

# CURRICULUM VITAE of Prof. Dr.h.c Prof.h.c Hannu Tenhunen

## Personal Facts:

Name: Hannu Tenhunen, Born: in Joroinen, Finland, 16.4.1957

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## Summary CV of Prof. Hannu Tenhunen

Hannu Tenhunen was born in Joroinen, at eastern part of Finland, in 1957. He has two children and shares life with Leena Siren. He received degrees of Diploma Engineer in Electrical Engineering and Computer Engineering (with majors in Electron Physics and Digital Signal Processing, and minors in Mathematics, Theoretical Physics, and Solid-State Physics in 1982, and Ph.D. in Electrical Engineering from **Cornell University**, Ithaca, NY, USA, in 1985 with major in Microelectronics and minor in Applied and Engineering Physics (Microfabrication) (in 2.5 years). He has been nominated to **docent positions** at Tampere University of Technology and Helsinki University of Technology, in 1994 and 1999, and appointed as **visiting professor** at Cornell University in 1998 and a part-time visiting professor at University of Turku since 1999. He was awarded **honorary doctor degree (Dr.h.c.)** from Tallinn Technical University, Estonia, in 2003 for advancement of education and research in electronics. In 2003 he was also nominated to an honorary TUCS **Research Fellow** by University of Turku and Åbo Akademi University in Finland. He was appointed to **honorary professor** at Beijing Jiaotong University, China, also in 2003. In 2004 he received prestigious SSF Senior Individual Grant. He was also NorFA visiting professor at University of Turku 2003-2005 and **Professor Invite'** at Institut National Polytechnique de Grenoble (INPG) in 2005. In 2004 he was awarded Nokia Visiting Fellow grant and in 2005 appointed as honorary **advisory professor** in Fudan University, Shanghai, China. He was appointed in October 2005 to be **adjunct professor** at Chinese University of Hong Kong.

During 1978-82 he was with Electron Physics Laboratory, Helsinki University of Technology, and worked on quantum mechanical electron structure of crystalline and amorphous semiconductors. From 1983 to 1985 he worked at Cornell University and its National Submicron Facility as a **Fulbright scholar**. During this time he worked with 0.5-0.25 micron CMOS technologies and IC design.

From September 1985 he started at Tampere University of Technology, Applied Electronics and later at Signal Processing Laboratory as an **associate professor** with duties in setting up the LSI and VLSI design activities and to integrate DSP and VLSI activities together. He was also the **coordinator (program director) of National Microelectronics Program of Finland** during 1987-91, a 150 MSEK national research investment. He also worked as **Head of Laboratory** of Signal Processing Laboratory, which had over 70 researchers. From November 1989 he worked as **research professor on ASIC design** methodologies and applications. Since January 1992 he has been with Royal Institute of Technology (KTH), Stockholm, where he is a **professor of electronic system design** and head of ESDlab. Since 1992 he has established an active laboratory with state-of-the-art resources based on external support. The laboratory aims to be among the top 3 laboratories in Europe and within top 5 in world in its activity area. During his time at KTH he has initiated and/or being a **founding member and proposal writer** for the nine large scale interdisciplinary national programs and graduate schools; where the latest one is large scale Vinnova national excellence centre iPack.

Professor Tenhunen has also contributed as an **evaluator and expert** of national research and educational programs in Europe and European Union research projects and programs, as well as evaluated research institutes, in 2003 IMEC in Belgium and multi billion Euro MEDEA+Eureka-programme as a whole. He has been evaluator to electronics engineering programs in Norway and engineering education and graduate studies in Åbo Akademi. He has evaluated graduate school in ITC area INFOTECH at University of Oulu. He evaluated IMEC research institute in June 2006 for government of Belgium.

