
# Complexity Management and Modelling of VLSI Systems

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A thesis submitted to the Faculty of Engineering
for the Degree of Doctor of Philosophy.

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January 1988

# Contents

# Abstract

The major objective of the research described in this thesis is to describe effective methods for the partitioning of Very Large Scale Integrated (VLSI) systems.

A comparison is made between the structural design of large programs and large VLSI designs. A methodology for VLSI structural design is proposed based on many of the precepts of structural program design. The methodology requires restructuring of the design process; a specific form of design representation; and the addition of computer aided modelling of both the algorithmic function and geometrical form of the structural design.

The design process is divided into a designer intensive top-down planning phase, and an automatic bottom-up construction phase.

A model of design is described in which the commonly used layered set of abstractions are replaced by a single structural description. The language introduced for this purpose incorporates a number of features to reduce the apparent complexity of the system description. The abstract representation of intermodule synchronization and communication allows a process of stepwise refinement to be applied to these as well as the more usual structural entities.

Two computer aided modelling tools have been developed that together constitute a facility for rapidly analyzing alternate structural partitionings in the search for an acceptable design.

The first computer aided modelling tool is a functional simulator incorporating a novel interprocess communication and scheduling mechanism. This allows the efficient implementation of the description language intermodule communication semantics. The interactive nature of the simulator facilitates initial debugging and qualitative evaluation of the design. A profiling facility allows for the quantitative evaluation of the partitioning based on data flow and module activity.

The second computer aided modelling tool is a hierarchical floorplanner that facilitates the evaluation of the embedding of the proposed structural design into the plane. An investigation of structured floorplan design shows that the process is inherently knowledge intensive, and that much of that knowledge is inexact. The floorplanner incorporates several novel knowledge representations that are used to express diverse classes of designer expertise. A representation for spatial reasoning provides for the

efficient manipulation of rectangles in a mosaic. Another representation has been developed for reasoning with the inexact knowledge used by designers in predicting the implementation of floorplan modules in a hierarchical design. A production system is used as a design manager to guide the overall development of the design.

A case study is presented that demonstrates the utility of the methodology and computer aided design tools in VLSI system design.