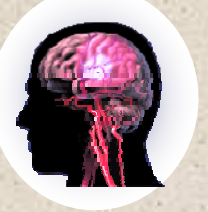

Supercomputing at UC

Professor Tim David

University of Canterbury

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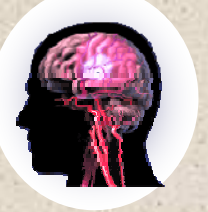
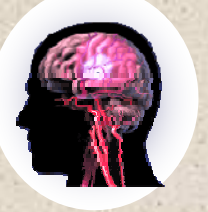
Intro



The UC Supercomputer (UCSC) is the latest version of a 128 processor Power 5 machine, supplied by IBM

Tech Specifications



- The UCSC system is a tightly-coupled, high-performance computer system composed of IBM's p5-575 high-end compute nodes.
- Each compute node contains 16 of the latest generation IBM Power 5, 1.9 Giga Hertz (GHz) processors and 32 GigaBytes (GB) of memory.
- UCSC comprises eight nodes, providing a 128 processor machine with a theoretical peak performance of almost one teraflop per second. (A teraflop is 10^{12} floating point instructions).

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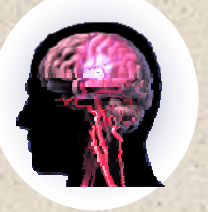
Storage Management



- The disk solution utilises Storage Area Network (SAN) technology and provides approximately 11 TeraBytes (TB) of highly available storage. Utilising IBM's General Parallel Filesystem (GPFS) — a high performance parallel filesystem — the storage is accessible from all nodes.
- A backup and archive facility, using IBM's Tivoli Storage Manager (TSM) software and a tape library is provided. The media used to perform the backups is the latest generation Ultrium format Generation 3 media (LTO3) and allows for 800GB capacity on each compact catridge.

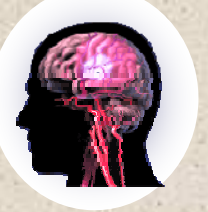
Connectivity

- All nodes have a high speed, low latency interconnect (infiniband) to allow users to exploit parallelism across nodes using programming interfaces such as Message Passing Interface (MPI).

Software

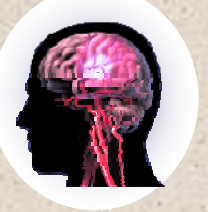
- A rich software environment is provided on UCSC. Both IBM AIX and SUSE Linux operating systems are provided. In addition, a comprehensive scientific computing software stack is provided, including:
- Optmised IBM Fortran, C amd C++ compilers for AIX and Linux
- Parallel Environment for Messaging Passing Interface (MPI)
- A batch job scheduling system (LOADLEVELLER)
- Engineering and Scientific Libraries
- Optimisation and profiling tools
- Examples of parallel applications used in the various academic disciplines that will be running on the UCSC include:
- FLUENT - for computational fluid dynamics
- WRF & MM5 - for weather research and forecasting
- GAMESS - for atomic and modular electronic structure