His educational interests are within VLSI, future technology abstraction, circuit and system integration paradigms, and related system applications, and continuing education towards industries. He has lectured courses from semiconductor physics to computer engineering and designed and/or lectured over **50 different courses** during the last 20 years. He has contributed significantly in **restructuring the educational programs** in electronics both in Tampere University of Technology in mid 80s and at KTH in 1990s. He has contributed to **internationalization of advanced education programs** via establishment of International Signal Processing Program in Tampere in late 80s and NorFA Nordic Program on Modern Electronic System Design, NorESD in 1993. So far, the NorESD program with over 30 courses and close to 500 participants has been the largest single coordinated activity towards continuing education for industry in this area. His program director role and contributions in vitalizing the national educational and research activities in microelectronic circuit and systems designs during 80s were one of the strategic enablers for the global success of Finnish electronics industries during 90s. His current activities are focused in establishing internationally competitive educational program within the new KTH-Kista Information Technology program with focus on **modern electronic design and System-on-Chip curriculum** issues and overall renewal of the course and curriculum content. The new course and curriculum approaches created and adapted by Prof. Tenhunen has resulted to multiple international reviewed publications and invited presentations. Most recently, these activities have resulted to establishment of the popular **international Master Program** on System-on-Chip Design at KTH. Currently this program is the leading and most successful in Europe in SoC area. Prof. Tenhunen was one of the key architects in late 1990s for the current KTH large-scale initiative in Kista within information technology and he is **dean of School of Information Technology (IT-Universitet)** responsible on faculty and educational program development for the new IT-University located in Kista. Under his leadership KTH's IT-University is the largest School at KTH and has a significant European role in terms of profile, approach and strategy for new curriculum and faculty integration. The key strategy is based on focus in IT impact to society and individuals and on strongly internationalized faculty and student bodies providing a unique campus in the Nordic area. Currently IT-University in Kista has over 3500 full-time students, over 70 full and associate professors, and total activity volume over 520 MSEK. In 1992 Prof. Tenhunen was the 3rd KTH professor located in Kista with no educational degree programs in Kista. The KTH approach is currently adapted to other university campuses nationally and internationally.

Prof. Tenhunen has contributed to the **academic leadership** as member of KTH Executive group (KTH ledningsgrup), chairman of the board for IT-University (ordförande utbildningsnämnd IT-universitet), chairman of the faculty recruitment board, and member of multiple KTH internal operation and policy boards and committees. From his laboratory 6 professors has been produced to different universities and 39 PhDs.

He has been active in **Turku University** since May 1999 as part-time **visiting professor**, most recently as **NorFA** (Nordisk forskarakademi) professor. Since that he has contributed in restructuring educational programs, department structures, and initiating research and new courses in electronics. The new activities have helped partially University to Turku to gain examination rights in technology (DI, TkL, TkT) in electronics, information technology, and telecommunication from 2004 forward. In September 2005-2010 he had been the part-time

**Director of Turku Centre of Computer Science (TUCS, [www.tucs.fi](http://www.tucs.fi))**, a collaborative multi-university research center. Since May 2006 he has been invited professor of nanoelectronics at University of Turku and is director of Computer Systems Laboratory.

His **research interest and publications activities** have been in areas:

- Interconnect centric and robust/interference free design of electronic systems, architectures and methods
- Design of embedded and integrated systems towards signal processing, communication, and internet-of-things applications
- Flexible electronic systems and intelligent integration to paper and pulp based substrates and packages
- 3D integration technologies and modelling & design of 3D circuits and systems using through-silicon-via (TSV)
- VLSI applications in personal communication and fundamental design constraints and future paradigms necessary to harvest the technology potential
- Platform based design methods and architectures based network-on-chip architectures
- Embedded dependable systems based on agent controlled autonomic systemic architectures (HW/SW)
- VLSI Design and Circuits, especially towards DSP
- IC Mixed Signal Circuits and Systems including sigma-delta A/D and D/A
- Integrated Heterogeneous Sensible Systems
- Technology policies and educational strategies in area of rapidly evolving ICT technology.

His current research interests are ULSI/SoC circuits and systems for wireless and broadband communication, and related system design methodologies. He has made over **735 reviewed international publications** on IC technologies and VLSI systems worldwide, and **over 170 national publications/presentations**. He has **9 patents** granted worldwide. He is actively contributing to many international conferences as general chairman, session chairman, technical program committee member, invited speaker, panel organizer and panel member, and just presenting papers. He is e.g. technical program committee member of International Solid State Circuit Conference (ISSCC) (from 1989 forward), **general chairman** of European Solid-State Circuits Conference in 2000, and a long standing (since 1991) chairman of the successful IEEE NORCHIP series of Nordic conferences for the circuit design community, vice-chairman of Multiprocessor SoC workshop (MPSOC) in 2004. Since 2006 he has been elected to steering committee of European Solid State Circuit Conference and European Solid State Device Conference. He will be the general chairman of ESSCIRC/ESSDERC Conference 2011 in Helsinki. In 2008 he was co-chair of IEEE COMPSAC Conference in Turku. He has also contributed to launch of new scientific journals and is serving as associate editor for those. He has served as **referee to all key conferences and scientific journals in his area**. He has served as **technical program committee member to all key conferences in his area**. He has been an invited guest editor for 7 different scientific journals (special issues), and coordinated as editor of publishing more than 5 books in new research areas. He has contributed over 25 invited journal papers.

