**********Draft**********

pibuild
refernce to github notes
Using C with Bare Metal Ultibo
Single Value Decompostion SVD KLT
07/10/21

**********Draft**********

This micro sd will run on Rpi3 a Rpi4 4Gb or Rpi4 8Gb PI400 will provide better results.

The standard software provides a lot of software VLC. Libreoffice, Editors, Image viewers, GIMP. Videos can be download and play using VLC.

This version provides the software to learn about FPGAs and Bare Metal by adding 481 packages and several compiled C & Python Tools (autofpga, icestorm, nextpnr, yosys, zipcpu, and verilator). In additons the dependencies (libgtk2.0-dev libcairo2-dev libpango1.0-dev libgdk-pixbuf2.0-dev libatk1.0-dev libghc-x11-dev) for Lazarus IDE (Ultibo-Edition). With https://github.com/develone/Ultibo_Projects you can compile Bare Metal applications for Rpi, Rpi2, Rpi3, and RPi4.

After connecting a keyboard/mouse, usb pwr, supply and HDMI TV. The system will boot to Login screen. These are a few screenshots of a Raspberry Pi that I recently built. This version has additional software installed to support Bare Metal development. This also has the software to do Synthesis of Verilog Code using Yosys. yosys -V
Yosys 0.9+4052 (git sha1 0ccc7229, gcc 8.3.0-6+rpi1 -fPIC -Os). The Synthesis output needs to Placed & Routed using nextpnr. nextpnr-ice40 -V
nextpnr-ice40 -- Next Generation Place and Route (Version 4419c36d). The output of nextpnr creates a catzip.bin bitstream which can be used to program the FPGA. The catzip.bin needs to be tested if the clock frequency is not to high using icestorm. icetime -d hx8k -c 40 catzip.asc
// Reading input .asc file..
// Reading 8k chipdb file..
// Creating timing netlist..
// Timing estimate: 18.37 ns (54.44 MHz)
// Checking 25.00 ns (40.00 MHz) clock constraint: PASSED.

These are software packages needed to work with FPGAs autofpga, icestorm, nextpnr, yosys, zipcpu, and verilator.


Tatiana
Shut Down
Log In
acer

After entering the correct passwd user devel will be logged in to DeskTop.