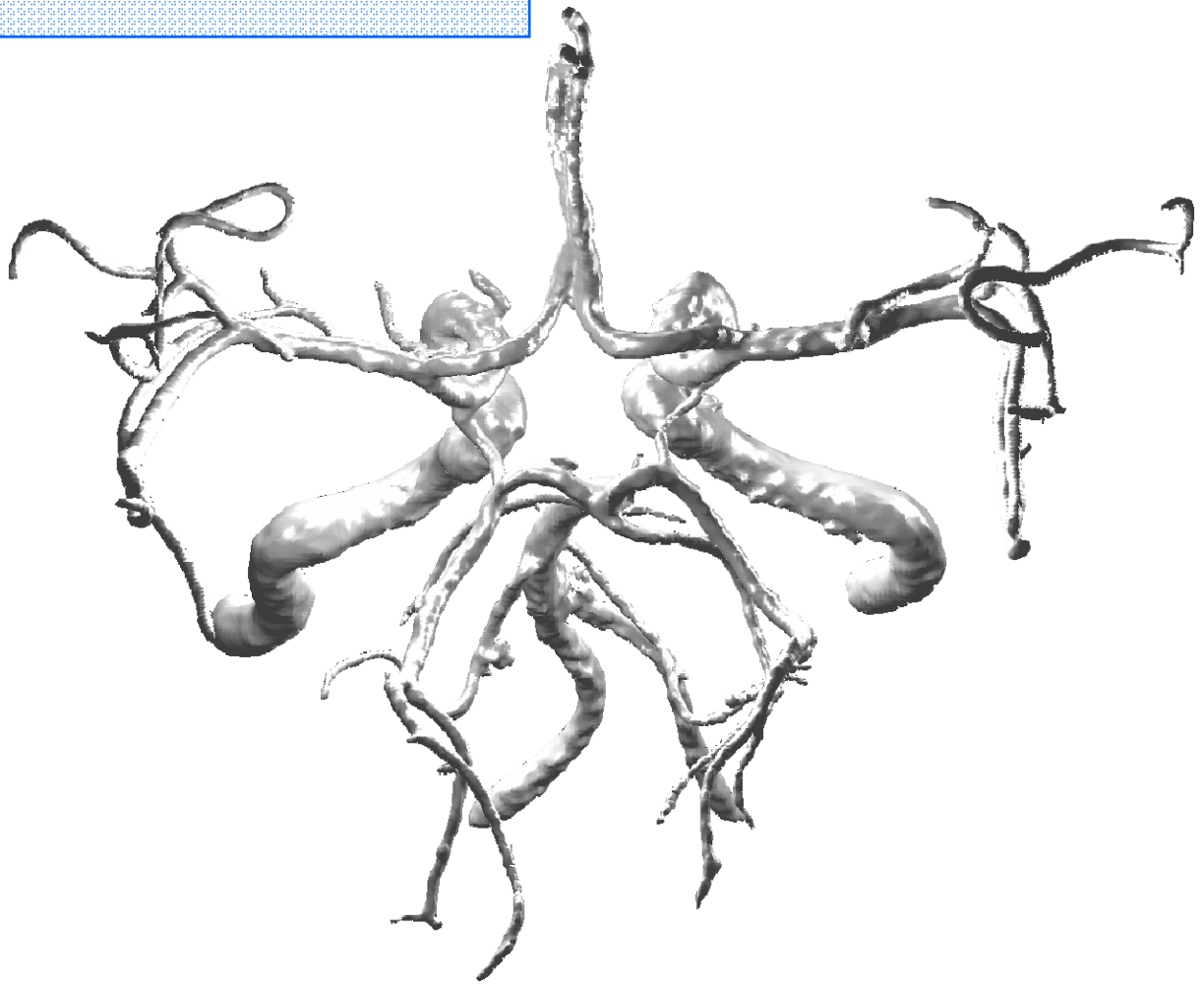
Some real-life examples



- Micro-lensing (light really does bend !)
  - Requires the calculation of millions of light rays passing through space
- Blood flow in the brain
  - Flow through complex geometry varying with environment
- Cell chemistry
  - Hundreds of chemical reactions going on in a cell microns in size.
- Weather/wind prediction
  - Complex maps of NZ telling when to switch on windfarms

Arteries in the Brain





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Particle flows in the brain

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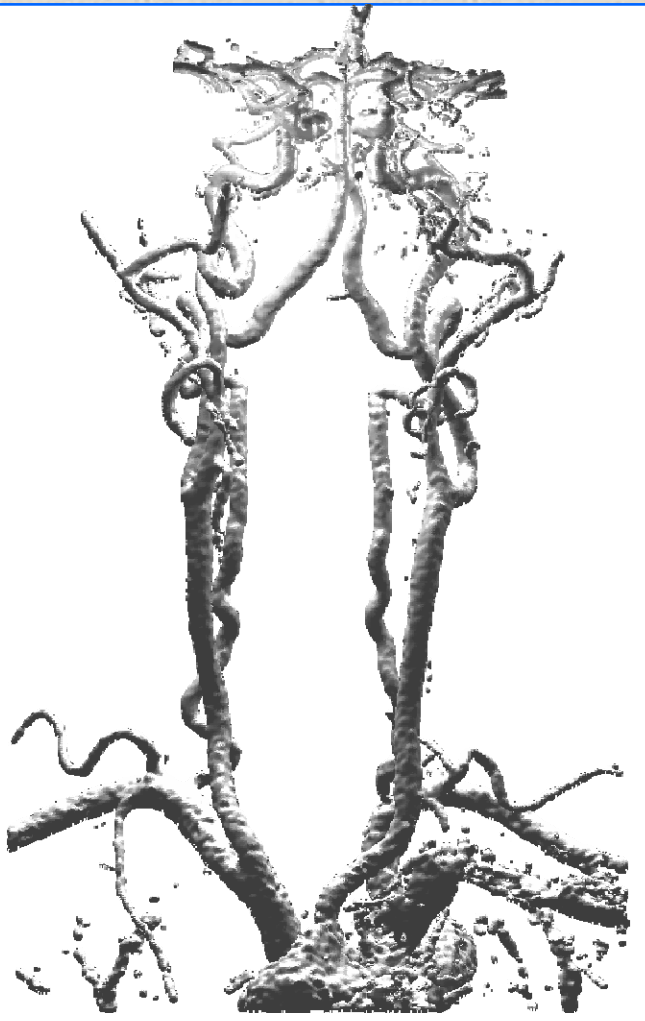
Ongoing Work

