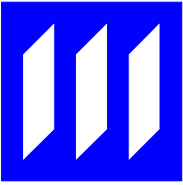# Porting Legacy Engineering Applications onto Distributed NT Systems

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*Parallel Applications Centre,
2 Venture Road, Chilworth, Southampton
SO16 7NP*

P.C. Macey
*SER Systems Ltd, 39 Nottingham Rd.,
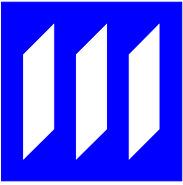Stapleford, Nottingham NG9 8AD*

PAFEC VibroAcoustic

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

Support: CEC PACAN-D Project (Esprit 24871)

Partners: PAC
              SER Systems Ltd
              Celestion International
              Motor Industry Research Assoc.
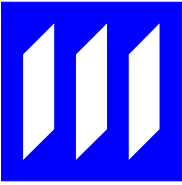
**University
of Southampton**

LUSAS FE

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

Support: CEC PARACOMP Project
                                (Esprit 24474)

Partners: PAC
                      FEA Ltd
                      Messier-Dowty

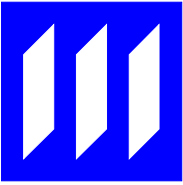# Parallel Applications Centre

Identifying, evaluating and applying advanced IT systems for business and industry

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.

**University
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PAFEC

Target Environment

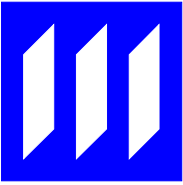- WindowsNT (INTEL) 4 cluster
  4..6 processors
- Digital Visual Fortran 5
- MPIPro or PaTENT MPI (Genias GmbH)

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.
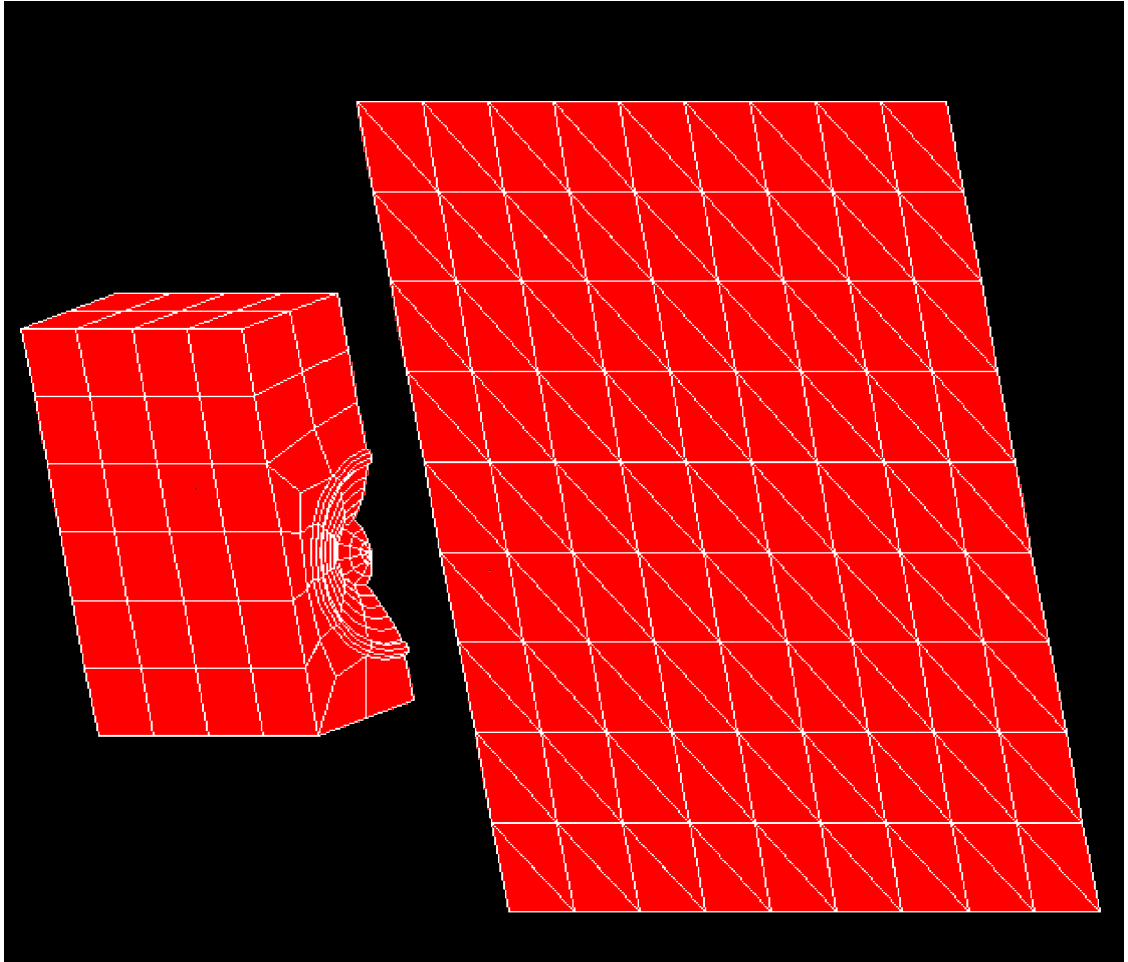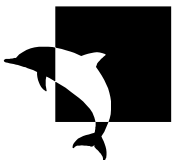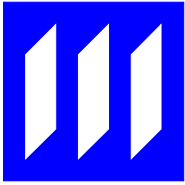- Nine out of ten phases left unchanged.