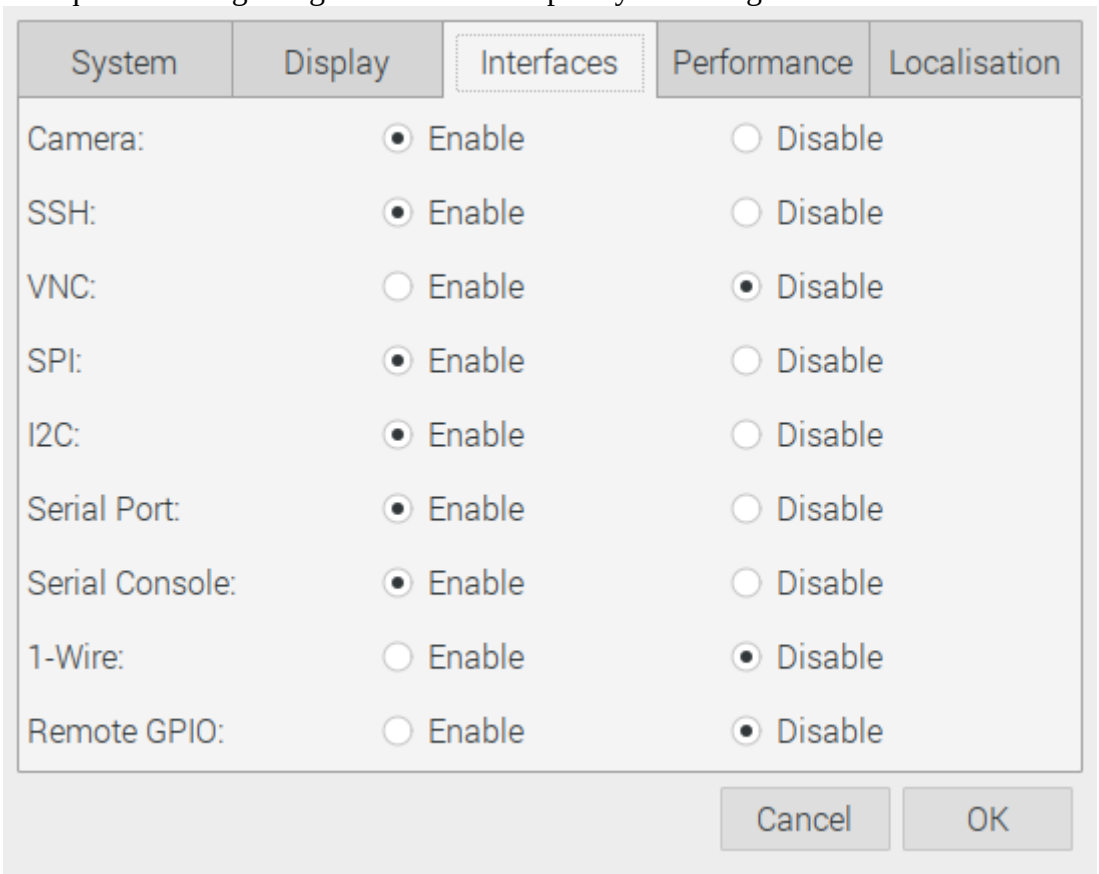
Users can use ssh to make remote connection to the newly created Raspberry Pi.

```
File  Edit  Tabs  Help
devel@mypi3-20:~ $ ssh -Y tatiana
devel@tatiana's password:
Linux tatiana 5.10.17-v7+ #1421 SMP Thu May 27 13:59:01 BST 2021 armv7l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Thu Jul  8 21:23:01 2021 from 192.168.1.245
devel@tatiana:~ $ uname -a
Linux tatiana 5.10.17-v7+ #1421 SMP Thu May 27 13:59:01 BST 2021 armv7l GNU/Linu
x
devel@tatiana:~ $
```

This does require enabling using Preferences/Raspberry Pi Configuration.



This is also where the Hostname and if a prompt is required to Log in is performed.

I also have a simulation of the software in the FPGA.

To start the simulator with no trace ./arm-main.tb is run ~/pi400/catzip/sim/verilated
if the -d option is used the VCD file trace.vcd is generated.

