LIB:$L_SU/configs
export PERL5LIB=$PERL5LIB:$L_SU/specs
export PERL5LIB=$PERL5LIB:$L_SU/sunix

for category in big_streams data datum plot filter header \
    inversion migration model \
    NMO_Vel_Stk par picks shapeNcut shell statsMath transform \
    well
do
    export PERL5LIB=$PERL5LIB:$L_SU/configs/$category
    export PERL5LIB=$PERL5LIB:$L_SU/specs/$category
```

```
done

for category in data datum plot filter header \
    inversion migration model \
    NMO_Vel_Stk par picks shapeNcut shell statsMath transform \
    well
do
    export PERL5LIB=$PERL5LIB:$L_SU/sunix/$category
done

export PERL5LIB=$PERL5LIB:$L_SU/gmt:$L_SU/R:$L_SU/big_streams:$L_SU/messages
export PERL5LIB=$PERL5LIB:$L_SU/misc
export PERL5LIB=$PERL5LIB:$L_SU/reqs:$L_SU/specs:$L_SU/sqlite:$L_SU/streams:$L_SU/geo-
psy:$L_SU/images

# NOTICE: Because there are executable L_SU-related Perl scripts, PATH must be already defined
# within your .bashrc file
# and located somewhere above the current lines, i.e. above the first "for L_SU"
export PATH=$PATH:$L_SU
export PATH=$PATH:$L_SU/big_streams

# for executable L_SU-related compiled and linked programs
export PATH=$PATH:$L_SU/fortran/bin
export PATH=$PATH:$L_SU/c/bin

# for Seismic Unix
export CWPROOT=$LOCAL/cwp_su_all_44R22

# for pgplot
export PGPLOT_DIR=$LOCAL/pgplot
# default display device for pgplot
export PGPLOT_DEV=/XWINDOW
```

1.3 Operating system software required by Seismic Unix and L_SU

In order to install **Seismic Unix** properly you will need to make sure the following libraries and standalone programs are installed.

All OS's will need:

- *evince*
- *ncftp*

1.3.1 Ubuntu

Some users experience problems when installing Tk modules in L_SU or Xmotif modules in Seismic Unix. Often this occurs because of missing libraries. For example, some missing libraries such as the following can be installed manually with the following command:

```
% sudo apt update
% sudo apt install nftp (e.g., 3.2.5-2.1)
% sudo apt-get install dpkg-dev
% sudo apt-get install libx11-dev libfreetype6-dev libxft-dev libmotif-dev
% sudo apt-get install aptitude libpng-dev libz-dev libjpeg-dev
% sudo apt-get install evince (automatically shipped with ubuntu)
% sudo apt install gfortran (e.g., 4:9.3.0-1ubuntu2)
% sudo apt install libxext-dev (e.g., 2:1.3.4-0ubuntu1)
% sudo apt install git
```

1.4 Perl modules required by L_SU

Before any further installation steps you first must have installed the Perl language on your linux box. Most linux-type systems come automatically with the Perl language. You can check to see if you have Perl installed and its version at the same time, by entering the following command:

```
% perl -v
```

1.4.1 Linux

If you install Perl as a regular user the process will create “**perl5**”, as a sub-directory in your home directory. You will have to accept these modifications. You do not need to do anything.

But, as a result, you will find several lines of code installed also automatically inside your local `“.bashrc”` file.

I recommend that all software be installed with superuser permissions (**sudo**).

1.4.2 Loading cpan

For all types of operating systems, we recommend that the easiest way to install public Perl modules is to use **cpan**. First of all, **cpan**, a utility that is written in Perl. You will have to have root privileges, at least temporarily when you install **cpan** and the following modules. Later you will be able to use them in L_SU as a regular user. (**cpan** can be downloaded from <https://www.cpan.org/>)

If you are working under **Ubuntu**, install **cpan** as follows:

