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PREP 2000 Conference Report

Points from talks attended at PREP 2000 (April 11th to 13th, Nottingham). Please see conference proceedings for full papers and authors. The page number of each of the papers is included in the title.

Directions and Challenges in Integrated Circuit Scaling, Dr Mark T. Bohr, Intel Corporation.

- Commercial microprocessor clock frequency increases by ×1.25 per year - currently 1GHz.
- No hard limit within the next 5 years.
- Transistor count currently 28 million per chip - ×1.3 per year.
- Gate oxide thickness currently 2nm for a 0.05µm gate.
- 0.8nm gate oxide thickness is physical limit.
- Average chip interconnect pitch of 1µm.

Development of a Distributed Crossbar Switch Hypermesh Parallel Computer (pp. 1)

- To connect standard PCs together using custom hardware and develop an OS.
- Parallel machines are used only for specific problems because of Amdahls' law.
- Circuit switching blocks an entire path. Packet switching does not. Wormhole switching routs packet as soon as possible.
- A Hypermesh architecture uses crossbar type routing. Easier to map parallel applications. Could we map neurons onto each node?

Power Minimisation Techniques for Testing Low Power VLSI Circuits (pp. 7)

- Minimisation of power dissipation.
- Minimise switching and maximise reliability.
- If a lot of switching occurs at one on a single chip this will result in a large amount of power and/or ground noise.
- A 'scan chip' concept is used to transparently monitor for spurious transitions.

- Examination of BIST (Built In Self Test) circuitry and software to minimise its power usage.
- Theory has resulted in a 30% reduction over current BIST technology.

Tolerating Memory Latencies in Distributed Memory Multiprocessor Architectures (pp. 13)

- Memory latency is the time required to return information from memory.
- A processor wastes time in modern machines waiting for information to return. (e.g. Processor runs at 800MHz, RAM at 200MHz).
- Latency is an ever increasing problem.
- This is worse in multiprocessor systems as they must pull information from a remote node.
- Problem can be dealt with by using caching, dynamic scheduling (do something else), pre-fetch and multi-threading (execute another thread).
- Bigger memory latency, add more threads.
- Study indicates that 3 to 4 threads on a uniprocessor system will result in 80% processor utilisation.
- Process switching is not complex as system can simply store the program counter (PC).

A Fault Tolerant Router for Parallel Networks (pp. 19)

- Improved performance can be gained by decomposing a task into parallel parts.
- Can improve the reliability of distributed systems thorough modularity.
- Distributed systems have inherent problems when local communications are disrupted.
- Use a router switch to rout messages in a transputer type mesh.
- System can then deal with node failure, disconnection failure and noise errors.
- Decentralisation is the solution here. Improve node autonomy.
- 4% increase in hardware requirements needed for fault tolerance with no performance loss.

Towards a Java-Based Distributed VHDL Simulator (pp. 25)

- Simulator for very high speed circuit hardware description language (VHDL) implemented as a distributed simulation in JAVA.
- Problems with this system lie mainly in data distribution overheads.
- System invisible to user - can be used over the web.

The Introduction of Digital Processing Techniques to a Neutron Sensing System (pp. 30)

- A transportable neutron spectrometer finds neutrons dangerous to humans. Current system is old and all analogue technology.
- Neutrons are hard to detect. Look for alpha particle ejection due to neutron interaction, kinematic proton liberation in hydrogen atom collision or NE213 (organic molecule in organic solvent) scintillation.
- Analogue system misses pulses due to multiplexing from these three different sources.
- DSP implementation solves processing problems.

Experimental Comparison of the Effect of Intraband Coherent Crosstalk on System Performance for Multiple Interferers Applied to Any WDM Optical Network (pp. 171)

- Examines the experimental sources and effects of WDM crosstalk.
- Crosstalk sources can be incoherent (uncorrelated phases), interband (interchannel) or coherent (correlated phase).

A Fibre-Integrated Optical Injection Phase-Lock Loop for Millimetre-Wave Radio-Over-Fibre Applications (pp. 177)

- The use of mm wave frequencies for wireless communications within fibre fed microcells.
- Microcells are used as mm waves have no cornering capability.
- System has large bandwidth, small call size but unfortunately requires expensive components.
- System has one base station optically feeding multiple remote antennas.
- OIPLL system is not limited by laser linewidth or electrical components.
- System is a novel method for the generation of mm waves.

A Stabilised, Rationally Mode-Locked 10GHz Erbium Fibre Laser (pp. 188)

- To create high speed optical pulses with short pulse widths.
- Active mode locking can be achieved by modulating phase (PM) or amplitude (AM) in the cavity using an external modulator.

Code Acquisition Using a Sequential Detector in a Fibre-Based Optical CDMA Network in the Presence of Multi-User Interference (pp.192)

- Derives a performance measure, in this case mean acquisition time.