In addition of technical interest, he has been active in **technology policies** in Finland and Sweden, researching technology impact to industry, strategic and management issues in high technology adoption in end products, and organizing technology diffusion and dissemination activities for SME sector at Nordic and European level. These activities have also produced international reviewed publications. He has initiated the NorASIC-SMI project (within JESSI program and partially funded by Nordisk Industrifond), and has initiated and planned

MicroExcel project for distributed Nordic Center-Of-Excellence in microelectronics he also initiated the recent SoC-SME Nordic/Baltic SME sector activity and Nordic Network-of-Excellence in NoC area. He was one of the key architects for the European wide EuroSOC network-of-excellence and is organizing NoC related activities within that area. He has worked also as a board member in technology and science parks, research institute, and high technology start-up companies, as well as served as advisor to multitude of such activities. He has contributed significantly to Kemi Technology Park and Hermia in Finland, KTH Teknikhöjd, Kista Science Park, and to formation of start-up companies in different form VLSI Solution OY, Spirea AB, Synthesia AB, Imsys AB, SICS AB, FirstPass technologies AB, and Frame Access AB. During last two years he has launched a successful **Turku Innovation Platform** concept and has been active in establishing operational principles and governance for Knowledge and Innovation Communities from the university perspective. He has actively brought in Innovation and Entrepreneurship aspects to master and Ph.D. level educations as part of Nordic Master Program (granted by Nordisk Ministerråd) and Nordic Master School (as part of NordPlus) concepts integrating Turku towards Stockholm, Copenhagen and Talinn. These activities have resulted to multiple invited talks in various conferences and workshops.

Since 2007 he has been involved in establishment of the European Union flagship initiative European Institute of Innovation and Technology (EIT) as one of the architects for the ICT sector activities in EIT. This has resulted to establishment of Knowledge and Innovation Community EIT ICT Labs. Prof. Tenhunen serves in the management committee for EIT ICT Labs and in 2010-2012 as **Director of Education for EIT ICT Labs**.

During 2003/2004 Prof. Tenhunen launched strategic co-operation with two top universities in China, Fudan University, Shanghai, and Zhejiang University, Hangzhou. This has resulted to a joint degree educational program between KTH and Fudan University with degree granting rights in China.

Prof. Tenhunen's main **research contributions** so far are as follows

- DSP integration to VLSI was initiated in mid-80s, which resulted to significant competence build-up in university and in industries in Finland.
- Mixed signal initiative with start point in mid 80s in sigma-delta conversion area. Many of the key concepts, design principles, modulator structures and decimation/interpolation filter strategies were proposed during these days and currently utilized world wide in most of the products requiring high-resolution integrated analog front-ends
- Core processor and IP strategies were initiated in number of projects in late-80s and were in large scale during early 90s. These projects resulted to changes in corporate design strategies.
- During early 90s, Prof. Tenhunen changed focus from DSP issues to communication system issues for wired and wireless networks. Key focus has been in radio architectures trade-offs for analog and digital integration, broadband sigma-delta converter techniques. System issues have addressed the low power optimization at system functionality partitioning; architecture and implementation level for both CDMA and OFDM based systems. Technology direction has been in super miniaturization of radio systems towards low cost and footprint modules, Coin Radio. This activity has resulted to our current activities in new single level integrated modules for Seamless Integrated Electronic Systems. Many of the work results initiated in late 90s has already utilized in industries.
- Work on interference and signal integrity issues resulted in 1997 activities in Interconnect Centric Design area, where the key technology scaling issues towards end of the Si technology roadmap has been systematically addressed at different design abstraction levels. Furthermore, a natural extension of the reuse and IP centric work in

yearly 1990s resulted to activities in System-on-Chip integration from different perspective. Currently the focus in these areas is moving towards the next paradigm shift; integration on-chip based on networking concepts: Network-on-Chip. Based on our recent results we believe that the network-based approach will even survive through the transition to nanoelectronics and nanosystems. The main industrial utilization phase is expected here around 2009 and beyond along the experience from the previous research area contributions above.

