**Instructions for Building PETSc and CrunchFlow on Windows**

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**Building PETSc on Windows**

* Install Microsoft Visual Studio 2022 if you want to use the Visual Studio environment for debugging etc.
* Install Intel oneAPI Base Kit and oneAPI HPC (Fortran is in the HPC libraries)

Since the Configure scripts for PETSc really work well only with UNIX or Linux type systems, the recommended approach (see <http://www.mcs.anl.gov/petsc/documentation/installation.html#Windows>) is to install Cygwin. There may be other Unix emulators that work, not sure again.

Make sure you also get the entire Python distribution (this is not part of the Default installation) and you get the Gnu Make routine within the *Devel* package. Since Cygwin includes a “link” command that can interfere with the Intel compilers, you should carry out this command in a Cygwin BASH shell:

mv /usr/bin/link.exe /usr/bin/link-cygwin.exe

It turns out that much of the difficulty in getting PETSc to build easily is due to the failure to find the right Environmental Variables and compilers in the Cygwin BASH shell. The key is to follow these steps. Open a Windows (or DOS) Command shell (type “cmd” in Windows).

Then navigate within the *Command* window to:

C:\Program Files (x86)\Intel\oneAPI\

and give the command:

setvars.bat

This will set the various Intel oneAPI flags.

Or alternatively, navigate to the Apps startup in Windows 11 and click on (inside the Intel oneAPI 2024 folder)

Intel oneAPI command prompt for Intel 64 for Visual Studio 2022

This launches a command window with all of the oneAPI settings, and also ensures that Visual Studio 2022 will pick these up (otherwise Visual Studio will not know of the existence of Fortran). You may have to run this Command Prompt as Administrator (right-click on the Command Prompt tabe for Intel 64 to do this). Otherwise, some of the files that PETSc tries to write during the “configure” stage (see below) may be blocked.

After these are set, run the command within the same Command window where you have just set the Intel Environment Variables (no double-clicking) to

C:\cygwin64\bin\mintty.exe -

This launches a bash shell in the Cygwin Unix environment, but it has to be done by command line from the same Windows Command window where the environment variables were set.

If everything has worked correctly, the Cygwin bash shell should have inherited the Environment Variable settings from running the “setvars.bat” script. Test for this by now running within the same Cygwin terminal from a directory other than the one actually containing the files so as to test whether the compilers are in the system search paths:

which icx

and

which ifx

The location of these compilers should be echoed, if not, the paths have not been set correctly. If not (i.e., you get a message like “No ifx found in …”,), then you will need to add the location of these files manually.

Then, change directories to where you want to install PETSc, usually something like (note that we use the cygdrive/c address rather than C:\software) when in the Cygwin terminal:

cd /cygdrive/c/software

Next, install PETSc on your machine from <http://www.mcs.anl.gov/petsc/index.html>. Follow the installation instructions there. Downloading PETSc from GitHub always brings up some message about “Are you using WinZip…”, and then it fails. So better to just download the tar ball:

**To download PETSc from GitHub (ONLY ONCE WE FIX the ARGUMENTS IN Crunch)**

Petsc-3.22 does not work with CrunchFlow. We need to change the arguments in the Fortran calls. For now, use petsc-3.21 or earlier:

<https://web.cels.anl.gov/projects/petsc/download/release-snapshots/petsc-3.21.tar.gz>

Later (once fixed), we will go back to these instructions:

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Follow the instructions on the PETSc web site:

git clone -b release https://gitlab.com/petsc/petsc.git petsc

git pull # obtain new release fixes (since a prior clone or pull)

or download the PETSc tarball and do

gunzip petsc.tar.gz

tar xvf petsc.tar

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and then ideally in C:\software:

gunzip petsc-3.21.tar.gz

tar xvf petsc-3.21.tar

The change directories to the petsc directory:

cd petsc-3.21

export PETSC\_DIR=$PWD [this will be using the working directory as PETSC\_DIR]

or directly

export PETSC\_DIR=/cygdrive/c/software/petsc-3.21

**Debug Version**

In the Python scripts below, the value set for PETSC\_ARCH will override what is set elsewhere (e.g., in Windows Environment Variables, or in .bashrc). One can create as many PETSC\_ARCH as needed, since each configure build will create a separate directory with that name. The user can then switch between these various PETSC\_ARCH options, using either the Windows Environment Variable setting for PETSC\_ARCH, or in the user’s .bashrc profile.

Here we configure the “no MPI” version (--with-mpi=0).

