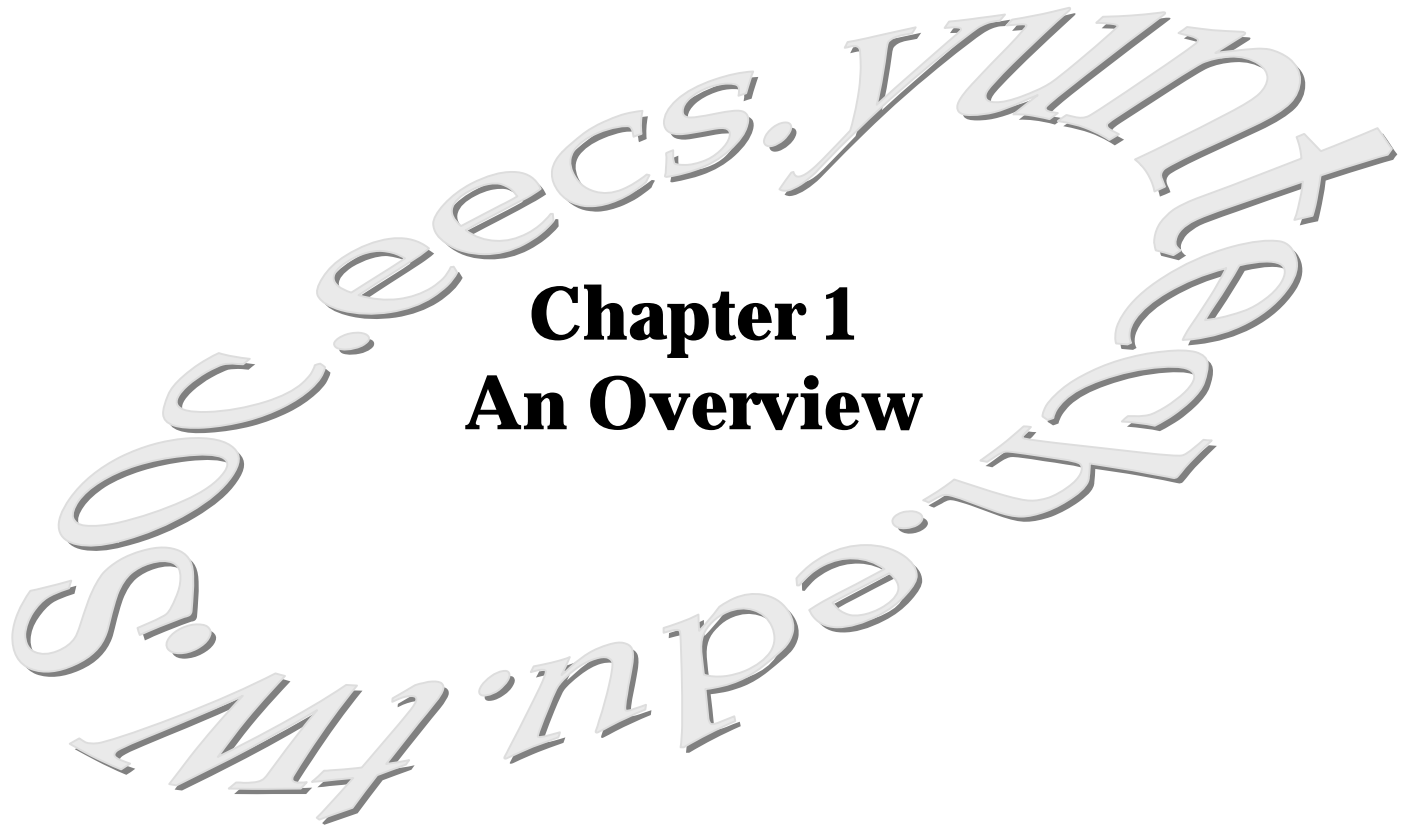


**Textbook: VLSI ARRAY PROCESSORS**  
**S.Y. Kung**

**Prentice-Hall, Inc.**  
開發圖書

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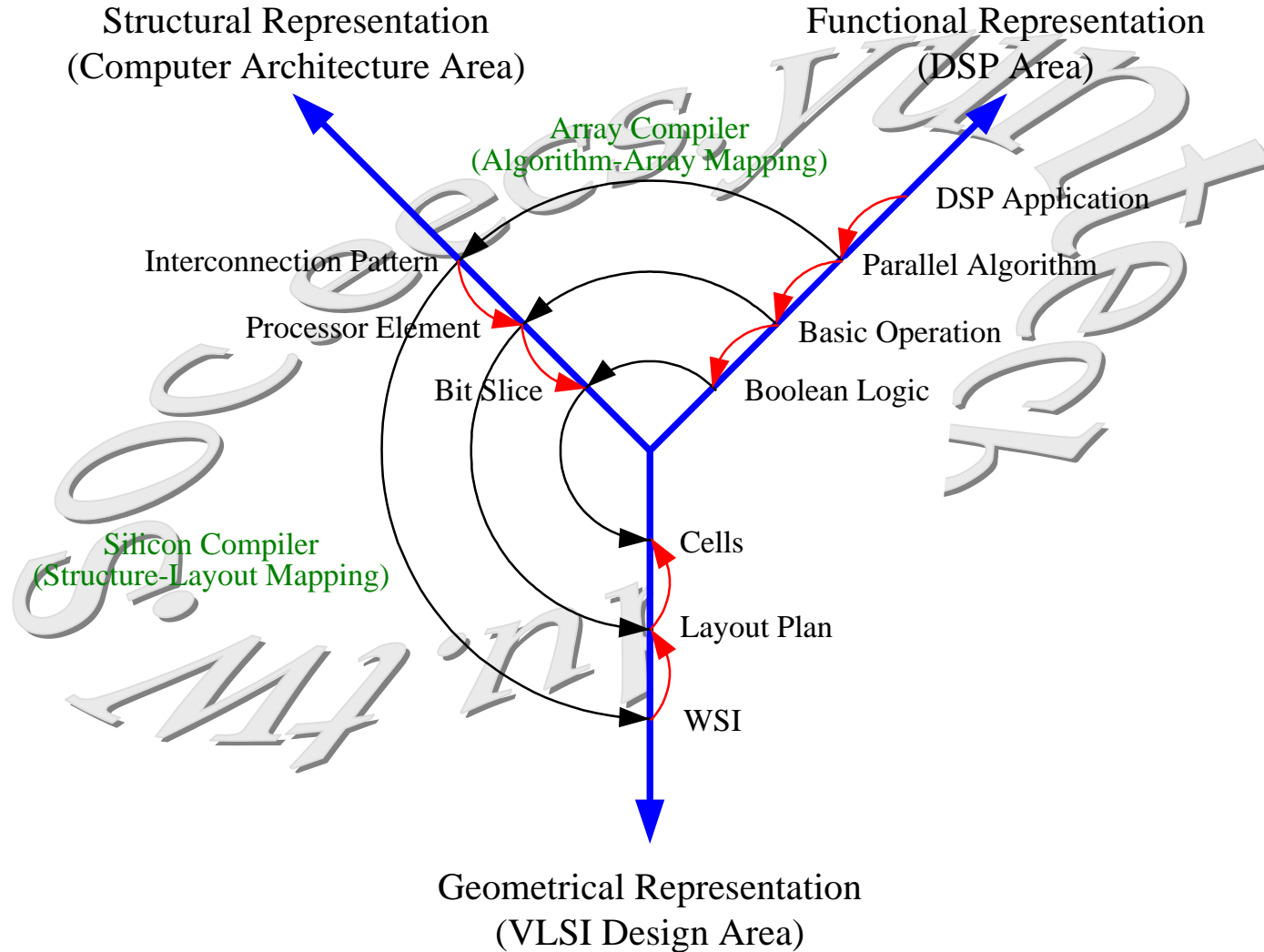
## **Chapter 1** **An Overview**

- 1.1 Introduction**
- 1.2 Array Processors for Signal and Image Processing**
- 1.3 VLSI Architecture Design Principles**
- 1.4 Overview of the Chapters**
- 1.5 Other Closely Related Research Disciplines**
- 1.6 Concluding Remarks**
- 1.7 Problems**

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- For the demands of modern real-time application
  - ☒ General purpose processor solution
  - ☑ Dedicated VLSI array processor

## ■ Y-Chart for Array Processor Design



- 1.1 Introduction
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- **Four Main Points of Attack in Designing VLSI Array Processors**

1. **Application**

2. **Algorithm**

3. **Architecture**

4. **Technology**



## ■ Application

1. Image Processing
2. Computer Vision
3. Nuclear Physics
4. Structure Analysis
5. Speech
6. Sonar
7. Radar
8. Seismic
9. Weather
10. Astronomical
11. Medical Signal Processing ...

