

MILC Code Basics

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MILC Code Capabilities

- Molecular dynamics evolution
 - Staggered fermion actions (Asqtad, Fat7, HISQ, etc)
 - Clover fermion action ($N_f = 2$)
 - Pure gauge
 - Schroedinger functional
- Hadron spectroscopy
 - Staggered mesons and baryons
 - Clover mesons and baryons
 - Mixed staggered/clover mesons
 - Static/light spectroscopy
 - Quarkonium spectroscopy (many sources)
- Current matrix elements
 - Leptonic decay (f_{π} , f_B , f_D)
 - Semileptonic decay (heavy-light)
- Miscellaneous
 - Topological charge
 - Glueball propagators
 - Dirac matrix eigenvectors and eigenvalues
 - Nonperturbative renormalization of currents

Supported File Formats

- Gauge configuration file formats
 - MILC, SciDAC (ILDG), NERSC, Fermilab
- Dirac propagator file formats
 - USQCD, Fermilab
- Staggered propagator file formats
 - USQCD, MILC, Fermilab

Supported SciDAC C-Coded Packages

- QIO (I/O)
- QMP (Message passing)
- QLA (linear algebra – single processor)
- QDP/C (linear algebra – data parallel)
- QOPQDP (“Level 3” optimized)
- (See James Osborn’s talks)

<http://usqcd.jlab.org/usqcd-software/>

Precision

- Global single or double precision
- Mixed precision in some applications

Portability

- Practically any scalar machine
- Any MPP machine with MPI
- QCDOC

MILC Code Organization

- Application directories
 - With compilation targets
- Library directory
 - Linear algebra routines
- Shared procedures (“generic”) directories
 - Shared across applications

MILC Code Organization

- Application directories: examples
 - cd ks_imp_dyn (application)
 - make su3_rmd (target) (Asqtad R algorithm)
 - make su3_spectrum (another target) (staggered spectroscopy)
 - cd ks_imp_rhmc (application)
 - make su3_rhmc (Asqtad RHMC algorithm)
 - make su3_rhmc_hisq (target) (HISQ algorithm)
 - cd clover_invert2 (application)
 - make su3_clov (clover spectroscopy, etc.)

MILC Code Organization

- Shared procedures directories: examples
 - generic
(common to all applications)
 - generic_ks
(common to staggered fermion applications)
 - generic_wilson
(common to clover and Wilson fermion apps)

Building the MILC Code

- Download source

http://www.physics.utah.edu/~detar/milc/milc_qcd.html

- Unpack
- Configure
- Build
- Check

Building the MILC Code

- Unpack
 - `tar -xzf milc_qcd-7.6.2.tar.gz`
 - `less README_UNPACK`
 - `make -f Make_unpack all`

Building the MILC Code

- Configure (crude old fashioned!)
 - Copy default Makefile to application directory
 - `cd ks_imp_rhmc`
 - `cp ../Makefile .`
 - Edit (example in next slide)
 - `Makefile`
 - `../libraries/Make_vanilla`
 - `../include/config.h`

Example: editing the Makefile

```
#-----  
# 1. Architecture  
  
# Compiling for a parallel machine?  Uncomment this line.  
#MPP = true  
  
#-----  
# 2. Precision  
  
# 1 = single precision; 2 = double  
PRECISION = 1  
  
#-----  
# 3. Compiler  
# Choices include mpicc cc gcc pgcc g++  
  
ifeq ($(strip ${MPP}),true)  
    CC = /usr/local/mvapich/bin/mpicc  
else  
    CC = gcc  
endif
```

Building and Checking the Code

- Build
 - `make su3_rmd`
- Check single precision su3_rmd
 - `make check "PROJS=su3_rmd" "PRECLIST=1"`
- Check all targets in this directory
 - `make check`

Running the code

- All of the following will work:
- `su3_rhmc < inputfile > outputfile`
- `su3_rhmc inputfile > outputfile`
- `su3_rhmc inputfile outputfile`

Sample parameter input (su3_rmd)

```
prompt 0
nflavors1 2
nflavors2 1
nx 16
ny 16
nz 16
nt 64
iseed 5682304

warms 0
trajecs 2
traj_between_meas 1
beta 6.76
mass1 0.05
mass2 0.5
u0 0.8441
microcanonical_time_step 0.02
steps_per_trajectory 4
max_cg_iterations 300
max_cg_restarts 5
error_per_site .000005
error_for_propagator .000002
reload_serial lat.sample.milc
save_serial_scidac lat.test.scidac
```

molecular dynamics

measurements

Summary

- The MILC code is versatile and portable
- I have given a brief overview of the code structure
- I have touched on the process of building and running the code

Tutorial 1 Goals

- Run precompiled code for asqtad molecular dynamics
- Modify the input parameters
- Build a different target
- Modify the Makefile and build the code
- Learn how to start a Markov chain
- Download and unpack the code (if time)