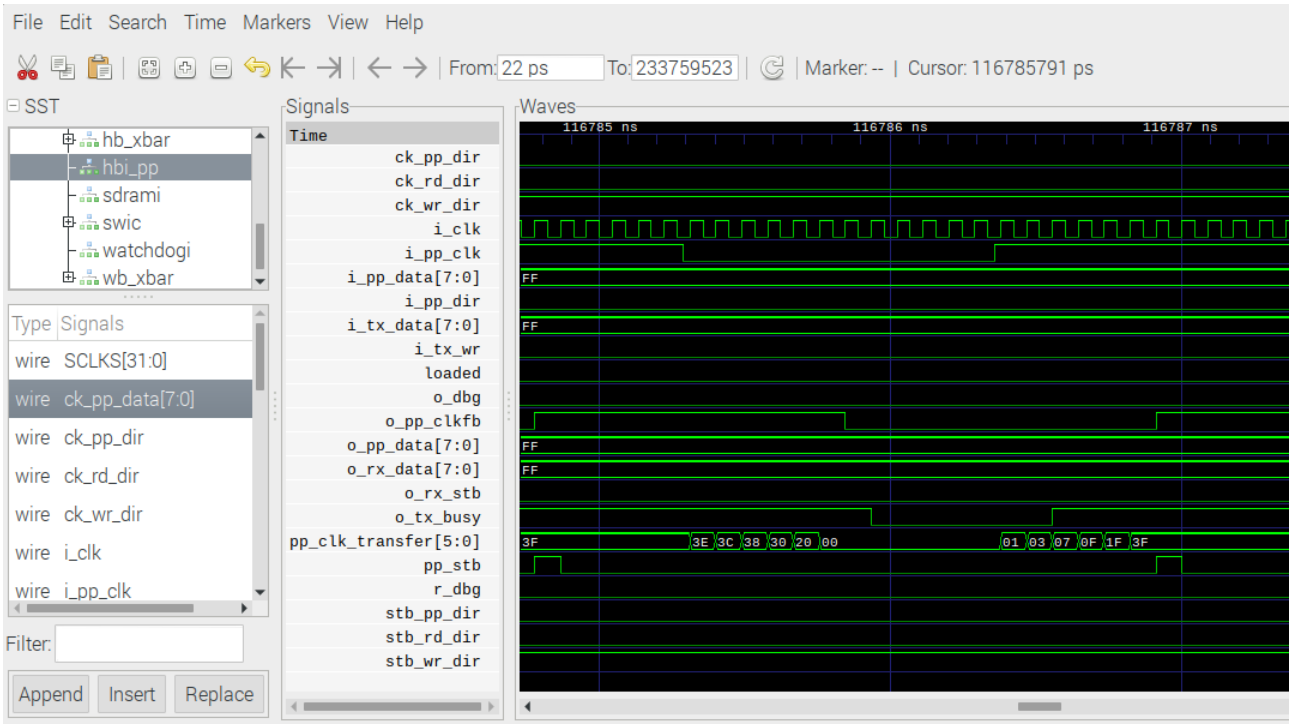
Shell 1

./arm-main_tb
Listening on port 8363
Listening on port 8364
> T
> Z
Accepted CMD connection