- Diagnostics for neurologists, including embolic pathways
- Expand model to include other organs via complex human models (“cardiovascular human”)
- Link with NASA, digital astronaut.



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Cell Functions and complex CFD

eNOS and Ca2+ Production in Arterial Geometries: an Integrated Fluid Mechanics/Cell Model

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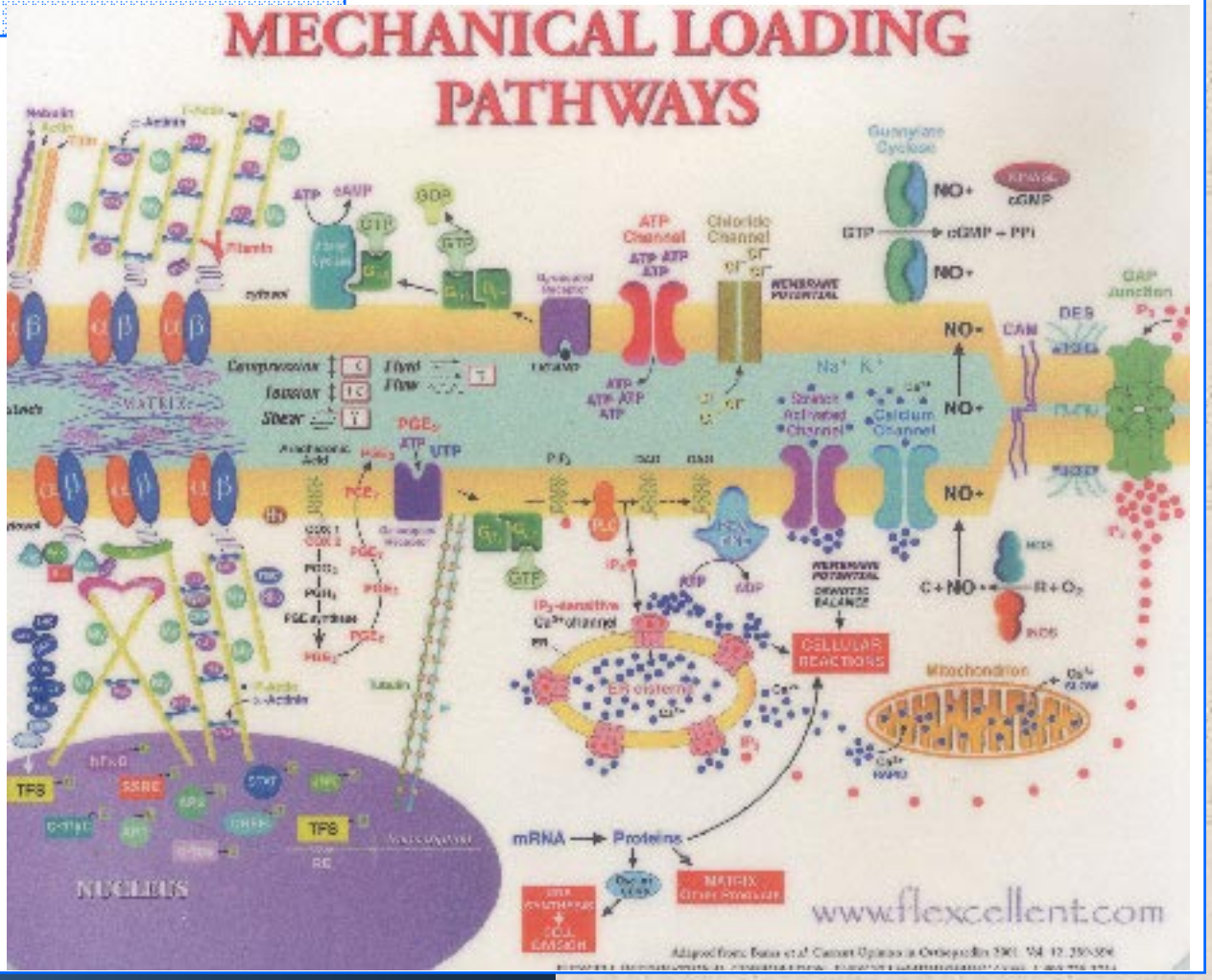
Endothelial Pathways

