Tutorial on using FFTW

Xubo Liu

Jan, 2024

The FFTW is a C++ library that designed for FFT and its inverse. It is not set up in general so one needs to download it first from FFTW.

1 Linking FFTW to Matlab

After installing the FFTW library, we can use the header file fftw3.h in C++ and compile functions in Matlab through MEX. The C++ source code is written in C language and passes objects into Matlab with the help of some commands like "mxCreateDoubleMatrix", "mxGetPr", etc. Users can learn the syntax by themselves. Here, we give a tutorial for linking the external library to Matlab and make it located in the Matlab enviornment.

1.1 Windows

Computers with a Windows system can visit the installed FFTW library directly by specifying the path to the folder where FFTW is downloaded.

1.2 MacOS with any Intel chips (before 2021)

Users who have the OS system based on the X86_64 architecture can easily link the library to Matlab. The FFTW will generally create files in the root folder on an OS system. In general the header file "fftw3.h" is under the path */usr/local/include* and the compiled dynamical library with a suffix *_x86_64.dylib* is saved under */usr/local/lib*. To compile a MEX file in Matlab (for instance, the "log_density.cpp" file in the package), one can simply do:

mex -I/usr/local/include -L/usr/local/lib -lfftw3 log_density.cpp -output log_density

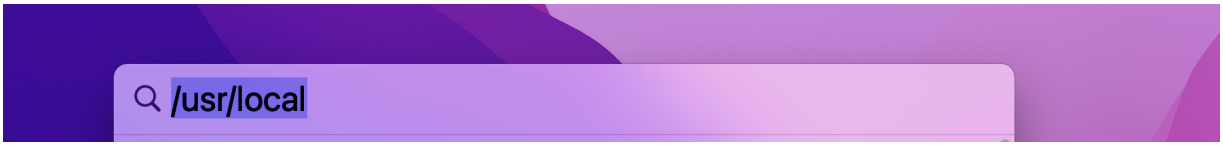
which will compile a file "log_density.mexmaci64" that can be used by OS users. And users only need to compile a C++ function in Matlab the first time they use it.

1.3 MacOS with any M chips

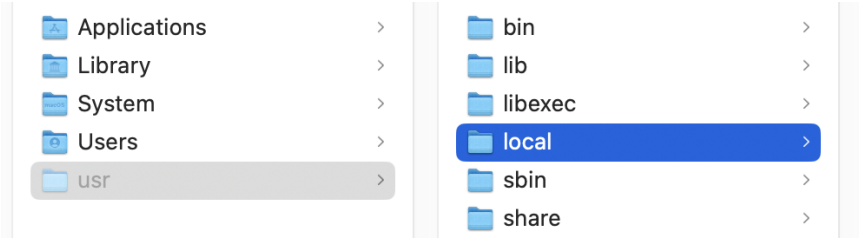
After 2021, the MacOS is based on new M chips. Users may encounter compatibility issues when locating FFTW because the system is built on ARM architecture and an ARM version of Matlab is not available yet to detect a dynamic lib file that ends with ".a". We spent time on solving this issue and successfully compile all necessary MEX files.

One can try to build their own "mexmaci64" files via MEX.

1. Put the "fftw3.h" header file we provided in the folder "/usr/local/include". If the path doesn't exist, please create it first. Macbook users can locate the path by searching "/usr/local" in the Spotlight Search (usually in the toolbar in the upper right corner of the desktop):



Then we can find:



2. Open or create the path: "/usr/local/Cellar/" and put the "fftw_x86_64" folder inside and get the path "/usr/local/Cellar/fftw_x86_64". Refer to Step 1 to find the path and folders.

3. To compile a C++ function via MEX, for instance, the "log_density.cpp", we can execute the following code in the Matlab Command Window:

   mex -I/usr/local/include -L/usr/local/Cellar/fftw_x86_64/lib -lfftw3 log_density.cpp -output log_density

   then we have a "log_density.mexmaci64" function saved in the current folder of Matlab that can be directly used. For first-time users, please complete the compilation of all C++ functions by running the "compile_cpp.m" file in the package.