< A01000015R
> A01000015R20210707
< [CLOSED]

Shell 2

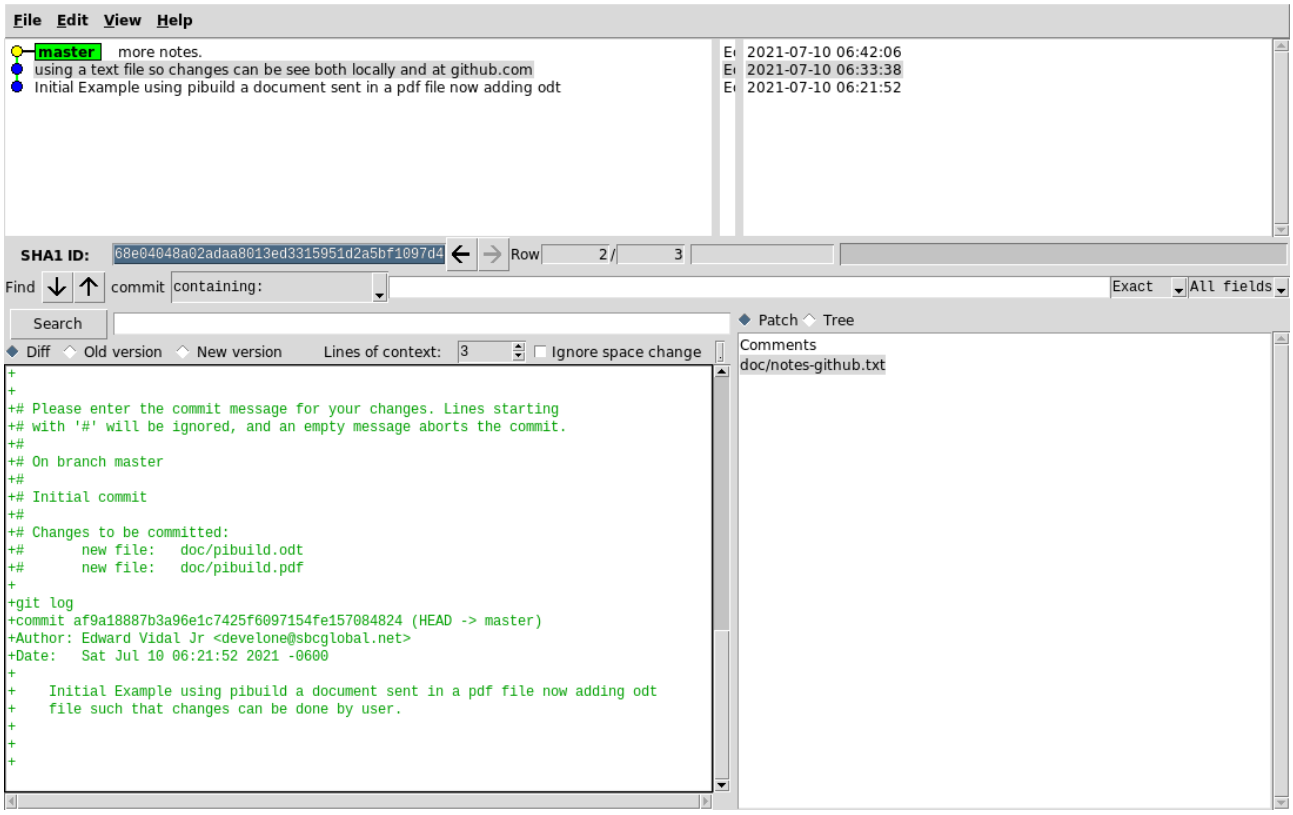
./arm-wbregs version
01000014 (VERSION) : [.!..] 20210707