```
% sudo apt-get upgrade
% sudo cpan -v
```

(Hint: choose to configure **cpan** automatically)

1.4.3 How to load required Perl modules from the CPAN

For the general case of any operating system, you will use **cpan** to install some or all of the following required Perl modules:

- ***MIME::Base64***
- ***Shell***
- ***Tk***
- ***Tk::JFileDialog***
- ***Clone***
- ***Tk::Pod***
- ***Moose***

The following packages below have been tested under the following operating systems

Perl module name in cpan format	Ubuntu (20.04.3)	Debian 9.9	Versions tested under CentOS7x	cygwin
MIME::Base64	3.16			3.15
Perl	5.26.1	5.24.1	5.16.3	5.26.3
Shell	0.73.1	0.73	0.73	0.73
Tk::JFileDialog	2.20?	1.62	2.2	2.20
Tk or PerlTk	804.036	804.033	804.034	804.034
Tk::Pod	5.41	5.41	5.41	5.41
Moose	2.2015	2.187	2.2010	2.2012
Clone	0.45	0.38	0.39	0.43
Refresh	0.17			
PDL::Core	2-0.61			

For each of the above packages use the following commands to install each of them.

1.4.3.1 Ubuntu

To help during **cpan** installations:

```
% sudo cpan Log::Log4perl
```

Then, continue to install the following:

```
% sudo cpan Tk (e.g., V804.036 installed)
% sudo cpan MIME::Base64 (e.g., V3.16 installed)
% sudo cpan Config::Simple (e.g., V4.58 installed )
% sudo cpan Shell (e.g., V0.73 installed)
% sudo cpan Clone (e.g., V0.45 installed)
% sudo cpan Tk::JFileDialog (e.g., V2.20 installed)
% sudo cpan Tk::Pod (e.g., V2.9943 installed)
% sudo cpan Moose (e.g., V2.2015 installed)
% sudo cpan Module::Refresh (e.g., V0.017 installed)
% sudo cpan PDL::Core (e.g., V2-0.61 installed )
```

To install **evince**, which is a viewer for postscript files and often already present in your system:

```
% sudo apt-get install evince (automatically forms part of OS)
```

To help when building Perl modules, install the following:

```
% sudo cpan Module::Build (e.g., V0.4231 installed)
% sudo cpan TAP:Harness (e.g., V3.42 installed)
```

cpan will find dependencies for the above packages and install them as well, so you may see a lot of additional packages installed during the process.

1.4.3.2 Cygwin/

2 Installation of L_SU from github

Most of the L_SU scripts, are written in Perl, available at: www.github.com/gllore and can be installed anywhere on your machine, as long as you prescribe their location to the operating system (See 1.3.4).

In order to download these files from the github site you can run the following shell script. You must have administrator privileges. The following example script will place the L_SU package within the “pl directory” that has the path: “/usr/local/pl”. The script below is saved as a file with any name you choose, e.g., “clone.sh”. You can create this file inside your home directory. Then to activate the instructions on the command line enter the following:

```
% bash clone.sh
```

2.1 Linux

The contents of the file “clone.sh” are as follows:

```
#!/bin/bash
# my name is clone.sh

# give a name to directory
installation_directory_for_L_SU=/usr/local/pl/

# create installation directory
mkdir $installation_directory_for_L_SU

# change into the installation directory
cd $installation_directory_for_L_SU

# clone the directory from the remote site on to your computer
git clone https://github.com/gllore/L_SU.git

# git status
git status
```

3 Fortran modules in L_SU

There are Tools in L_SU that communicate with programs written in Fortran (e.g., immodpg). These L_SU modules (e.g., for raytracing reflections and refracted arrivals) are written in Fortran and some as well, use fortran plotting libraries for interactive forward modeling.

You will first need to install the graphic libraries (PGPLOT)

*Instructions that follow are work with Ubuntu, but many of the following steps are very similar in other operating systems but you have to have the correct paths identified from when you installed Seismic Unix previously.

3.1 pgplot (*Ubuntu)

The principal plotting library is “**pgplot**”, which has to be downloaded and compiled separately.

Extensive instructions on the use and installation of pgplot are available from <https://www.astro.caltech.edu/~tjp/pgplot/>.

In brief:

- Download the library, as follows, from a remote web directory to your local home directory:

```
% ncftpget ftp://astro.caltech.edu/pub/pgplot/pgplot5.2.tar.gz
```

- Decompress the downloaded file: pgplot5.2.tar.gz, and place the reconstituted directories and files it contains within a general directory: “**/usr/local/src/pgplot**”, i.e.:

```
% mkdir /usr/local/src  
% tar -xvzf pgplot5.2.tar.gz  
% mv pgplot /usr/local/src/
```

- Prepare and compile code (A good explanation is available at https://www.gnu.org/software/gnuastro/manual/html_node/PGPLOT.html#FOOT220)