## **Detailed CV of Prof. Hannu Tenhunen**

### **Academic Qualifications:**

- 1982 Master of Science in Electrical Engineering at Helsinki University of Technology, Finland (total over 300 credit units)  
- Majors in Electron Physics (discrete semiconductor device and IC engineering), and Computer Engineering (digital signal processing)  
- Minors in Mathematics, Solid-State Physics, and Theoretical Physics
- 1982 Completed postgraduate course requirements for Licentiate of Technology degree at Helsinki University of Technology  
- Major in Electron Physics  
- Minor in Computer Engineering (digital signal processing)
- 1986 Doctor of Philosophy (Ph.D.) at Cornell University, Ithaca, NY, USA (Starting January 1983 and finished with thesis defence in September 1985)  
- Major in Electrical Engineering (Microelectronics)  
- Minor in Applied Engineering Physics (Microfabrication and characterization)
- 1989 Found qualified by academic review committee and appointed to Associate Professor of Analog and Digital Circuit Techniques in May 1989 at Tampere University of Technology, Electronics Laboratory
- 1989 Found qualified by academic review committee and first candidate for Full Professor in Information Technology (Tietotekniikka) at Tampere University of Technology, Pori Educational Unit. Cancelled application due to other duties (ASIC research professorship).
- 1989 Found qualified by academic review committee for Research Professor in Microelectronics at Technical Research Center of Finland (VTT), Semiconductor Laboratory, Helsinki
- 1990 Found qualified by academic review committee and appointed for Associate Professor of Digital and Computer Engineering (Tietojenkäsittelytekniikka) at Tampere University of Technology, Signal processing Laboratory
- 1990 Found qualified by academic review committee for Research Professor in Digital Signal Processing and Industrial Applications at Technical Research Center of Finland (VTT), Computer Systems Laboratory, Oulu.
- 1991 Found qualified by academic review board for Laboratory Director and Professor of Electronics Laboratory, Technical Research Center of Finland (VTT), Electronics Laboratory, Oulu.
- 1991 Found qualified by academic review committee and appointed for Full Professor in Electronic System Design, Royal Institute of Technology (KTH), Department of Electronics, Stockholm, Sweden, December 1991.
- 1992 Found qualified by academic review committee and appointed to Docent (professor competence) positions in Digital Circuits and Systems at Tampere University of Technology.
- 1998 Nominated to Visiting Professor, Cornell University, School of Electrical Engineering, Ithaca, NY, USA

- 1999-2002 Nominated to Visiting Professor (part-time), University of Turku, Laboratory of Electronics and Information Technology, Finland
- 1999 Found qualified and appointed to Docent (professor competence) in VLSI Circuit and System Design at Electronic Circuit Design Laboratory, Helsinki University of Technology, Finland
- 2003 Appointed to honorary doctor (Dr.h.c.) in microelectronics at Tallinn Technical University, Estonia for contributions in advanced education and research
- 2003 Appointed to TUCS Fellow at Åbo Akademi University, Turku School of Business and Management, and University of Turku at Turku Center for Computer Science
- 2003-2005 Granted a NorFA (Nordisk forskarakademien) visiting professor at University of Turku, Department of Information Technology
- 2004 Appointed to honorary professor at Beijing Jiatong University, China
- 2004 Appointed Professeur Invite´ by the faculty board of Institut National Polytechnique de Grenoble, France
- 2005 Appointed honorary professor by the University Council of Fudan University, Shanghai, China
- 2005 Appointed director of TUCS
- 2006 Appointed Adjunct Professor at Chinese university of Honk Kong.
- 2006 Appointed fixed term invited professor of nanoelectronics, University of Turku

### Research Interests:

- Interconnect centric and robust/interference free design of electronic systems, architectures and methods
- Design of embedded and integrated systems towards signal processing, communication, and internet-of-things applications
- Flexible electronic systems and intelligent integration to paper and pulp based substrates and packages
- 3D integration technologies and modelling & design of 3D circuits and systems using through-silicon-via (TSV)
- VLSI applications in personal communication and fundamental design constraints and future paradigms necessary to harvest the technology potential
- Platform based design methods and architectures based network-on-chip architectures
- Embedded dependable systems based on agent controlled autonomic systemic architectures (HW/SW)
- VLSI Design and Circuits, especially towards DSP
- IC Mixed Signal Circuits and Systems including sigma-delta A/D and D/A
- Integrated Heterogeneous Sensible Systems
- Technology policies and educational strategies in area of rapidly evolving ICT technology.