- System examined is optical carrier detect multiple access (CDMA) using orthogonal codes.

Optical Pulse Compression: Theory and Practice (pp. 198)

- Enhance transmission capacity by using dense optical time division multiplexing (OTDM).
- Dispersion shifted fibre (DSF) broadens pulse in frequency domain.
- Standard telecommunications fibre (STF) narrows pulse in time domain.
- Soliton propagation adapts pulse shape to the target fibre characteristics leading to pulse compression.
- Project objective is to compress a 5ps pulse to 1ps using comb-like dispersion shifted fibre (CDPF) method.
- Actual compression of 3.7 rather than 5 as simulated was achieved.
- Short pulse gives transmission problems due to dispersion.
- CDPF is a cheap alternative to dispersion shifted fibre decreasing fibre cost.

Acoustic Emission Signal Processing To Detect Impact Damage Location Using Neural Networks (pp. 380)

- A neural network can be used to locate impact damage.
- A 2 layer network is used. Sensor layer contains multiple neurons, output layer contains two - one representing x co-ordinate and one for y.
- A back propagation (BP) network was successfully trained to locate an impact in an isotropic material.

Predictive Handover Scheme for Wireless ATM Utilising Neural Networks (pp. 366)

- Project attempts to limit handover dropping and cell overload probability in a mobile network to a predefined level.
- Future wireless systems will have to use a microcellular architecture. Wireless resources not guaranteed at cell handover.
- A virtual connection tree (VCT) guarantees a specific quality of service (QoS) but is bandwidth inefficient.
- A neural network solution would reduce these bandwidth problems.
- Neural network can predict user movements and destination.
- Embeds a level of intelligence into handovers.
- Proposed system reduces the amount of blocking in comparison to VCT.

Probabilistic Neural Network for Biometric Computer User Verification (pp. 371)

- Security is the key: especially with growing e-commerce and online banking.
- Security currently implemented using strong encryption, user names and passwords.
- Why not use biometrics to increase security - measurable features of the human both physical and behavioural.
- This project looks at keystroke dynamics - an individual's typing style such as time of flight between keys, timing intervals etc.
- Cost effective solution - no additional hardware required.
- Outliers (pauses while typing) can confuse network. Must eliminate.
- System uses a probabilistic neural network (PNN) which can be trained rapidly. Unfortunately this results in a larger net than that of back propagation (BP).
- Euclidean distance exaggerates outliers due to square term. Therefore a Manhattan distance is used as there is no square term.
- PNN has proved to be better.

Rolling Force Prediction in Hot Strip Mill Using Online Neural Network Training (pp. 376)

- A dynamic database can largely improve generalisation ability of neural network.
- Dynamic training is a promising method for industrial application of neural network approach.
- Quality improvements in strip mill - not speed.

Improved Clustering Consistency for Fuzzy ART Neural Networks (pp. 381)

- ART: adaptive resonance theory. Clustering algorithm for unsupervised classification.
- Stable yet plastic. Self-organising, self-scaling, self stabilising and on-line learning.
- Fuzzy ART: 0 to 1 inclusive.
- System intolerant to noise >4%.
- True number of categories cannot be known.
- Problem is clustering consistency: Network should cluster corrupted into uncorrupted.
- Project has an error rate of 25% at 4% noise compared the 80% and 85% values of existing systems.

- This improvement is at the cost of execution speed.

Industrial Debate - New Technology

Is new technology good for mankind or simply a fashion accessory. The analogue shell is beginning to crack.

Peter Saraga - Philips

- Towards a digital future - is tech improving our lives.
- Vision is sympathetic products that know the user's profile.

Richard Ash - Agilent

- Ubiquitous computing and connectivity.
- We are changing the way we work and play in line with available technology.
- Bandwidth is becoming cheap.
- Continual trend toward the convergence of internet traffic and data comms.

Brent Ericson - Ericcson

- Added functionality in each new iteration of a device.
- People have limited time and money. Tech must bring some new value to the user.
- 1 billion people will be connected to the mobile phone network by 2004.
- Memory, logic and ASIC circuitry will soon be replaced by an entire System on Chip (SoC) solution.
- The games industry is the driving force - e.g. the Playstation 2's Emotion engine is capable of 6.4GFlops.
- New systems should try to build information around you.

Hermann Hauser - Amadeus

- Make good business out of good science.
- The mobile era is the EU era (e.g. Nokia, Ericsson). EU is the dominant market and has the dominant standards.
- SME's create jobs.
- Entrepreneurship is the key.

Wong Voon - Total Access Communications

- Emerging economies - the great digital divide.
- 3 billion people have never heard a dial tone.
- 95% of the world's internet connections are in the developed countries.

- PCs are not the most cost effective way of accessing the internet.
- Terrestrial fibre optic links don't land in anything other than the developed countries.
- Developing countries should be looking at celestial (satellite) links rather than terrestrial.

Keith J. Symington