The architecture is set in the configure script, but to maintain compatibility with the Crunch build later, give command:

export PETSC\_ARCH=oneAPI-noMPI-opt

For statically linked libraries, use:

./configure PETSC\_ARCH=oneAPI-noMPI-opt \

--with-cc=/cygdrive/c/software/petsc/lib/petsc/bin/win32fe/win32fe\_icx \

--with-fc=/cygdrive/c/software/petsc/lib/petsc/bin/win32fe/win32fe\_ifx \

--with-cxx=0 \

--with-mpi=0 \

--with-blaslapack-dir=/cygdrive/c/PROGRA~2/Intel/oneAPI/2024.1/lib \

--with-debugging=1 \

--with-shared-libraries=0

**Optimized Version**

./configure PETSC\_ARCH=oneAPI-noMPI-opt \

--with-cc=/cygdrive/c/software/petsc/lib/petsc/bin/win32fe/win32fe\_icx \

--with-fc=/cygdrive/c/software/petsc/lib/petsc/bin/win32fe/win32fe\_ifx \

--with-cxx=0 \

--with-mpi=0 \

--with-blaslapack-dir=/cygdrive/c/PROGRA~2/Intel/oneAPI/2024.1/lib \

--with-debugging=0 \

--with-shared-libraries=0

**For MPI version (optimized version)**

export PETSC\_ARCH=oneAPI-MPI-opt

./configure PETSC\_ARCH=mpi-oneAPI-opt \

--with-cc=/cygdrive/c/software/petsc/lib/petsc/bin/win32fe/win32fe\_icx \

--with-fc=/cygdrive/c/software/petsc/lib/petsc/bin/win32fe/win32fe\_ifx \

--with-cxx=0 \

--with-mpi-include=/cygdrive/c/PROGRA~2/Intel/oneAPI/mpi/latest/include \

--with-mpi-lib=/cygdrive/c/PROGRA~2/Intel/oneAPI/mpi/latest/lib/impi.lib \

--with-mpiexec=/cygdrive/c/PROGRA~2/Intel/oneAPI/mpi/latest/bin/mpiexec.exe \

--with-blaslapack-dir=/cygdrive/c/PROGRA~2/Intel/oneAPI/2024.1/lib \

--with-debugging=0 \

--with-shared-libraries=0 \

FPPFLAGS=-I/cygdrive/c/PROGRA~2/Intel/oneAPI/mpi/latest/include/mpi

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**Building CrunchFlow on Windows**

Building a version of CrunchFlow using only a CYGWIN shell is similar to a building on a Linux or UNIX machine. To build CrunchFlow within the Microsoft Visual Studio Environment, you can get the Intel Visual Fortran project file from the GitHub repository for CrunchTope:

<https://github.com/CISteefel/CrunchTope>

This way, the files that should go in the current release will be properly identified by the Project file. However, there may be some fine-tuning of the Project Settings required, so the desired options are given below. These correspond to what one should see when selecting the Project dropdown menu, selecting CrunchFlow Properties.

On the Windows machine, go to the Apps and run the oneAPI Intel 64 command prompt to set environment variables for the Visual Studio 2022 environment (otherwise it may not know to include Fortran projects as an option):

And click on the “Intel oneAPI Command Prompt for Intel 64 for Visual Studio 2022” and proceed to create a Fortran project after launching Visual Studio 2022.

You can make sure you get the right source files by putting them in “CrunchTope/Source” and then adding these to your newly created “vfproj” file for CrunchTope (see end of document):

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Additional Include Directories

$(OUTDIR)

$(PETSC\_DIR)

$(PETSC\_DIR)\$(PETSC\_ARCH)\lib\petsc\conf

$(PETSC\_DIR)\$(PETSC\_ARCH)\include

$(PETSC\_DIR)\include\petsc\flinclude

$(PETSC\_DIR)\lib\petsc\conf

$(PETSC\_DIR)\include\

$(PETSC\_DIR)\include\petsc

$(PETSC\_DIR)\$(PETSC\_ARCH)\lib

$(ONEAPI\_ROOT)\mpi\latest\include

$(ONEAPI\_ROOT)\mpi\latest\lib

$(ONEAPI\_ROOT)\mpi\latest\include\mpi

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Additional Library Directories

$(OUTDIR)

$(PETSC\_DIR)

$(PETSC\_DIR)\$(PETSC\_ARCH)\lib\petsc\conf

$(PETSC\_DIR)\$(PETSC\_ARCH)\include

$(PETSC\_DIR)\include\petsc\flinclude

$(PETSC\_DIR)\lib\petsc\conf

$(PETSC\_DIR)\include\

$(PETSC\_DIR)\include\petsc

$(PETSC\_DIR)\include\petsc\mpiuni

$(PETSC\_DIR)\$(PETSC\_ARCH)\lib

$(ONEAPI\_ROOT)\mpi\latest\include

$(ONEAPI\_ROOT)\mpi\latest\lib

$(ONEAPI\_ROOT)\mpi\latest\include\mpi

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