Welcome Address

Welcome to the Third International Symposium on Advanced Research in Asynchronous Circuits and Systems, and welcome to Eindhoven. This symposium is a successor to the symposia in Utah (November 1994) and Aizu-Wakamatsu (March 1996). By choosing a date approximately 12 months after the Aizu-Wakamatsu Symposium, the Steering Committee has opted for making “Async” an annual event.

An occasion like this provides a natural opportunity to reflect on the state of our art, i.e. that of specifying, modeling, designing, analyzing, optimizing, implementing, testing, and characterizing asynchronous circuits and systems. Over the recent years, we have witnessed a considerable expansion both in the size of our research community and in the number of its scientific publications. However, according to async.bib\(^1\), the annual number of publications on asynchronous circuits and systems is now stabilizing at about 100.

If our art is to continue to flourish and to evolve in a healthy way as a scientific and engineering discipline, we believe that it needs:

- A sound theoretical underpinning.
- Examples of asynchronous circuits or systems that demonstrate a clear benefit over their clocked counterparts in a convincing manner.
- Application of our research by industry to create products, such that asynchronous circuits add value to these products.
- Application of our research in commercial CAD tools.
- Education and training of students.

It is our strong belief that we must pay attention to each of these issues, so building a bridge from academic exercise to industrial exploitation.

The field of asynchronous design has a strong and broad theoretical foundation; few would argue that. There is less consensus, however, on to which extent (practical) benefits of asynchronous circuits have been demonstrated convincingly. Evidence is, nevertheless, accumulating that asynchronous circuits tend to dissipate less power, emit less electro-magnetic radiation and spread that radiation more evenly across the frequency spectrum. Furthermore, the inherent locality and modularity of asynchronous circuits may become recognized as their prime qualities for complex circuits realized in deep sub-micron VLSI technology.

The semiconductor industry is carefully monitoring developments in research on asynchronous circuits and systems. At least five major industrial research centers (in Japan, the USA, and Europe) are investing in the field, with emphasis on high-performance processors and low-power consumer products. Furthermore, 1997 appears to be the year that the first large-scale asynchronous integrated circuit will hit the commercial market\(^2\). Perhaps more importantly, asynchronous circuit techniques are increasingly often applied in largely synchronous VLSI circuits, to solve local performance and power problems.

More than a few asynchronous commercial successes are required for the Electronic Design Automation industry to become involved. Commercial exploitation of a simple asynchronous point-tool requires minimum sales of a few million US$ yearly. This can only be raised if the added value of asynchronous exceeds that by a considerable margin. Until that time, the semiconductor industry will develop their own tools and will look for cooperation with successful universities.

Exploitation of our research, as we can think of it today, is to be in CMOS VLSI circuits and systems. Most experts agree that the dramatic reduction in transistor dimensions will continue for another decade. In six years

\(^{1}\)A bibliography with abstracts is clickable from [http://www.win.tue.nl/win/cs/pa/wsinap/async.html](http://www.win.tue.nl/win/cs/pa/wsinap/async.html)

\(^{2}\)Sharp's New Media Processor.
from now, VLSI circuits will contain 10 times more transistors. Perhaps more importantly, at the physical level many phenomena will be different, both quantitatively and qualitatively. This may affect many issues at the heart of asynchronous design. How to match delays? Can isochronic forks be implemented? How to detect completion? How to avoid parasitic transitions? Is power dissipation still dominated by switching? etc. But also, can a 1 GHz clock be distributed across a few cm² of silicon? Is large scale application of asynchronous circuits feasible? Or is it unavoidable? Answers to these questions are critical to the future of asynchronous research!

The organizing committee of this symposium has tried to compile a program that covers the whole spectrum of asynchronous research. In addition to the technical sessions, five distinguished scientists have been invited to inspire us in our research, in part by addressing the above issues. Also, following the successful premiere in Aizu, we have included a plenary session on the demonstration of asynchronous CAD tools.

We have received a total of 66 papers, a number comparable to those of the previous editions of this symposium. Each paper was anonymously reviewed by 4 or 5 members of the Program Committee. The final list of accepted papers was decided after several exchanges of electronic mail messages among the committee members. We accepted 25 papers for publication in these proceedings.

We would like to thank first of all the members of the Program Committee for reviewing the papers and for assisting in the selection process. We also gratefully acknowledge the assistance of Margret Philips, Hans van Gageldonk, (both with Eindhoven University) and Rik van de Wiel (Philips Research Labs) in processing the approximately 500 email messages. Special thanks to the European Commission for sponsoring this symposium through ACiD-WG (Asynchronous Circuit Design - Working Group). Many thanks also go to the IEEE Computer Society (in particular to Anne Marie Kelly) for their help in preparing these proceedings. Last but not least, we thank and congratulate the researchers who responded to our call for papers by sending us their latest research results on asynchronous circuits and systems.

We end this welcome address on a sad note. Charles Molnar, a pioneer of research in asynchronous circuits and systems, passed away on December 13, 1996. A friend and colleague, he will be sadly missed.

Eindhoven, Jan 18, 1997

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