### Positions:

- Summer 1978 Research Assistant, Electron Physics Laboratory, Helsinki University of Technology; research in electronic structure of selenium using selfconsistent orthogonalized planewave (OPW) method.

- Summer 1979                      Research Assistant, Technical Research Center of Finland, Semiconductor Laboratory; research in electronic structure of tellurium and amorphous chalcogenide semiconductors.
- Summer 1980                      Research Assistant, Electron Physics Laboratory, Helsinki University of Technology; research in electronic structure of amorphous chalcogenide semiconductors.
- 1980 – 1983                      Research and Teaching Assistant, Electron Physics Laboratory, Helsinki University of Technology; research in thermodynamics of glass transition and structure of silicon dioxide and chalcogenide glasses (under Prof. T. Stubb).
- 1980 - 1981                      Teaching Assistant at Digital Systems Laboratory, Helsinki University of Technology. (Computability Theory, Theoretical Computer Science))
- 1980 - 1982                      Teaching Assistant at Physics Department, University of Helsinki (Final year laudatur-course Semiconductor Physics)
- 1983                                  Research Scientist, Academy of Finland; Design of VLSI circuits (8 months, CUSRAM chip).
- 1983 - 1986                      Statutory Research and Teaching Assistant, Helsinki University of Technology (on the leave of absence during 1.8.1983 -31.7.1986).
- Jan 1983-August 85              Fulbright Visiting Fellow, in National Research and Resource Facility for Submicron Structures (12 months), Cornell University, Ithaca, NY, USA
- 1983 - 1985                      Graduate Research Assistant, School of Electrical Engineering, Cornell University, Ithaca, NY, USA; research in dielectric isolation technology in submicron CMOS process technology group of Cornell for silicon-on-insulator VLSI structures (under Prof. J. P. Krusius). Funded by IBM General Technology Division, Burlington.
- Sept. 1985-June 86              Acting Associate Professor of Electronics, Electronics Laboratory, Tampere University of Technology, Finland. Activities include establishing microelectronics curriculum in TUT and laboratory and starting up VLSI research team and getting external funding for it. Research focus is on high performance circuit design and simulation including semiconductor process and device modelling.
- June 1986-Feb 87                Statutory Military Service, Finnish Air Force Depot, Research Associate, High performance VLSI signal processing for radar applications (6 months).
- Sep. 1986 - Dec. 86              Visiting Lecturer, Tampere University of Technology, Electronics Laboratory, course Design of Analog Integrated Circuits.