The VCD file was created by using the simulator with -d option and the command ./arm-wbregs version

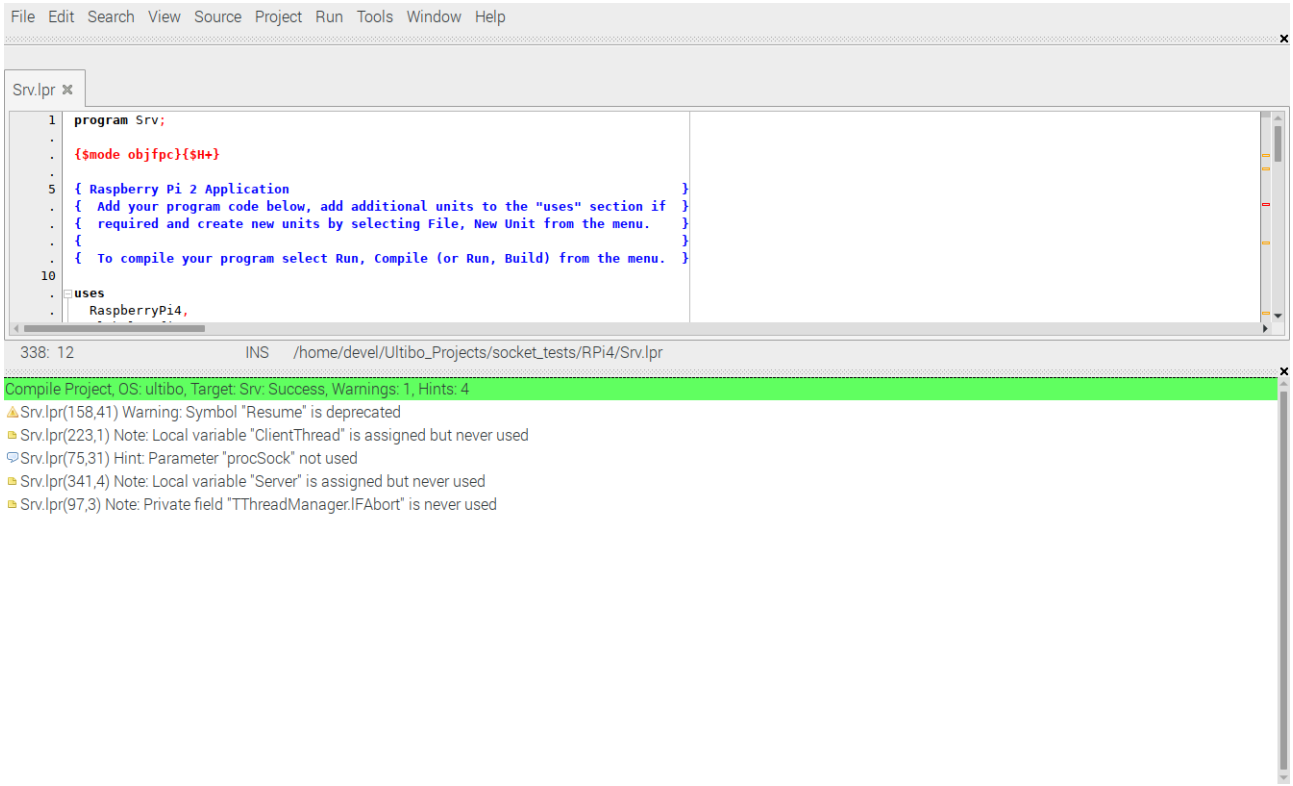


On the Rpi you can gitk & to see the changes made to local repo.

After a more changes.



Using C with Ultibo Bare metal.



Using my repo svd_rgb https://github.com/develone/svd_rgb.git .

ssh -Y pi400-1
Warning: the ECDSA host key for 'pi400-1' differs from the key for the IP address
'2600:1700:69f0:42c0::2b'
Offending key for IP in /home/devel/.ssh/known_hosts:11
Matching host key in /home/devel/.ssh/known_hosts:44
Are you sure you want to continue connecting (yes/no)? yes
devel@pi400-1's password:
Linux pi400-1 5.10.17-v7l+ #1421 SMP Thu May 27 14:00:13 BST 2021 armv7l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Fri Jul 9 15:51:47 2021 from 2600:1700:69f0:42c0::2c
devel@pi400-1:~ $ git clone https://github.com/develone/svd_rgb.git
Cloning into 'svd_rgb'...
remote: Enumerating objects: 126, done.
remote: Counting objects: 100% (126/126), done.
remote: Compressing objects: 100% (95/95), done.
remote: Total 126 (delta 40), reused 112 (delta 26), pack-reused 0
Receiving objects: 100% (126/126), 19.36 MiB | 6.18 MiB/s, done.
Resolving deltas: 100% (40/40), done.