## ■ Algorithm

1. Point Type
2. Filtering Type
3. Matrix Algebra Type
4. Transform Type
5. Sorting Type

## ■ Throughput Requirements for DSP Algorithms

| Processing Function  | Necessary Throughput |
|--|----------------------|
| Linear Operations, $O(N)$ <ul style="list-style-type: none"><li>- spatial filtering</li><li>- convolution</li><li>- edge detection</li></ul>                               | $10^2$ - $10^5$ MOPS |
| Second-order Operations, $O(N^2)$ <ul style="list-style-type: none"><li>- sorting operation</li><li>- median filtering</li><li>- nearest-neighbor classification</li></ul> | $10^3$ - $10^7$ MOPS |
| High Order Operations <ul style="list-style-type: none"><li>- matrix based</li><li>- spectral processing</li><li>- adaptive operation</li></ul>                            | $10^4$ - $10^8$ MOPS |

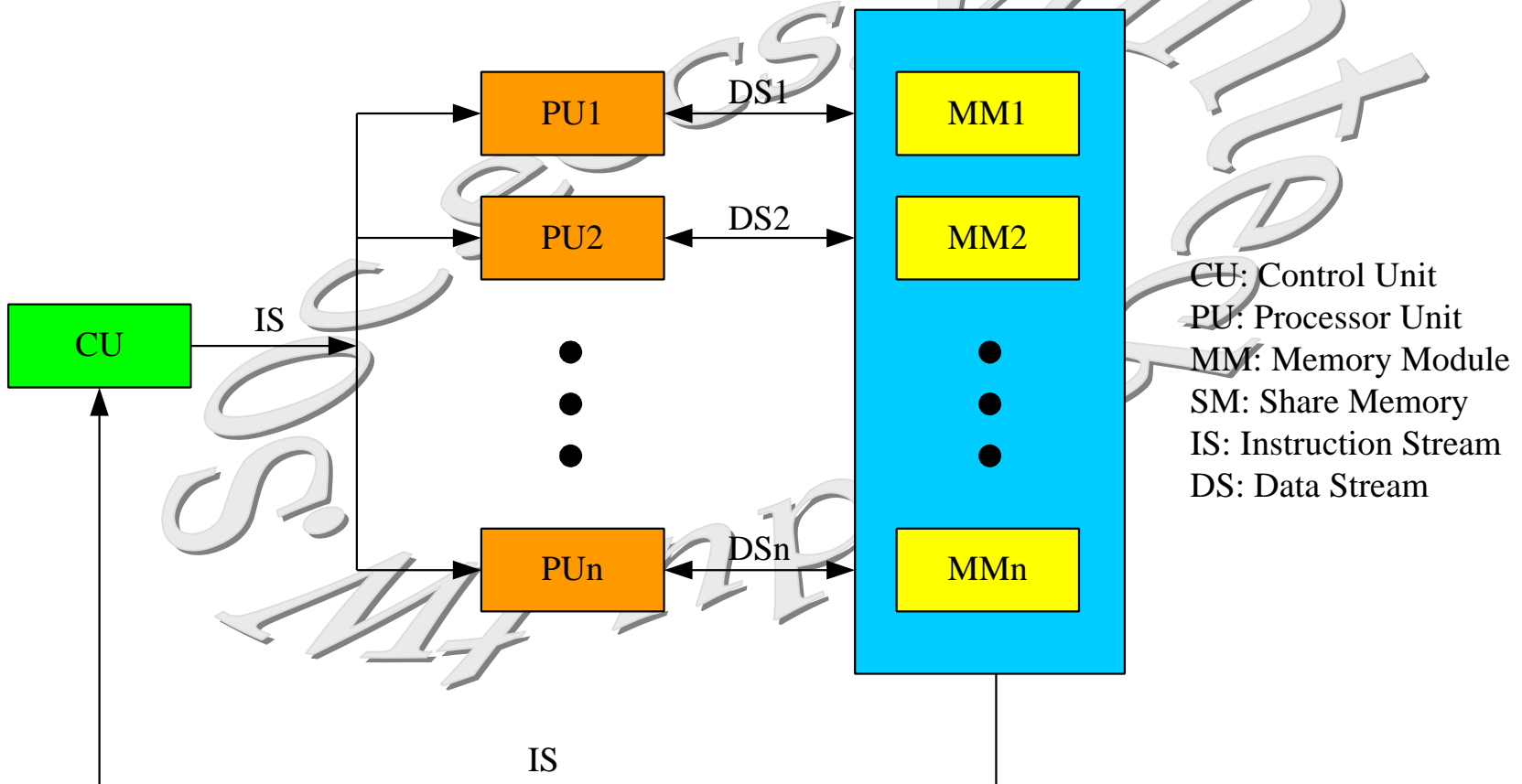
## ■ Architecture

1. SIMD Array
2. MIMD Array
3. VLSI Array Processor

# 1.2 Array Processors for Signal and Image Processing

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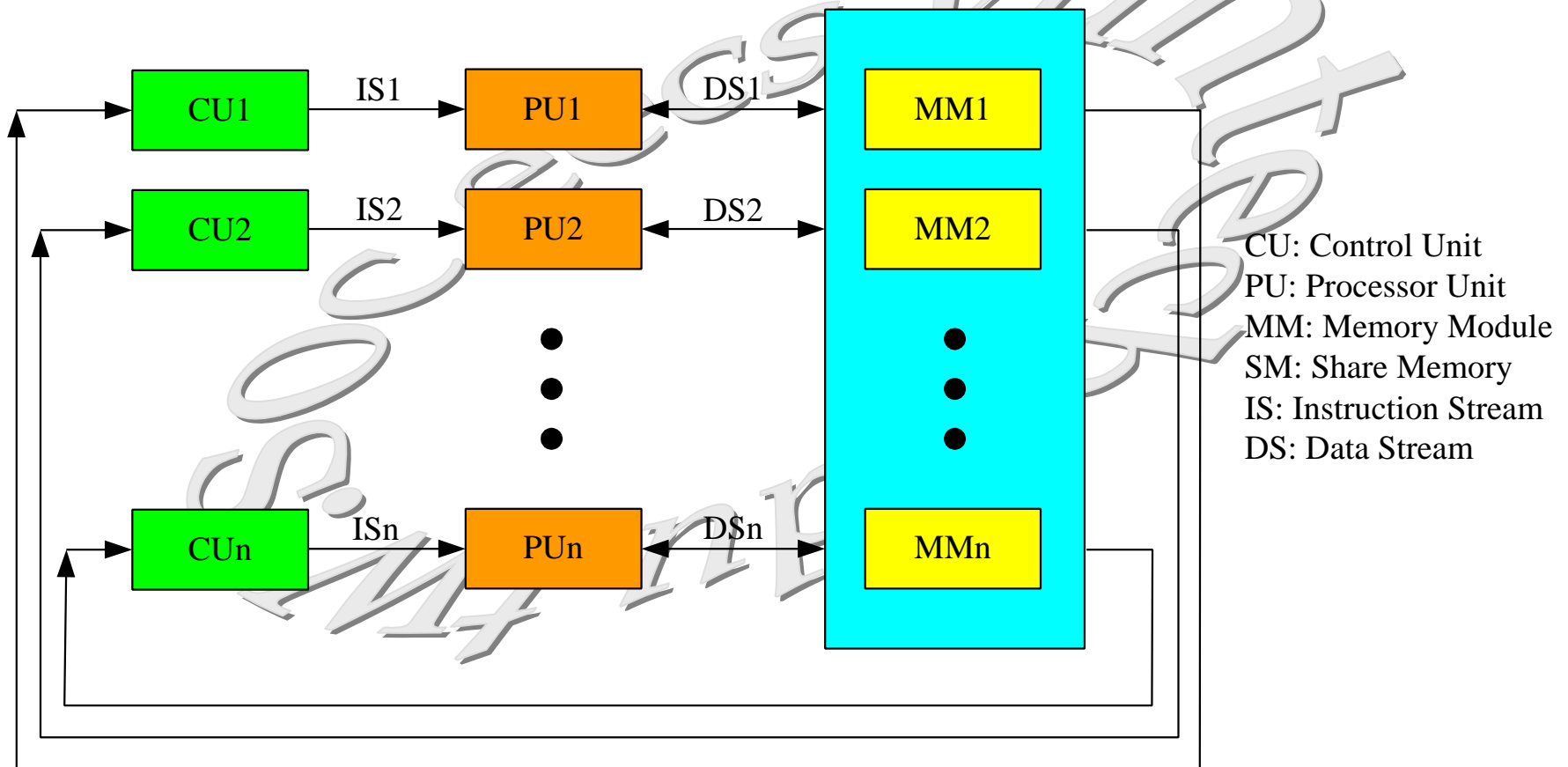
## ■ SIMD (single instruction multiple data stream) Array