- Jan 1987-May 87 Visiting Lecturer, Tampere University of Technology, Electronics Laboratory, course Digital and Analog Integrated Circuits.
- Feb. 1987 VLSI Research Group Leader (Principal Scientist), Electronics and Computer Systems Laboratories, Tampere University of Technology. Activities include: (i) establishing an active VLSI research group of size 25 research assistants and associates, and acting its research leader and program manager, (ii) active research on VLSI circuit structures, analog/digital interfaces, digital signal processing systems on silicon, fast microarchitectures for DSP, and space electronics.
- July -Dec. 1987 Acting Professor of Electronics. Electronics Laboratory, Tampere University of Technology, Activities include: (i) teaching VLSI Design, Analog Circuit Design and CAD/CAE methods in electronics courses, (ii) supervising thesis work for 4 PhD-level students and 12 MSci students (members of VLSI Research Group), (iii) acting as a member of organizing committees for many professional post-graduate continuing education short courses in electronics, (iv) prepared and lectured multiple continuing education and post-graduate courses on ASIC integration.
- 1987 - 1991 Program Coordinator, National Microelectronics Research and Development Program, funded by Technology Development Centre of Finland and Finnish Industry 100 million FIM for 1987 -1991. Activities include: (1) Developing research program goals for 1987 - 1991, (2) monitoring current research projects, (3) preparing research program and budgets, (4) proposing and organizing following new programs (i) FINSILC, all Finnish universities active in electronics will be equipped with commercial silicon compilers for education and research, (ii) FINCHIP, a commercial multichip project to provide prototype services and small production runs (100 - 10 000 IC year) using Finnish technology in order to enhance ASIC competitiveness of Finnish electronics industry, (iii) SMARTPOWER, intelligent power integrated circuits, a project combining National Microelectronics and Mechatronics programs providing system design know-how (DSP, VLSI) and technology know-how (BiMOS, PIC) to power electronics and mechatronics industry. Major contribution in this area was the shift of the research activities from research institutes to universities, integrating universities and industries in close cooperation. This program produced (as seen in retroactive perspective in 1998) the key competence and the key senior personnel which significantly contributed to Finnish industry success in 1990s (e.g. Nokia).
- Aug. 1988-Sep. 1989 Head of Laboratory and Acting Professor of Electronics Tampere University of Technology, Signal Processing Laboratory. Teaching duties include Computer Systems, Digital Hardware Techniques and VLSI System Design, responsible on hardware system design (research and teaching). Heading research laboratory of size 55 people.



- 1989 Nominated as Associate Professor of Electronics in May 1989 at Tampere University of Technology (on leave of absence due to being Head of Laboratory and acting professor at Signal Processing Laboratory).
- 1990 Nominated as Associate Professor of Computer Engineering at Signal Processing Laboratory of TUT in August 1990. Established Computer Engineering Laboratory and organized external funding of 6.5 MFIM for equipments and software. On leave of absence.
- 1989-94 Holding a 5-year research grant (research professor) on ASIC Techniques funded by private companies. On leave of absence on teaching duties. Research focus on ASIC system design, design methodologies, and technologies. Active supervision of graduate students.
- 1989-91 Visiting Lecture, Signal Processing Laboratory, TUT, courses Digital Systems Design, VLSI for Digital Signal Processing (Graduate course), Practical Packaging Technologies for Electronic System Design (Graduate seminar), High Speed Digital System Design, Part I, Interconnections, Packaging and Circuits (Graduate seminar)
- 1992- Professor of Electronics, Institute of Electronic System Design, The Royal Institute of Technology, Stockholm, Sweden. Creating from scratch an active research program in electronic system design directed towards communications and completely renovating electronics and VLSI education at Royal Institute of Technology. Establishment, with external funding, a laboratory of 25 persons. Initiated and founding member of 4 graduate schools (with 5-10 year financing each): 2 already decided (Personal Communication and Computing, and Microelectronics and Photonics design activities), 2 currently under final review stage. Duties include defining the laboratory research profile, education and curriculum profile, and recruit the staff and graduate students (3 associate professors, 3 staff members, and 15 graduate students are currently associated to Electronic System Design Laboratory).
- 1994 Docent at Tampere University of Technology in Digital Systems. Activities include courses in VLSI, Physical Architecture of VLSI/ULSI Systems, and short continuing education courses to industry and graduate students in modern design methodologies and mixed signal designs.
- 1998 Visiting professor, Cornell University, School of Electrical Engineering, Ithaca, NY, USA (fall semester). Research on global interconnects for ULSI.
- 1999 Docent at Electronic Circuit Design Laboratory, Helsinki University of Technology. Duties include building a new circuit oriented digital circuit design curriculum and providing undergraduate and graduate courses

- 2000-2003 Visiting part-time professor, University of Turku, Laboratory of Electronics and Information Technology, Turku, Finland
- 2001- 2005 Appointed to Dean of School of Information Technology, Royal Institute of Technology (IT-Universitet, KTH). Responsible of development KTH profile in Kista with 60 professors and associate professors, 3500 full-time equivalent students, and 520 MSEK education and research activity volume, and large scale international educational programs.  
-see [www.it.kth.se](http://www.it.kth.se)
- 2006-2010 Director, Turku Centre for Computer Science, TTurku, Finland
- 2006 Invited Professor of nanoelectronics, University of Turku
- 2010-2012 Director of Education, EIT ICT Labs, European Institute of Innovation and Technology.

