Pattern matching in DAME using Grid enabled AURA technology

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Overview

- DAME
- The data
- AURA
- Performance
- AURA-G
- Data Encoding
- Tool
- Next stages
DAME

• Aims to show how Grid can support diagnostics and prognostics
• Undertaken on Rolls Royce Aero-engine vibration and performance data within a Grid frame work
• Detailed paper in already presented
The pattern matching problem

- Vibration data from all engines in flight
- *Detect*
  - events on that engine that look unusual
- *Search*
  - for similar events on other engines that are known about or not known about
- *Reason*
  - Using historical data that is associated with past similar events
Solutions

• Detect:
  – Uses a QUOTE on wing statistical classifier system – Oxford University

• Search:
  – Uses AURA pattern matching methods to search large vibration data sets - York

• Reason:
  – Uses CBR tools based on existing technology - Sheffield
The data

- Engines can produce 1Gb per engine per flight.
Searching the data

- Large amounts of noisy signal data.
- AURA provides
  - Proven technology for searching large data sets
  - Ability to scale and maintain performance
  - Can be parallelised
AURA

- Takes vectors and compares them to stored examples
- Uses bit level comparison methods and binary matrix operations.
Data storage & recall

Correlation Matrix Memories

Input pattern

Output pattern

AURA SearchEngine

Binary

2 1 0 2 0 0 0

* * *
AURA software

• AURA redesign
  – To allow use within the Grid
  – To improve performance of the AURA library in terms of both memory usage and search times.
  – To make the library easier to use.
  – To engineer the library to commercial software standards.
AURA Library Performance for 500,000 columns of Address Matcher data

Threshold Method

- New Library (Unoptimised)
- New Library (Optimised for Speed)
- New Library (Optimised for Memory)
- Old Library (Compact CMM)
- Old Library (Compact + Conserved)
- Old Library (Efficient CMM)
- Old Library (Efficient + Conserved)
- Raw data 16 bit (6.8M bits in Compact form)
- Raw data 32 bit (6.8M bits in Compact form)
- Zipped text file

All hands 2003
AURA-G

• OGSI GT3
  – Supports
    – Multi-users
    – Multi-memory systems
• Layers
  1. First is the client side
  2. Globus service management
  3. Local high performance connectivity –
     • cortex-1 clustering software
     • PRESENCE II hardware
  – We have an AURA service
     • CMM, pre-process, backcheck services
Implementation

• Operation in DAME architecture
  – Part of DAME automatic workflow
  – Developing a tool set
Data representation

- Extract tracked order – then search for similar examples
- Must code the data for use in the memories
- Use Delta Modulation coding
  - A variant of Differential Pulse Code Modulation
DM encoding

1000000000010101000010100000000 Bit string to search for
AURA-G time series match tool
Next stages

- Implement next tier of AURA-G
- Perform scaling trials on engine data
- Refine similarity methods