- Atherosclerosis
- Concentration on Ca2+ and NO pathways
- Stretch and WSS activated channels
- Coupled to fluid dynamics
- Cell models “easily” (!) increased



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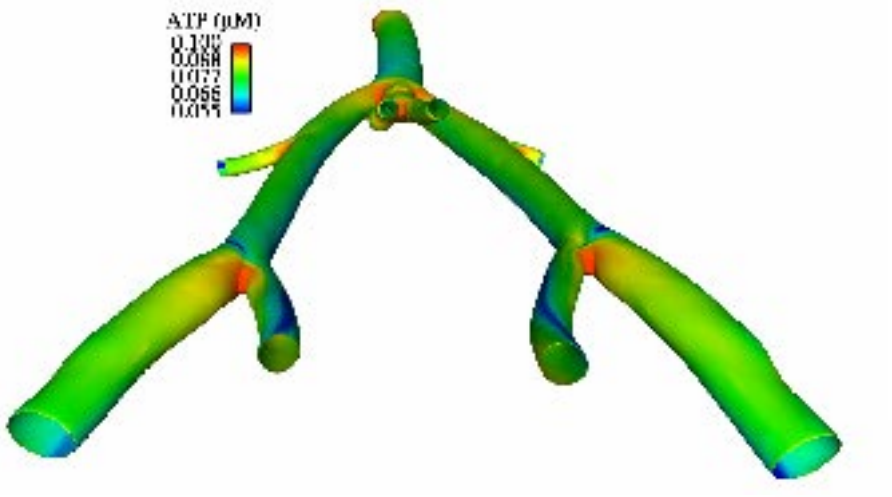
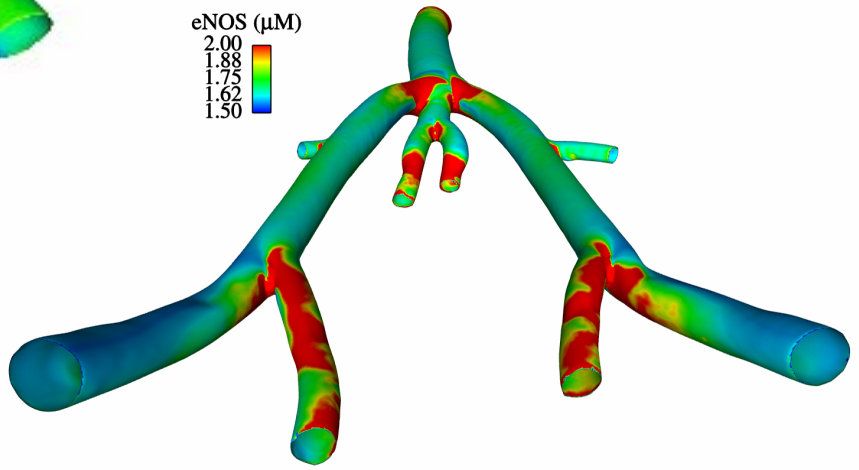
eNOS and ATP Maps





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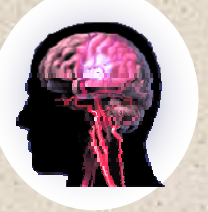
What makes it “Super”?



- As with any powerful machine, the quality of systems integration, operation, and application support are critical to achieving success.
- The UCSC is an incredibly powerful IBM computer that comes packaged with many years of experience. It is these synergies that make UCSC ‘super'.
- We have developed over very short period of time a viable service for the academic and industrial community

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