devel@pi400-1:~ $ cd svd_rgb/src/

devel@pi400-1:~/svd_rgb/src $ make

```
gcc -c -o obj/svd.o svd.c -I../include
gcc -c -o obj/disp_mat.o disp_mat.c -I../include
gcc -c -o obj/mul_mat.o mul_mat.c -I../include
gcc -c -o obj/pnmio.o pnmio.c -I../include
gcc -c -o obj/error.o error.c -I../include
gcc -c -o obj/mythread.o mythread.c -I../include
gcc -c -o obj/trans_mat.o trans_mat.c -I../include
gcc -c -o obj/master.o master.c -I../include
gcc -o master obj/svd.o obj/disp_mat.o obj/mul_mat.o obj/pnmio.o obj/error.o obj/mythread.o
obj/trans_mat.o obj/master.o -I../include -lm -lpthread

devel@pi400-1:~/svd_rgb/src $ ./master
In main red.pgm Sred.bin rcred.bin 0 0
In main grn.pgm Sgrn.bin rcgrn.bin 0 0
In main blu.pgm Sblu.bin rcblu.bin 0 0
name: Allen
age: 20
0x0

 1st thread processing th_id[0] 0xb6d1d460
In mysvd input_file: red.pgm
In mysvd first_output: Sred.bin
In mysvd second_output: rcred.bin
In mysvd status: 0
In mysvd num_bytes_rd: 0

ncols=512 nrows=512
In mysvd status input file read: 1 num_bytes_rd 262144
red.pgm th0.len1 = 0
len = 1050624 th0.len2 = 1050624 th0.len3 = 1050624 th0.len4 = 1050624
setting up ptrs with malloc
pa 0xb603a808 ppa 0xb603a008
pv = 0xb623c808 ppv = 0xb623c008
pvt = 0xb5e38808 ppvt = 0xb5e38008
pds = 0xb5f39808 ppds = 0xb5f39008
puds = 0xb613b808 ppuds = 0xb613b008
pudsvt = 0xb5c36808 ppudsvt = 0xb5c36008
U row = 512 col = 512
Singular Values
V row = 512 col = 512
V' row = 512 col = 512
Call mul u * s
UDS row = 512 col = 512
Call mul u * ds * vt
USDVT row = 512 col = 512
ps converted from float to int 0xb64005b8
# of data written 0x40000

 2nd thread processing th_id[1] 0xb6d1d460
In mysvd input_file: grn.pgm
In mysvd first_output: Sgrn.bin
In mysvd second_output: rcgrn.bin
```

```
In mysvd status: 0
In mysvd num_bytes_rd: 0

ncols=512 nrows=512
In mysvd status input file read: 1 num_bytes_rd 262144
grn.pgm th1.len1 = 0
len = 1050624 th1.len2 = 1050624 th1.len3 = 1050624 th1.len4 = 1050624
len = 1050624 th1.len2 = 1050624 th1.len3 = 1050624 th1.len4 = 1050624
setting up ptrs with malloc
pa 0xb5efd808 ppa 0xb5efd008
pv = 0xb60ff808 ppv = 0xb60ff008
pvt = 0xb5cfb808 ppvt = 0xb5cfb008
pds = 0xb5dfc808 ppds = 0xb5dfc008
puds = 0xb5ffe808 ppuds = 0xb5ffe008
pudsvt = 0xb5af9808 ppudsvt = 0xb5af9008
U row = 512 col = 512
Singular Values
V row = 512 col = 512
V' row = 512 col = 512
Call mul u * s
UDS row = 512 col = 512
Call mul u * ds * vt
USDVT row = 512 col = 512
ps converted from float to int 0xb64c05d0
# of data written 0x40000

 3rd thread processing th_id[2] 0xb6d1d460
In mysvd input_file: blu.pgm
In mysvd first_output: Sblu.bin
In mysvd second_output: rcblu.bin
In mysvd status: 0
In mysvd num_bytes_rd: 0

ncols=512 nrows=512
In mysvd status input file read: 1 num_bytes_rd 262144
blu.pgm th2.len1 = 0
len = 1050624 th2.len2 = 1050624 th2.len3 = 1050624 th2.len4 = 1050624
len = 1050624 th2.len2 = 1050624 th2.len3 = 1050624 th2.len4 = 1050624
setting up ptrs with malloc
pa 0xb5bfa808 ppa 0xb5bfa008
pv = 0xb5eff808 ppv = 0xb5eff008
pvt = 0xb59f8808 ppvt = 0xb59f8008
pds = 0xb5af9808 ppds = 0xb5af9008
puds = 0xb5cfb808 ppuds = 0xb5cfb008
pudsvt = 0xb57f6808 ppudsvt = 0xb57f6008
U row = 512 col = 512
Singular Values
V row = 512 col = 512
V' row = 512 col = 512
Call mul u * s
UDS row = 512 col = 512
Call mul u * ds * vt
```

USDVT row = 512 col = 512
ps converted from float to int 0xb64c05d0
# of data written 0x40000
all threads joined
In main status 4 num_bytes_rd 262144
In main status 4 num_bytes_rd 262144
In main status 4 num_bytes_rd 262144

devel@pi400-1:~/svd_rgb/src $ octave
libEGL warning: DRI3: failed to query the version
libEGL warning: DRI2: failed to authenticate
GNU Octave, version 4.4.1
Copyright (C) 2018 John W. Eaton and others.
This is free software; see the source code for copying conditions.
There is ABSOLUTELY NO WARRANTY; not even for MERCHANTABILITY or
FITNESS FOR A PARTICULAR PURPOSE. For details, type 'warranty'.