PAFEC

The key phase is a Gaussian elimination for an acoustic BE mesh coupled to a structural FE mesh.

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

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

PAFEC

The test case

PAFEC

The final product
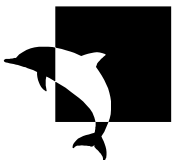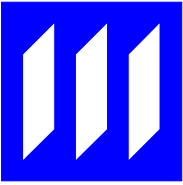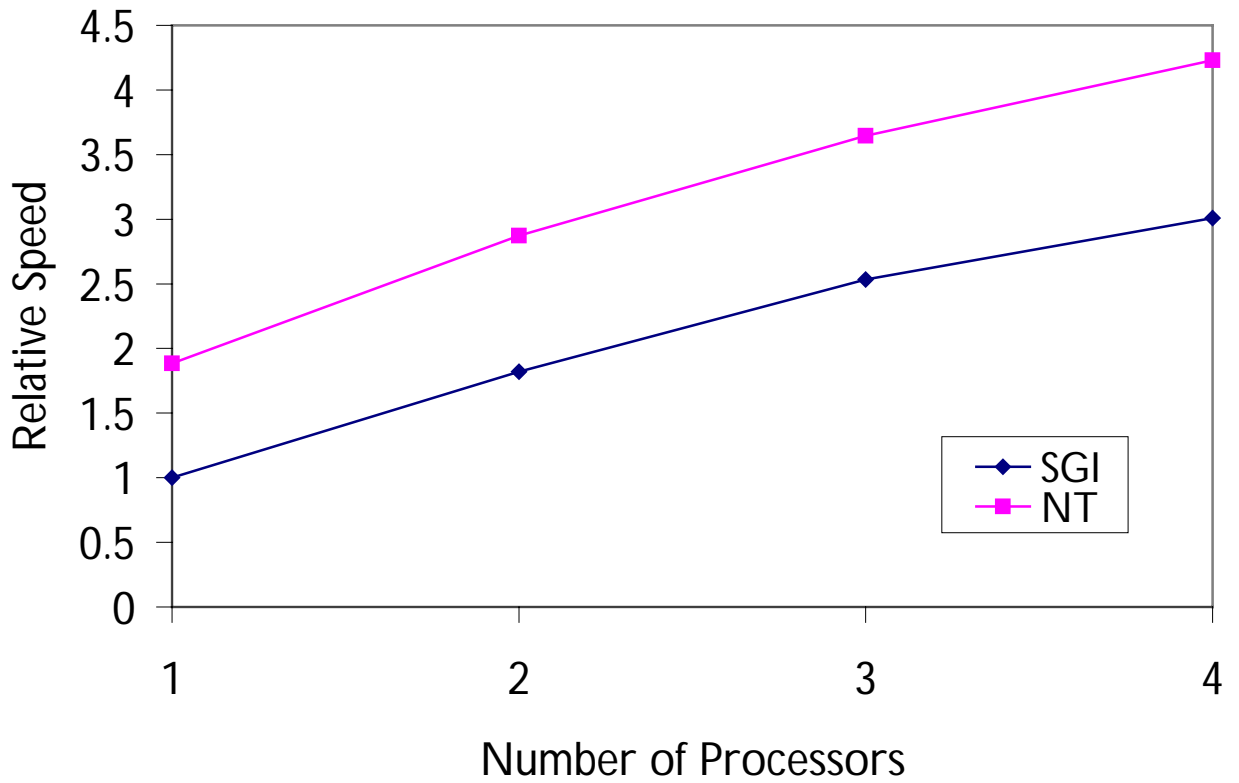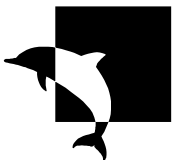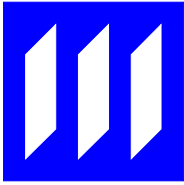
PAFEC