```
% cd /usr/local/src/pgplot  
$ gedit drivers.list
```

Remove the “!” for the following lines, save and close the file:

```
XWDRIV 1 /XWINDOW  
XWDRIV 2 /XSERVE
```

Specify the type of fortran compiler to use by opening the following file:
/usr/local/src/pgplot/sys_linux/g77_gcc.conf file:

```
% gedit /usr/local/src/pgplot/sys_linux/g77_gcc.conf
```

Change the following lines from:

```
FCOMPL="g77"
```

to

```
FCOMPL="gfortran",
```

and from :

```
XINCL="-I/usr/X11R6/include"
```

to

```
XINCL="-I/usr/include/X11"
```

and from:

```
LIBS="-L/usr/X11R6/lib -lX11"
```

to:

```
LIBS="-L/usr/lib -lX11"
```

and save it. This is a very important step during the compilation of the code.

Create a folder within **"/usr/local"** and copy the modified **"drivers.list"** to the new folder.

```
% mkdir /usr/local/pgplot
```

(Remember that your directory address for unpacking files is at location: **/usr/local/src/pgplot** but that the final address where you will install pgplot is at: **/usr/local/pgplot**)

```
% cd /usr/local/pgplot
```

```
% cp /usr/local/src/pgplot/drivers.list ./
```

Type the following command:

```
% /usr/local/src/pgplot/makemake /usr/local/src/pgplot linux g77_gcc
```

to make the **"Makefile"**, but make sure you are still in the directory (**"/usr/local/pgplot"**).

If all goes well, you should see: **"Determining object file dependencies"**.

Stay in the same directory (**"/usr/local/pgplot"**) and finish up by running the following these three commands in order:

```
% make libpgplot.a
```

```
% make grfont.dat
```

```
% make pgxwin_server
```

```
% make prog
```

```
% make clean
```

You are now ready to try out the demonstrations. Go to **/usr/local/pgplot**:

```
% cd /usr/local/pgplot
```

Once you are in the directory, run the following program and you will see what pgplot can do:

```
% pgdemo1
```

Modify your **.bashrc** file to include necessary variable definitions (Section **1.2.1** for Linux and Error! Reference source not found. for Windows)

That is, add the following line(s) to your **.bashrc** file

```
export PGPLOT_DIR=/usr/local/pgplot
```

3.2 mmodpg (*Ubuntu)

For interactive, forward modeling of the arrival times of refraction and reflections we use **mmodpg** (Vera, 1994). Go the directory where you installed L_SU and inside the directory called **“fortran”** run an installation script called **“run_me_only.sh”**. The following examples should work across several operating systems:

You can compile the fortran programs in the fortran directory:

```
% cd /usr/local/pl/L_SU/fortran
```

The instruction for compiling and linking the programs is:

```
% sh run_me_only.sh
```

3.3 SioSEIS

From the SIOSEIS Website: " SIOSEIS is a software package for enhancing and manipulating marine seismic reflection and refraction data, sponsored by the National Science Foundation (NSF) and the Scripps Industrial Associates. The system currently runs on Mac OSX (PowerPC and Intel) and PCs (Linux and CYGWIN) E-mail phenkart@gmail.com for inquires. Open source can be downloaded from "<http://sioseis.ucsd.edu/index.html>"

I recommend you read the documentation at this website for many details on this valuable software.

L_SU integrates some of the functionality of SIOSEIS in order to convert data written in a SEG2 format into SU formatted data.

You can use your browser to navigate to that website and download the file or you can directly load it into your folder by the following command:

3.3.1 Linux (general)

```
% wget http://sioseis.ucsd.edu/src/sioseis-2016.3.1.tar.bz2
```

After you untar and decompact this software read the README file to learn how to install the programs while using root privileges. Later, when L_SU looks for Sioseis you should have the path to the binary defined.

In order to decompact use bunzip as follows:

```
% bunzip sioseis-2016.3.1.tar.bz2
```

Then, you can untar the directory

```
% tar -xvf sioseis-2016.3.1.tar
```

After you compile the programs, move the directory and all of its contents to your preferred system location:

```
% mv sioseis-2016.3.1 /usr/local/sioseis
```

Note that since gfortran10 you must include the following line together with the other FFLAGS in the “**makefile**”.

FFLAGS += w -fallow-argument-mismatch -O2

Use of this additional switch during compilation will prevent errors.

3.3.1.1 System environmental variables

If you use the common bash shell, the file “**.bashrc**” should contain the following command when **SIOSEIS** is installed within the directory “**/usr/local/sioseis**”:

```
export $PATH=$PATH:/usr/local/sioseis
```

Commonly, your “**.bashrc**” file can contain other general definitions to achieve an identical result, for example:

```
export LOCAL=/usr/local
export SIOSEIS=$LOCAL/sioseis
export $PATH=$PATH:$SIOSEIS
```

If these environment variables are already defined in your **.bashrc** script, do not define them again, as you may possibly hinder your ability to work with the operating system.

3.3.1.2 System environmental variables

If you use the common bash shell, the file “**.bashrc**” should contain the following command when **SIOSEIS** is installed within the directory “**/usr/local/sioseis**”:

```
export $PATH=$PATH:/usr/local/sioseis
```

Commonly, your “**.bashrc**” file can contain other general definitions to achieve an identical result, for example:

```
export LOCAL=/usr/local
export SIOSEIS=$LOCAL/sioseis
export $PATH=$PATH:$SIOSEIS
```

3.4 C-based modules in L_SU (linux)

3.4.1 Synseis

For simple interactive, normal-incidence synthetic seismogram modeling we use Synseis (under “**Tools**” tab). If you want to be able to use this tool proceed as follows:

- Go to the directory where you installed L_SU and once inside move into the directory called “c/synseis” run an installation script called “run_me_only.sh”. The following examples should work across several operating systems:

You can compile synseis in the c directory:

```
% cd /usr/local/pl/L_SU/c/syneis
```

The instruction for compiling and linking the programs is:

```
% sh run_me_only.sh
```

4 Seismic Unix installation

At present, for the latest versions of Seismic Unix, we recommend that you download Seismic Unix and install the program as per <https://wiki.seismic-unix.org/doku.php>

But, if you prefer there is also a version that you can download from the github.

4.1 Clone for ubuntu 20.x

Download version 44R22 of Seismic Unix from the following site:

<https://wiki.seismic-unix.org/doku.php>

Once you have downloaded and untarred and unzipped the “/src” directory into your local directory you can carry out the following instructions in individually or as a set of instructions in a file called, for example, “**copy.sh**”

```
>sudo sh copy.sh
```

```
#!/bin/bash
```

```
# this file is called copy.sh
```

```
# give a name to directory
```

```
installation_directory_for_SU= /usr/local/cwp_su_all_44R22
```

```
# create installation directory
```

```
mkdir $installation_directory_for_SU
```

```
# change into the installation directory
```

```
cd $installation_directory_for_SU
```

```
# copy from your local directory into the new directory
cp -r /your/local/directory/src .
# ... and position yourself one directory above:
cd ..

# change permissions and ownership
chmod -r your_login_name $installation_directory_for_SU
chown -r your_login_name $installation_directory_for_SU

# create a directory where your executable binary files ("bin") will be stored
mkdir bin
```

(We strongly recommend that you change the permissions and ownership of the directory that will contain the Seismic Unix files to a local user, such as yourself.)

4.1.1 Preparation of Makefile.config

Determine the location of your "**lib**"(aries) and "**include**" directories. For example, you can find these by issuing the following commands:

```
%sudo updatedb
%locate include/X11 | more
```

Please follow the instructions in all the "**Installation_Instructions**" files. Before you carry out the installation, make the following changes to the file:

"/usr/local/cwp_su_all_44R22/src/Makefile.config".

```
IX11 = /usr/include/X11
LX11 = /usr/lib/x86_64-linux-gnu
IMOTIF = /usr/include/X11
LMOTIF = /usr/lib/x86_64-linux-gnu
OPTC = -g -std=c99 -Wall -pedantic -Wno-long-long
FC = gfortran
FOPTS = -g
FFLAGS = $(FOPTS) -ffixed-line-length-none
```

(In the case above the installation is for a 64-bit operating system.)

4.1.1.1 Compilation and Installation

As per the explanation of the "Installation_Instructions", stay in the following directory:

"/usr/local/cwp_su_all_44R22/src" and run the following commands one at a time:

