Porting Legacy Engineering Applications onto Distributed NT Systems

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PAFEC VibroAcoustic

Loudspeaker design for Celestion International. Initially an iPSC/860 specific code which was parallelised using MPI onto Unix and Windows NT during the project.

Support: CEC PACAN-D Project (Esprit 24871)

Partners: PAC
SER Systems Ltd
Celestion International
Motor Industry Research Assoc.
LUSAS FE

Finite Element analysis of composite material structures for Messier-Dowty. Main work was porting the Intrepid task scheduler from UNIX to Windows NT. PAC had no access to LUSAS source code.

Support: CEC PARACOMP Project (Esprit 24474)

Partners: PAC  
FEA Ltd  
Messier-Dowty
The PAC is an autonomous part of the Department of Electronics and Computer Science at the University of Southampton. We are located on the Chilworth Science Park, 5 km from the main University campus.

The PAC enables its clients to compete more effectively through the innovative application of new and established information technologies. We specialise in:

- enhancing productivity through the capture and reuse of knowledge;
- exploiting information assets through data warehousing and data mining; and
- improving co-operation through the use of internet technologies and intranets.
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Target Environment
- WindowsNT (INTEL) 4 cluster 4..6 processors
- Digital Visual Fortran 5
- MPIPro or PaTENT MPI (Genias GmbH)

Generic Porting Issues
- We chose not to use the visual environment; this hampered later use of the debugger.
- WindowsNT command interpreter did not accept long command lines from the UNIX build.
- Only 50 key subroutines out of 18000 parallelised.
- Nine out of ten phases left unchanged.
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The key phase is a Gaussian elimination for an acoustic BE mesh coupled to a structural FE mesh.

\[
\begin{pmatrix}
\vdots \\
\vdots \\
S & \cdots & T \\
\vdots & \ddots & \vdots \\
G^*E & \cdots & H
\end{pmatrix}
\begin{pmatrix}
U \\
\vdots \\
p
\end{pmatrix}
= 
\begin{pmatrix}
F \\
\vdots \\
p_l
\end{pmatrix}
\]

- The S component is standard Finite Element
- The radiative part induces complex asymmetric couplings through T and G*E to the surface elements.
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The test case
PAFEC

The final product
SGI: 75MHz processors/shared memory
NT: 166MHz processors/10Mbit Ethernet
LUSAS

Target Environment

- Windows NT (INTEL) 4 cluster 1..4 processors.
- Visual C++ 5
- Sockets and mounted filesystems

Generic Porting Issues

- Tcl/Tk and Motif configuration interfaces replaced by Windows dialogues.
- Rshd-launched daemons replaced by NT services.
- Environment variables replaced by machine-wide registry keys.
- Lexer/parser cross-compiled.
- Copies through NT filesystem found to be much faster than socket copies.
INTREPID Scheduler

- Developed for UNIX at PAC.
- Matches task components to heterogeneous resources:
  (CPU load, Memory load, Duration)
- Primary IPC is through the file system.
- Domain decomposition control interface to LUSAS is in Visual Basic.
1/8\textsuperscript{th} model of a composite landing-gear lug
LUCAS

- WindowsNT GUI modeler.
- Domain decomposition by bandwidth minimization on one processor.
- Solver is two nested loops:
  - Slow load application
  - Iterative stress/strain equilibration.
- Inner loop inter-domain communication is via file system.
- Computational load per cell varies widely.
- Large deformations.
• Performance on a heterogeneous mix of NT boxes.
• Memory footprint has a big impact.
• Heavy filesystem load.