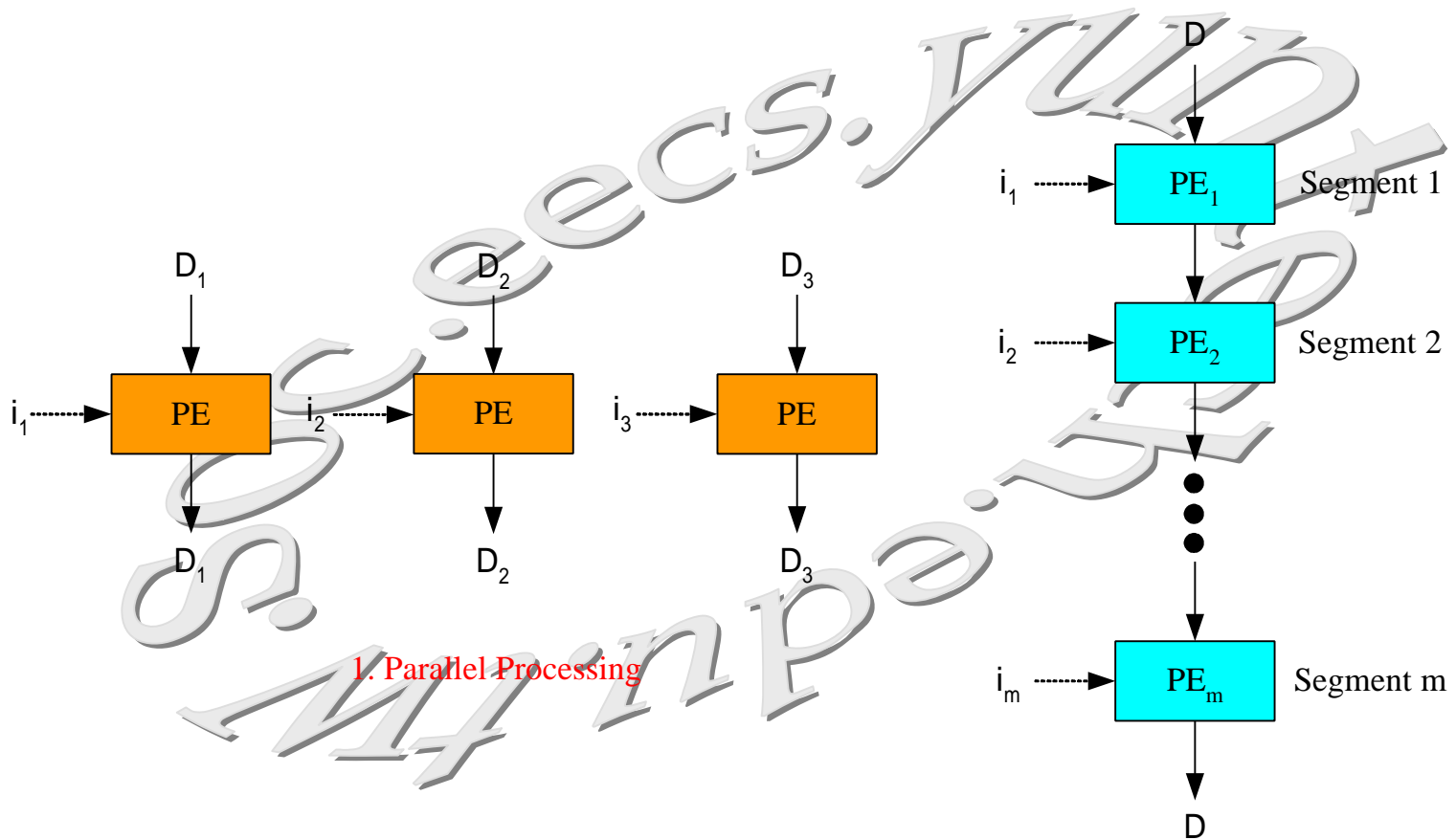
# 1.2 Array Processors for Signal and Image Processing

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## ■ MIMD (multiple instruction multiple data stream) Array



