Title: MCNP5 IMPROVEMENTS FOR WINDOWS PCS

Author(s): J. Timothy Goorley, Forrest B. Brown, Lawrence J. Cox

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MCNP5™ Improvements for Windows PCs

Tim Gooley, Forrest Brown, Lawrence J. Cox
MCNP Development Team, X-5, Los Alamos National Laboratory

Abstract
With the release of MCNP 5, much more emphasis has been placed on improving its functionality on PCs running Microsoft Windows® (9X/NT/2000/XP). Enhanced installation and build systems, support for more Fortran compilers, integration with X11 graphics build files, and MPI and PVM parallel capabilities have been implemented in MCNP 5 for Windows PCs, allowing users to utilize dual CPU PCs, clusters of homogeneous Windows PCs, or heterogeneous clusters. MCNP 5 can be installed with an InstallShield® setup program, similar to other Windows programs, for users who only need to install executables and data libraries. For those users who need to compile the source, the GNU make utility can be used in conjunction with three supported Fortran compilers. Alternatively, Compaq Developer Studio® can be used to compile MCNP 5. The X-Windows plotting capabilities have been improved, and all the appropriate open source X11R6 files for compiling MCNP 5 are bundled with the MCNP 5 source code.

Improved X-windows Graphics
There have been a number of improvements in the X-Windows plotting systems which is the recommended graphics system for all platforms. The improvements include:
- More mouse-driven commands available in plotting screen.
- More FONTS capabilities can be plotted.
- W3SH grid plots and importance superimposed user geometry.
- Mesh cell characteristics.
- 64 Color Plotting Scheme.
- X-Windows library and include files in IBS_PLOT.

Although X-Windows files are included with IBS_PLOT, an X-server is still necessary to plot. Our experience has been that some servers have been tested any of the X-Windows (e.g., EQuations' Encore, NT, and DynamicWindows (e.g., www.undertech.com). The freeware X11 X-server XFree86 has also been tested successfully.

MPI and PVM Capabilities
With the release of IBS_PLOT, the parallel capabilities of MCNP have been extended to Windows PCs. IBS_PLOT can run across a cluster of several hundred IBS_PLOT/2000/XP PCs using the Message Passing Interface (MPI) or Parallel Virtual Machine (PVM) communication protocols. Using either method, the behavior of IBS_PLOT is effectively the same.

For homogeneous clusters or dual/quad PC, mpi will run an identical number of processes on each "slave" process:
- mpi -f /run/mcnp/ibsp/Mpi
- mpi -t /run/mcnp/ibsp/Mpi/ibsp_name

For a heterogeneous cluster, mpi will run 200 particles on each "slave" process and collect the appropriate timing information.
Using this information, IBS_PLOT will determine how many processes each "slave" process should run.

REFERENCES
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MCNP Development Team, X-5
X-Division (Applied Physics)
Los Alamos National Laboratory

MCNP Improvements for Windows PCs

With the release of MCNP 5, much more emphasis has been placed on improving its functionality on PCs running Microsoft Windows® (9X/NT/2000/XP).

- Installation - InstallShield
- Build system
  - CVF Developer Studio
  - Gmake
- X-Windows
  - More capabilities
  - Library and include files with MCNP5 Source
- Parallel Capabilities
  - Parallel Virtual Machine (PVM)
  - Message Passage Interface (MPI)
- Incorporated into Start Menu
- MCNP Visual Editor
Installing MCNP executables

There are two methods for installing MCNP5 on a Windows PC:

- **InstallShield® Installer** - installs everything needed to start running the sequential MCNP5 executable.
  - It also modifies the environmental variables.
  - No additional software needed to install.
  - Provides parallel executables.
  - Will NOT recompile source.

- **Gmake install** - After the user copies the directory structure to local drive, “gmake install” will compile the source, run the test problems and summarize unexpected differences.
  - Will NOT modify environmental variables.
  - Requires previously installed Fortan Compiler and Unix shell (Cygwin).
  - Will create mpi parallel executables, but not PVM.
  - Will recompile source.