SGI: 75MHz processors/shared memory
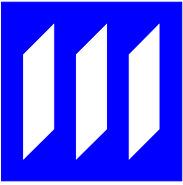NT: 166MHz processors/10Mbit Ethernet

LUSAS

Target Environment

- WindowsNT (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.
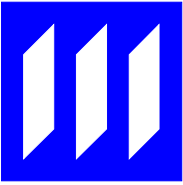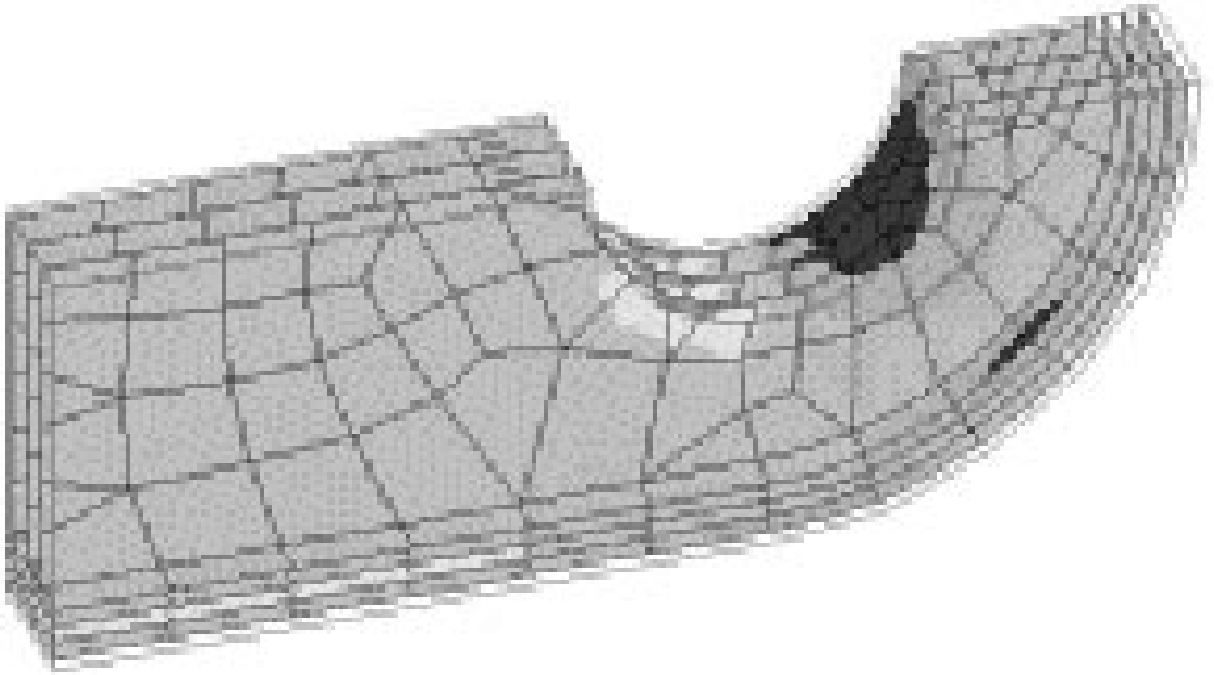
INTREPID Scheduler

