STI Center of Competence
Michael Manzke
Graphics Vision and Visualisation GV2
School of Computer Science and Statistics
Trinity College Dublin
Trinity College:
- Founded in 1592, is the oldest university in Ireland.
- Over 12,000 students and 1,200 staff.
- First Computer Science Department in the country
- Largest School in the country
  • > 50 Faculty
  • Large by international standards
• Trinity was ranked*:
  – 53rd in the world
  – 13th in Europe.
• Trinity is the only Irish university to make it into the top 100 world universities.
• The THES world university rankings lists the world’s top 200 universities measured on:
  – Research quality
  – Graduate employability
  – International outlook
  – Teaching quality

*According to the latest Times Higher Education Supplement world university ranking
School of Computer Science and Statistics:

- Applied Information Systems Group
- Centre for Health Informatics
- Compiler Design Research Group
- Computational Linguistics Group
- Computer Architecture Group
- Centre for Research in IT in Education
- Distributed Systems Group
- Foundations and Methods Group
- **Graphics, Vision & Visualisation Group**
- Knowledge and Data Engineering Group
- Networks and Telecommunications Research
- **Software Structure Group**
- Statistics
• TCD’s STI Center of Competence is managed by the Graphics, Vision & Visualisation GV2 group

• Most Cell research is related to the:
  • Graphics, Vision & Visualisation Group
  • Software Structure Group (Dr. David Gregg)
• Graphics Vision and Visualisation (GV2)
  • Our main areas of research include:
    • Image/Video and Audio Processing & Analysis
    • Perception and graphics
    • Real-time rendering and animation
    • Custom and multi-core hardware architectures
    • Image annotation & text illustration
  • 9 Faculty
  • 7 Postdocs
  • 20 PhD students
  • 3 Engineers
Cell Infrastructure
Metropolis Server Architecture

Servers are composed of:

- 10 x86 Intel servers
- 10 CELL servers
- Networked using Infiniband
Architecture for behavior server (1)

World segregated into zones
Architecture for behavior server (2)
Architecture for behavior server (3)
Cell Real-Time Ray-Tracing

• Begun to port the RT² Real-Time Ray-Tracing System[1] to the Cell processor.
  • The massive vector processing capabilities of the platform it is well suited to packet tracing[2].
  the tracing of multiple rays together through a scene hierarchy using SIMD.


Boids
- Locating 5 nearest neighbours
  - Find all boids within max. interaction radius
  - Figure out which remaining boids are the k-nearest neighbors

Big Fast Crowds on PS3 – Reynolds2006

Developing Massive Crowds for PS3 – Van Eyck, O’Connell, Collins 2008
• Other optimizations & scalability
  – Vectorized 5NN search
  – Shared job queue
  – Atomic operations for write synchronization
Dr. David Gregg (Software Structure Group)

• Group of 6 PhD students and 3 engineers

• Research themes
  – Compiler optimizations
  – Processor microarchitecture
  – Interaction of hardware and software
Java VM Optimizations on CELL

• Java used in many important applications
• Challenge for Java
  – Want to offload work to SPEs
• How to implement Java VM on SPE?
  – Compact, fast interpreter
  – Small code from JIT compiler
• Collaboration with UC Irvine
Java VM Optimizations on CELL

Java Grande Forums Section 2 Size A - Pipelining % Increase from CellVM Base

Program Counter Pipeline
Extended with Operand Pipeline
Extended with Operand Pipeline (offset pre-scaling)

Percentage

Series | LUFact | HeapSort | Crypt | FFT | SOR | Matrix Mult

Game Glue

• Scripting for games
  – High-level “glue” code for designers
  – Glue components together dynamically

• Full support for multi-core

• Developed on Playstation 3 and PC

• Fast, memory constrained VM

• 3 full-time research engineers
Finite Element Analysis

- Accelerate engineering simulation
  - E.g. Simulation of a truck axle
Finite Element Analysis

• Sparse linear algebra problem
  – Running time dominated by sparse matrix by dense vector multiplication
  – Irregular memory accesses
  – Tricky to parallelize

• Achieved speedups of 4-5 compared to fast PC
Compiling Streaming Languages

- High-level parallel languages
- Stream data type
  - Enables data parallelism
  - Data locality between ‘kernels’ that operate on streams
- Current work is aimed at auto-vectorization
Collaboration with IBM Dublin

• IBM Dublin Software Lab

• Dynamic Adaptive Virtualization
  – Being built by IBM Dublin HPC group
  – Offload computationally intensive functions
  – From desktop to faster machines
    • e.g. Offload financial computations of options pricing from PC to QS21 BladeCenter®

• TCD’s role is in exploration of new features and applications
  – Not building DAV
Workshop Organization

• TCD hosted a Cell BE workshop
  – November 2006
  – Keynote talks
  – Cell BE Training
  – http://isg.cs.tcd.ie/cellworkshop/

• Workshop on Cell Systems and Applications 2008
  – Steve Collins and David Gregg on PC
INNOVATION PARTNERSHIPS

Company / Third Level College Collaboration
IBM (Ireland) & Sony Electronics Inc.

CELL Motion Capture and Compression System

• This project aims to develop CELL optimised tools for automatic capturing of human motion and subsequent compression of that motion for efficient storage.

• The motion tracking and capture methods will use only a single camera for interactive applications.

• Real-time video will be captured, analysed and the motion of a 2D skeleton estimated.
  • This represents the projection of the user onto the view-plane of the camera
Questions