



**Markus Koskimies**

# **Programming A Massive Cellular Processing Array**

**A Practioner's Approach**

**Master's Thesis Research Plan**

**University of Oulu**

**Department of Information Processing Science**

**October 2005**

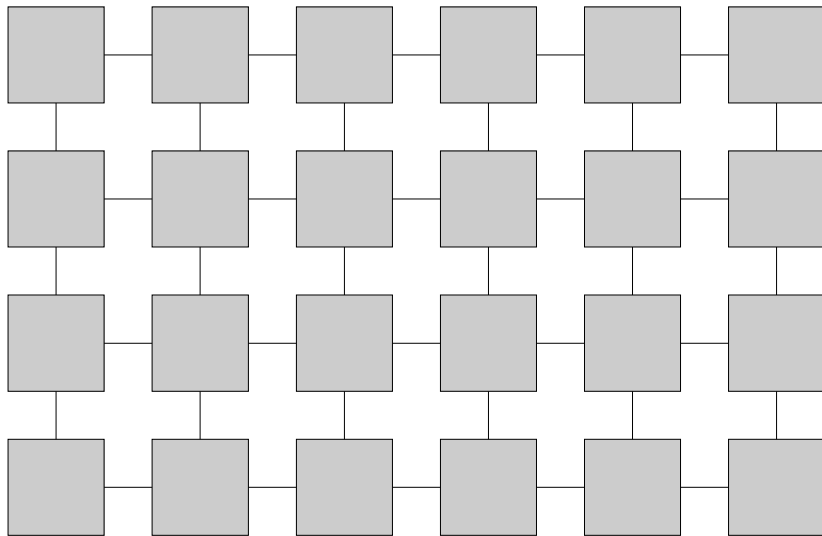


# Master's Thesis

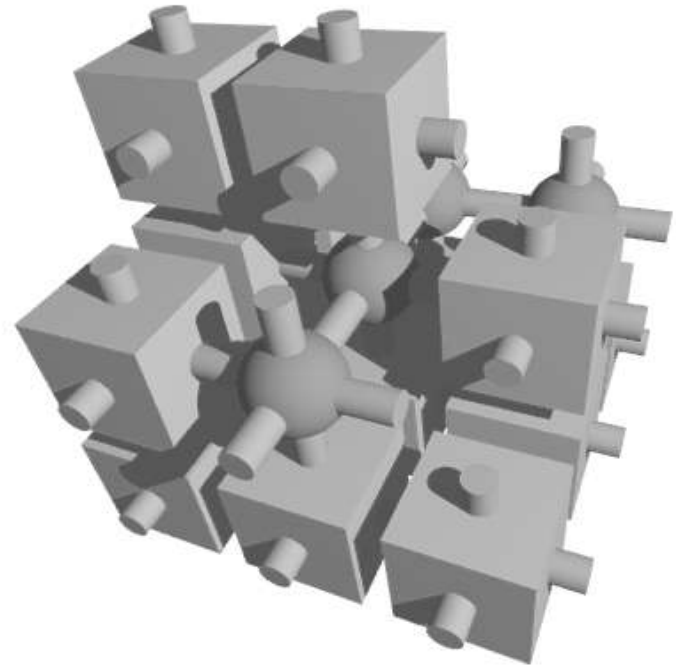
- **Supervising:**
  - **Prof. Petri Pulli, University of Oulu**
  - **Prof. Valentin Cristea, University Politehnica of Bucharest**
  - **Sr. Assistant Peter Antoniac, University of Oulu**

# What Are Cellular Arrays?

**Two-dimensional example:**



**Three-dimensional example:**



# Research Question

- **General purpose cell array processor?**
  - **Reliable, exact precision computation - Is it possible and how?**
  - **How are we able to implement algorithms?**
  - **What are the requirements for cells?**
  - **What programming languages to use?**
  - **Which kind of software architectures can be applied?**

# Research - Objectives

- **Developing a model for making software for cellular processing arrays**
- **Identifying the problems in constructions**
- **Providing possible directions for future development**

# Research Scope

- **The whole research area (cellular processing arrays) is unimaginable wide...**
  - Hits to the fundamentals of computing, computers and their software
  - Strict (but clever enough) limitations and scoping is definitely needed

# Research – Out-of-Scope

- **For example:**
  - **No:** Studying manufacturing problems & solutions
  - **No:** Quantum uncertainty, statistical computation models
  - **No:** Amorphous arrays
  - **No:** Embryonics, redundancy and reliability studies
  - **No:** Evolutive and genetic programming
  - **No:** Mapping the software to a CA
- **...Although those all are interesting and important**