- Developed for UNIX at PAC.
- Matches task components to heterogeneous resources:
    (CPU load, Memory load, Duration)
- Primary IPC is through the file system.
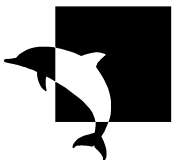- Domain decomposition control interface to LUSAS is in Visual Basic.
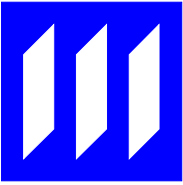
LUSAS

1/8th model of a composite landing-gear lug
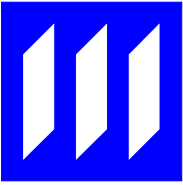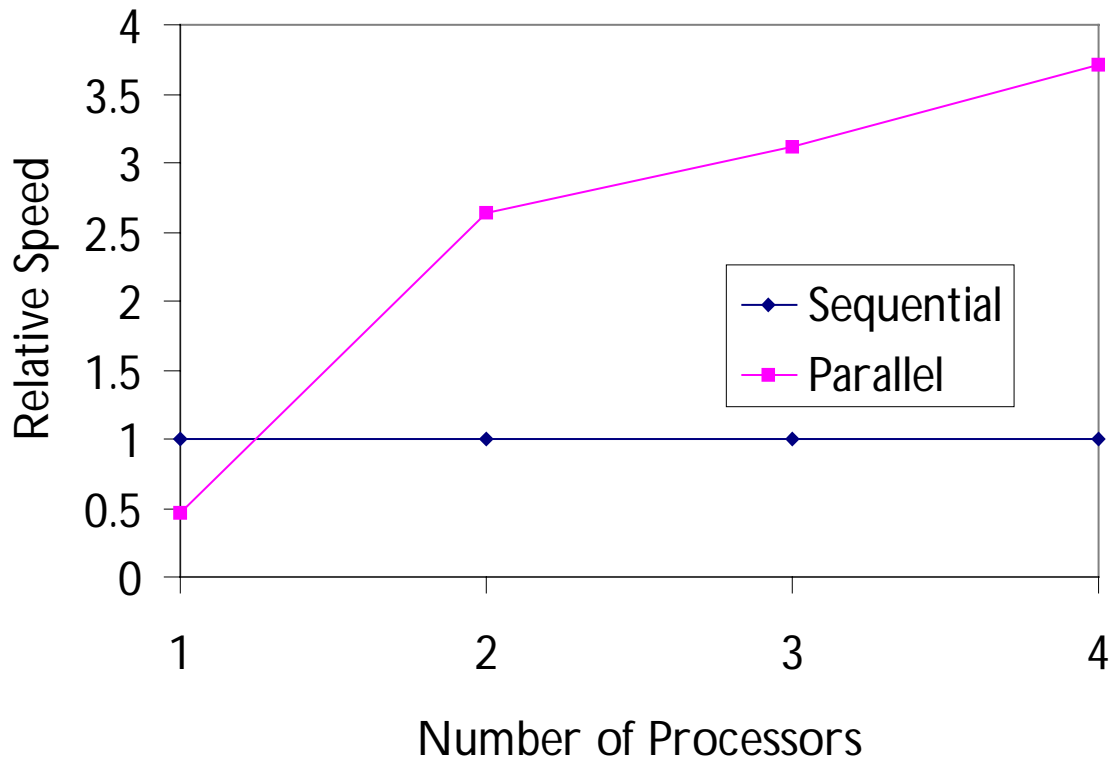
LUCAS

- WindowsNT GUI modeler.
- Domain decomposition by bandwidth minimization on one processor.
- Solver is two nested loops:
  - o Slow load application
    - o Iterative stress/strain equilibration.
- Inner loop inter-domain communication is via file system.
- Computational load per cell varies widely.
- Large deformations.

LUSAS

- Performance on a heterogeneous mix of NT boxes.
- Memory footprint has a big impact.
- Heavy filesystem load.