```
%make install
```

```
%make xtinstall
```

Beyond this point additional installations are not essential. Should you choose to continue, note that errors during installation of some of the fortran libraries can be overcome by manually deleting the pre-existing library: *"*.a"* and re-running:

```
%make finstall (non-essential)
```

```
%make xminstall (non-essential)
```

4.2 Clone for ubuntu 20.x

As well, a version of Seismic Unix (R19) is available at: <https://github.com/JohnWStockwellJr/SeisUnix> and can be installed anywhere on your machine, as long as you prescribe their location to the operating system (See 1.2).

If you are familiar with the program **git** (must be installed on your OS), the following is an example of my installation procedure, contained within a shell-script file. This file can be called what you please, e.g., *"clone_SU.sh"*

There are small differences between the script for linux and for Windows, that depend only on file locations.

In order to download these files from the github site you can run the following shell script. You must have administrator privileges. The following example script will place the Seismic Unix package within the *"/usr/local/"* directory that has the path: *"/usr/local/cwp_su_all_44R19"*. The script below is saved as a file with any name you choose, e.g., *"SU_clone.sh"*. You can create this file inside your home directory.

After files have been cloned you will have to read through the installation instructions and prepare Seismic Unix to compile, link to libraries and install on your local machine. Instructions are found in the directory: *"~cwp_su_all_44R19/src"*

Run the following instructions individually and in sequence from the command line, or place the following instructions into a script, e.g., *"clone_SU.sh"* as follows:

```
#!/bin/bash
# my name is clone_SU.sh

# give a name to directory
installation_directory_for_SU= /usr/local/cwp_su_all_44R19

# create installation directory
mkdir $installation_directory_for_SU

# change into the installation directory
cd $installation_directory_for_SU
```

```
# clone the directory from the remote site on to your computer
git clone https://github.com/JohnStockwellJr/SeisUnix.git

# move files from one directory into the current directory
mv SeisUnix/* ./
mv SeisUnix/. */

# git status
git status
```

Execute the script contained in “**clone_SU.sh**”, while using administrative privileges as **sudo**, e.g.:

```
% sudo sh clone.sh
```

4.2.1 Preparation of Makefile.config

Please follow the instructions in all the “**README**” files but first make the following changes to the

“/usr/local/cwp_su_all_44R19/src/**Makefile.config**”:

4.2.1.1 Ubuntu 20.x

Determine the location of your “**lib**”(aries) and “**include**” directories. For example, you can find these by issuing the following command:

```
%sudo updated
%locate include/X11 | more
```

Please follow the instructions in all the “**Installation_Instructions**” files. Before you carry out the installation, make the following changes to the file:

“/usr/local/cwp_su_all_44R19/src/**Makefile.config**”.

```
IX11 = /usr/include/X11
LX11 = /usr/lib/x86_64-linux-gnu
IMOTIF = /usr/include/X11
LMOTIF = /usr/lib/x86_64-linux-gnu
OPTC = -g -std=c99 -Wall -pedantic -Wno-long-long
FC = gfortran
FOPTS = -g
FFLAGS = $(FOPTS) -ffixed-line-length-none
```

(In the case above the installation is for a 64-bit operating system.)

4.2.1.1.1 Compilation and Installation

Stay in the current directory:

“`/usr/local/cwp_su_all_44R19/src`” and run the following commands one at a time:

```
%sudo make install
%sudo make xtinstall
%sudo make xminstall
```

4.3 Installation of “demos”, example data sets and flows

4.3.1 Linux systems

Once the installation of project: **L_SU**, is complete on your system, you can copy some of the accompanying demonstration data sets to your home directory, where, for example, “`/home/user`” is the complete path to the location of a user’s (“**user**”) home directory. Put these instructions in another convenient shell script called, e.g., “**copy_demos.sh**”

```
#!/bin/bash
# my name is copy_demos.sh

# give a name to directory
installation_directory_for_L_SU=/usr/local/pl

cp -R $installation_directory_for_L_SU/L_SU/Servilleta_demos /home/user/
cp -R $installation_directory_for_L_SU/L_SU/LSBB /home/user/
```

The L_SU tutorial manual makes use of these two demonstration projects. “**Servilleta_demos**” contains files from the 2018 IRIS internship orientation program and LSBB contains files from Pau University in France, courtesy of Dominique Rousset and Guy Sénéchal, both extensive contributors to the improvement of Seismic Unix.