Building MCNP executables - gmake

This method requires that you previously install:

- **Cygwin** - A unix shell for Windows
  - [http://www.cygwin.com](http://www.cygwin.com)
  - Should also install gmake, perl, and gcc packages.
  - Optional X11 client package - XFree86

- **A Fortran 90 Compiler**
  - Compaq Visual Fortran 90 (v 6.6B)
  - Lahey Fortran 95 Professional (v 5.70c)
  - Absoft Pro Fortran 95 (v 8.0)

- **A C Compiler**
  - GNU gcc (v 2.95.2-5 [Cygwin special])
  - Microsoft C/C++ (v 12.00.8168 )
  - Fujitsu C/C++ [only with Lahey] (v 3.0)
X-Windows Graphics - Geometry Plotter

- Mouse Driven

- 64 color plotting for
  - gram density
  - atom density
  - temperature
**MCNP5 Windows Parallel Capabilities**

With the release of MCNP5, the parallel capabilities of MCNP have been extended to Windows PCs. MCNP5 can run across a cluster of several Windows NT/2000 PCs using the Message Passing Interface (MPI) or Parallel Virtual Machine (PVM) communications protocols.

- **PVM**
  - will allow a cluster with Unix, Linux, etc. computers.
  - places some restrictions on mixing Windows 9x with NT/2000 machines.
  - **MCNP restrictions on mixing Big Endian with Little Endian Architecture**
  - `Mcnp5pvm inp=test tasks #`

- **MPICH.NT**
  - will NOT allow a cluster with Unix, Linux, etc. computers.
  - places some restrictions on mixing Windows 9x with NT/2000 machines.
  - `Mpirun -hosts x host1 y hosts 2 z ... mcnp5mpi inp=test`

- Note clusters can span your desktop (Dual/Quad) or continents.
Running Parallel MCNP5 - Output

Both PVM and MPI MCNP jobs have similar screen output:

dump 1 on file loyf3r.r nps = 0 coll = 0
c tm = 0.00 nrr = 0
xact is done

cp0 = 0.27
master starting 2 tasks with 1 threads each 03/19/03 15:06:03
master sending static commons...
master sending dynamic commons...
master sending cross section data...
master completed initialization broadcasts.
master set rendezvous nps = 200 03/19/03 15:06:20
master set rendezvous nps = 1000 03/19/03 15:06:34
master set rendezvous nps = 2000 03/19/03 15:07:15
master set rendezvous nps = 3000 03/19/03 15:07:57
master set rendezvous nps = 4000 03/19/03 15:08:46

Running Parallel MCNP5

Small Laptop Cluster Timing Study
DELL Inspiron 8200
Pentium IV®, 1.6 GHz, 1024 Mbytes RAM, 512 kbytes L2 Cache
DELL Latitude C800
Pentium III®, 1.0 GHz, 512 Mbytes RAM, 256 kbytes L2 Cache

<table>
<thead>
<tr>
<th>Wall Clock Runtimes (min:sec)</th>
<th>Sequential</th>
<th>PVM tasks 2</th>
<th>PVM tasks 2</th>
<th>MPI 3 processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task Distribution</td>
<td>Pentium 4</td>
<td>Pentium 3</td>
<td>P4:Master +Slave</td>
<td>P4:Master +Slave</td>
</tr>
<tr>
<td>NPS 10,000</td>
<td>9:41</td>
<td>30:25</td>
<td>11:41</td>
<td>10:05</td>
</tr>
<tr>
<td>NPS 100,000</td>
<td>90:55</td>
<td>298:54</td>
<td>143:32</td>
<td>83:27</td>
</tr>
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<td>P4:P3 Ratio</td>
<td>-</td>
<td>-</td>
<td>0.73:1</td>
<td>2.1:1</td>
</tr>
</tbody>
</table>
Integration with Start Menu

From the start menu there are now links to:

- Run the test problems
- Start a command prompt
- Open the MCNP5 Manual
  - (If Acrobat Reader is installed)
- Run the Visual Editor

Visual Editor

MCNP5 Visual Editor now distributed with MCNP

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