Octave was configured for "arm-unknown-linux-gnueabihf".

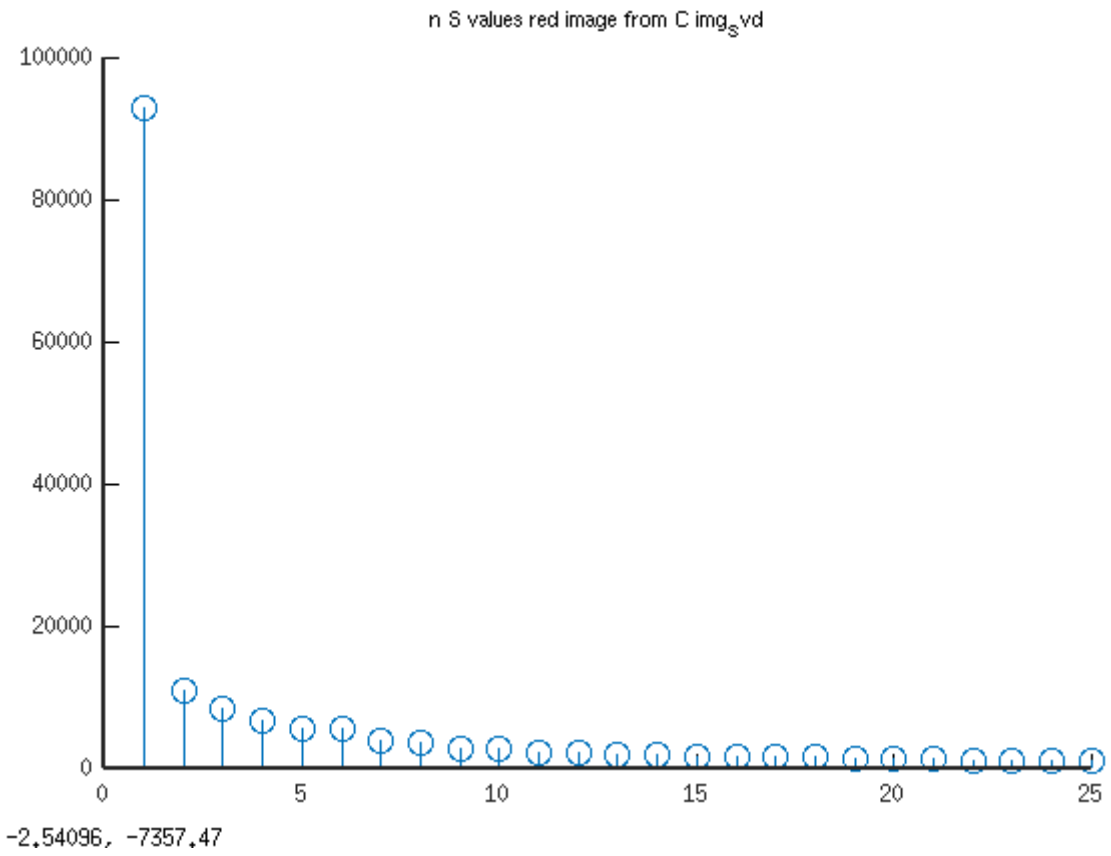
Additional information about Octave is available at https://www.octave.org.

Please contribute if you find this software useful.
For more information, visit https://www.octave.org/get-involved.html

Read https://www.octave.org/bugs.html to learn how to submit bug reports.
For information about changes from previous versions, type 'news'.

octave:1> disp_S

You see 12 figures


n S values red image from C imgSvd
100000
80000
60000
40000
20000
0
0
5
10
15
20
25
-2.54096, -7357.47