# Research Plan (1)

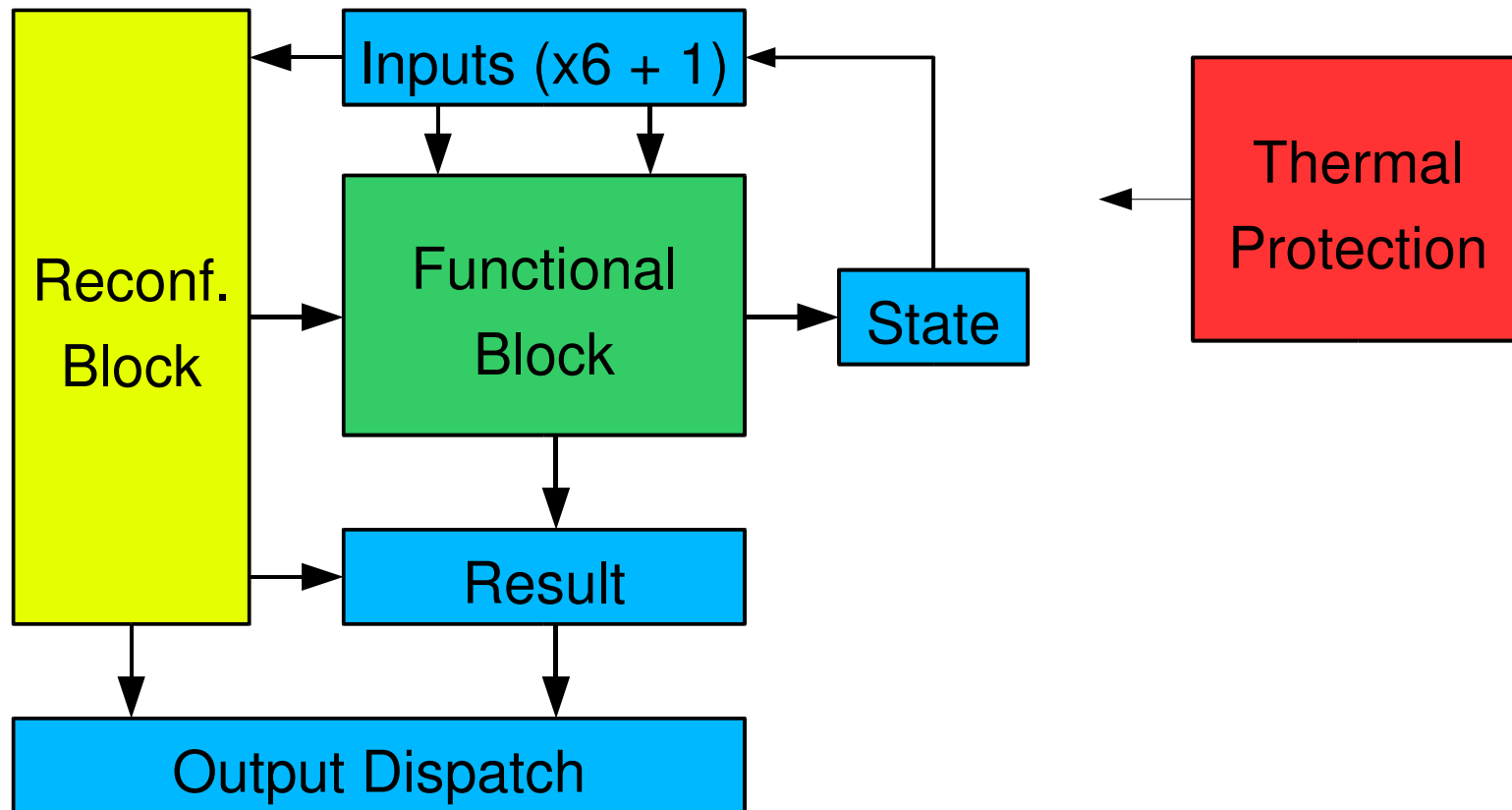
- **Task 1: Developing a cell model for simulator:**
  - **Based on the current knowledge**
  - **Not tied to any speculated fabrication method**
  - **Used as a background for array construction**



# Research – LCM

- **LCM: Logical Cell Model**
  - **Currently, there is no (reasonable) hardware for massive arrays**
  - **Thus the whole study is based on an abstract, non-existent cell model**

# LCM - Current Thought



# Research Plan (2)

- **Task 2: Making software for simulated array**
  - **Based on the developed cell model**
  - **Experimenting, measuring & analysing software building and performance**

# Research – Result Analysis

- **Cell model:**
  - Evaluated in simulator construction
  - Also: Theoretical, discussive analysis
  - Comparisons to fabrication speculations and other models

# Research – Result Analysis

- **Simulator (software architecture) results:**
  - Comparisons between alternative implementations, result tables
  - To general models of regular traditional processors
  - Conclusions and analysis

# Research - Methodology

- **Generally a constructive research:**
  - **Constructions and their evaluation in different ways**
  - **Basing constructions to theoretical frameworks**
  - **Quantitative and analytical methods**

# Preliminary Table of Contents

- **1. Introduction, backgrounds and theoretical issues**
- **2. Overview of Possible Fabrication Methods**
- **3. Logical Cell Model**
- **4. Example Programs**
- **5. Simulations, Results**
- **6. Constructing A Computer System**
- **7. Discussion**
- **8. References**

# Preliminary Schedule

- **Autumn 2005:**
  - Developing the logical cell model
  - Developing the necessary simulator(s)
- **Spring 2006, the begin:**
  - Developing example software
  - Running simulations, examining results
- **Planned deadline: May 2006**



# Preliminary References

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- Margolus, N.: *"Crystalline Computation"*. In The Feynman Lecture Series on Computation, Volume 2. A. Hey (ed), Addison-Wesley, 1998.
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