CODE AVAILABILITY AND RUN INSTRUCTIONS FOR

"An optimized treatment for algorithmic differentiation of an important glaciological fixed-point problem"

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Software requirements

- A fortran 90 compiler (a range of possible vendors and options will be suitable)
- OpenAD (http://www.mcs.anl.gov/OpenAD/)
- To use the PETSc optimization, a working instance of PETSc (http://www.mcs.anl.gov/petsc) must be installed, and a fortran mpi compiler (e.g. mpif77) must be available.

There are a potential dependency issues if using PETSc that will be specific to your individual PETSc configuration. Please see the "using PETSc" section for further discussion.

Code availability and Installation

- Follow instructions at http://www.mcs.anl.gov/OpenAD/access.shtml to install the OpenAD software. Note that before any use of OpenAD, the script setenv.sh must be sourced per the instructions on the above web page. (It is suggested to add this instruction to a configuration script.) The version of the source used for this work is contained in gzipped tarball snapshot 493.
- Follow instructions at http://mitgcm.org/public/source_code.html to download the most recent instance of MITgcm or download checkpoints at http://mitgcm.org/download/other_checkpoints/. Checkpoint **c65r** will contain the code appropriate for these experiments. *(However, the experiment discussed in detail in the paper is a "verfication" experiment which is run nightly and checked for any differences, so it is likely the latest version of the code will work.)*
- The PETSc sources is available at http://www.mcs.anl.gov/petsc/download/index.html. Version 3.3 Patch 6 (3.3-p6) was used for this work. It is suggested that at least 3.0 be used. Similarly, it is possible that later versions may deprecate some of the PETSc calls in the MITgcm code. If you are using a later version and experience issues, please email the lead author.

Running experiment

There are 2 ways to run the simple experiment described in the paper.

Method 1:

1) In the MITgcm directory, navigate to `MITgcm/verification/`
2) Type the command `./testreport -t halfpipe_streamice -oad`

Method 2:

1) In the MITgcm directory, navigate to MITgcm/verification/halfpipe_streamice/build
Type the following commands:
2) `../../../tools/genmake2 -ds -m make -oad -mods=../code_ad -ieee`
3) `make adAll` (note compilation will take some time)
4) `cd ../run`
5) `ln -s ../input_oad/* .`
6) `ln -s ../build/mitgcmuv_ad .`
7) `./mitgcmuv_ad`

You may consult the MITgcm documentation on how to view the output files. Adjoint values are stored in output files beginning with "adxx_".

Note that to change the number of time steps and size of the domain, files in `MITgcm/verification/halfpipe_streamice/input` and `MITgcm/verification/halfpipe_streamice/code` will need to be modified. The MITgcm tutorial material should be consulted for this (http://mitgcm.org/public/r2_manual/latest/online_documents/node88.html). For specific information on the ice model please see http://mitgcm.org/public/r2_manual/latest/online_documents/node256.html.

Using PETSc

Code-level and compilation changes to MITgcm must be made in order to use PETSc.

- Step (2) above should be replaced by `../../../tools/genmake2 -ds -m make -oad -mods=../code_ad -ieee -mpi` (run "`make CLEAN`" before building again)
- In the file MITgcm/verification/halfpipe_streamice/code_oad/STREAMICE_OPTIONS.h, insert the line `#define ALLOW_PETSC` just below `#define STREAMICE_HYBRID_STRESS`

See also the MITgcm help page "building with mpi" (http://mitgcm.org/public/r2_manual/latest/online_documents/node97.html)

If using PETSc 3.3-p6, function declarations from the **include/finclude/petsc.h** are necessary for compilation. Beyond this, the specific steps to link to the PETSc libraries during compilation and runtime will depend on your installation of PETSc. We provide here our PETSc configuration command:

```
--configModules=PETSc.Configure --optionsModule=PETSc.compilerOptions --
configModules=PETSc.Configure --optionsModule=PETSc.compilerOptions --
configModules=PETSc.Configure --optionsModule=PETSc.compilerOptions --
CFLAGS="-fPIC -march=native" --CXXFLAGS="-fPIC -march=native" --FFLAGS="-
fPIC -march=native" --with-debugging=0 --with-hypre=1 --download-hypre=1 --
with-umfpack=1 --download-umfpack=1 --with-spooles=1 --download-spooles=1 -
-with-mpi=1 --with-mpi-interfaces=1 --with-fortran-interfaces=1 -with-
shared-libraries=1 --with-mumps=1 --download-mumps=1 --with-scalapack=1 --
download-scalapack=1 --with-blacs=1 --download-blacs=1
```