## ■ VLSI Array Processor: Derive Concurrency



1. Parallel Processing

2. Pipeline Processing

- **Manufacturing Technology**

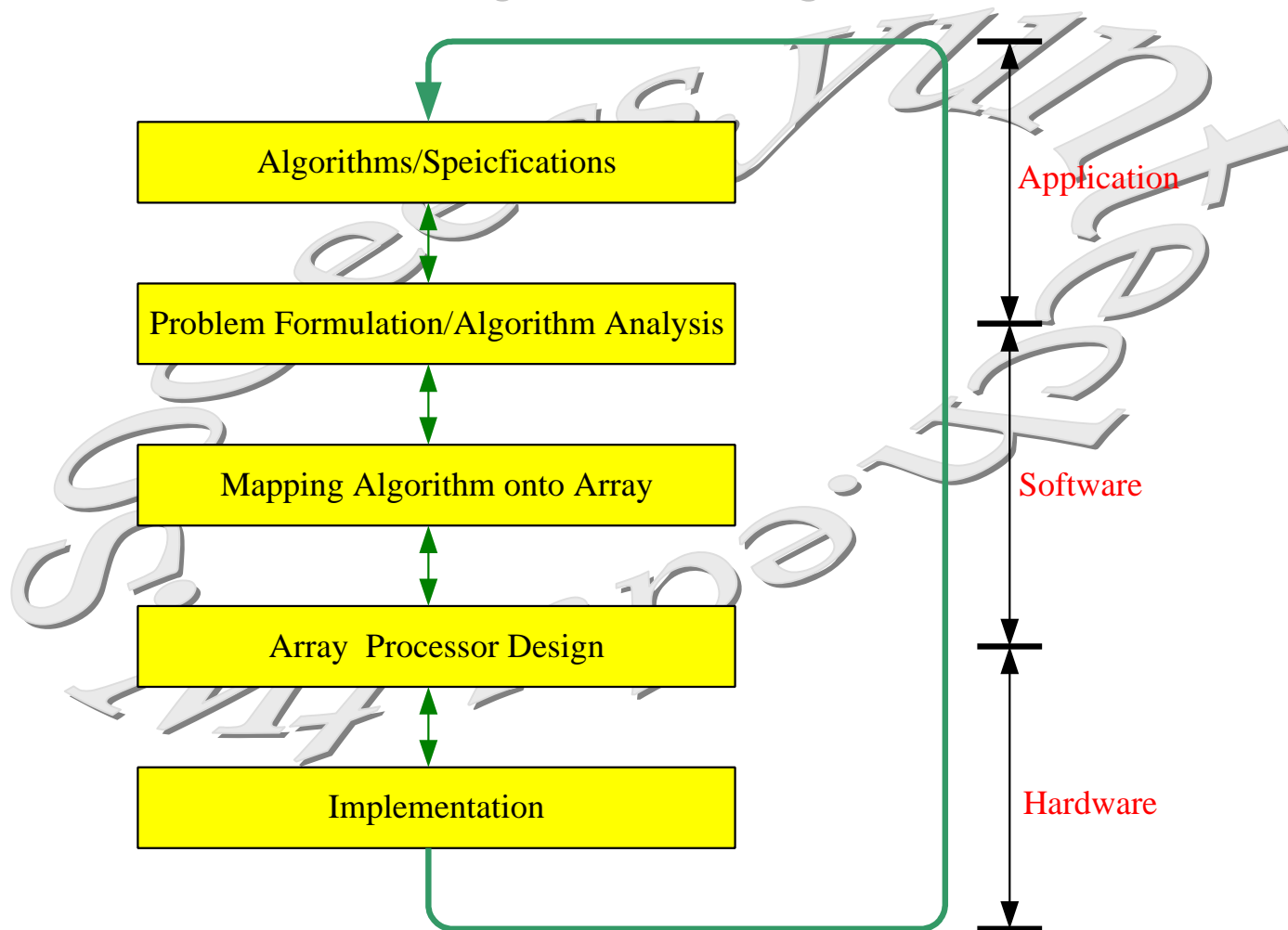
1. **CMOS: Low Cost SoC Technology**
2. **BiCMOS**
3. **GaAs: Very High Speed Application**



# 1.4 Overview of the Chapters

- 1.1 Introduction
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## ■ Vertically Integrated VLSI (ASIC) System Design



## ■ The Book Chapters are Covered

1. Introduction – An Overview
2. Signal and Image Processing Algorithms
3. Mapping Algorithm onto Array Structures
4. Systolic Array Processors
5. Wavefront Array Processors
6. System and Software Design
7. Implementation of Array Processors
8. Application to Signal and Image Processing