### Other activities:

#### Participated in professional and post-graduate training

- 1980 Summer Institute in Quantum Chemistry, Solid State Physics, and Quantum Biology, Uppsala, Sweden
- 1981 NATO Advanced Study Institute: Science and Technology of Large Scale Integrated Circuits: Present Situation and Future Prospects, Erice, Sicily, Italy
- 1982 Helsinki International Summer School on Semiconductors, Helsinki, Finland
- 1982 Technology Forecasting in Practice, Helsinki, Finland
- 1983 Lithography and Dry Etch Process Short Course, National Submicron Facility, Ithaca, NY, USA
- 1986 Design of Analog/Digital Application Specific Intergrated Circuits, Helsinki, Finland
- 1986 Modern Digital Signal Processing Techniques, Tampere, Finland
- 1986 GaAs Integrated Circuits, Tampere, Finland
- 1987 Space Technology and Instrumentation: International Workshop, Tampere, Finland
- 1987 DSP Specialist Workshop, Finland/Sweden
- 1987 NATO Advanced Study Institute: Logic Synthesis and Silicon Compilation for VLSI Design, L'Aquila, Italy
- 1986-91 Multiple continuing education courses (over 20) as a course director and/or lecturer  
(organised by INSKO or Coninuing education center EDUTECH at Tampere University of Technology)
- 1996 NATO Advanced Study Institute of Low Power Design for Deep Submicron Technologies, Italy
- 1997-98 Multiple one to 5 day graduate level courses to Ericsson Radio Systems, Ericsson Components, Nokia Mobile Phones, and Nokia Research Center on A/D converters, mixed signal designs, and on physical architectures of VLSI/ULSI systems.
- 1995 Organised and lectured 3 day continuing education course on Sigma-Delta Converters for Ericsson Components AB staff.
- 1995 Organised and lectured a graduate course on Physical Architecture of ULSI/VLSI Systems at Helsinki University of technology (won the best course price for academic year 1994/95)
- 1996 Organised and lectured 8 day continuing education course on Physical Architecture of ULSI/VLSI Systems for Ericsson Radio AB staff

- 1997 Organised and lectured 8 day continuing education/graduate course on Physical Architecture of ULSI/VLSI Systems for Ericsson Radio Systems AB staff
- 1998 Organised and lectured 8 day continuing education/graduate course on Mixed Signal System Design for Ericsson Radio Systems AB staff
- 1996 Organised and lectured 5 day continuing education course for Nokia Corporation staff on Physical Architecture of ULSI/VLSI Systems in Tampere
- 1997 Organised and lectured 3 day continuing education/graduate course for Nokia Mobile Phones staff on Physical Architecture of ULSI/VLSI Systems in Tampere
- 1997 Organised and lectured 3 day continuing education course for Nokia Mobile Phones staff on Mixed Signal System Design in Oulu
- 1998 Organised and lectured 14 hour continuing education course/graduate on Sigma-Delta Noise Shaper Design for Ericsson Radio Systems AB staff
- 1996-98 Co-organised and lectured 30% of 32 hour continuing/graduate course on A/D Conversions for Ericsson Radio Systems AB and KTH staff.
- 1998 Organised and lectured graduate course on Low Power IC Design at Helsinki University of Technology, Finland
- 1998 Co-lectured with Prof. Kari Halonen) continuing education course IC Design to Nokia Mobile Phone staff in Oulu
- 1997 Organised and lectured 1 day continuing education course on Low Power Electronic System Design at Nokia Mobile Phones, Oulu
- 1999 Organised and lectured graduate course in VLSI Design at Turku University, Turku, Finland
- 1999 Organised and lectured undergraduate course in LSI Design at Helsinki University of Technology
- 2000 Organised and lectured a 3-day graduate course on IC circuit and layout design to Nokia Telecommunication Oy and Fincitec Oy staff
- 2000-3 Organised and lectured a 3 day intensive final-year undergraduate and graduate course on deep submicron VLSI electrical design at Helsinki University of Technology
- 2001 Organised a workshop on Network-on-Chip at ESSCIRC Conference, Villach, Austria
- 2002 Organised a tutorial day on interconnect centric design at ESSCIRC2002, Firenze, Italy
- 2003 Organised a tutorial day on interconnect centric design at ESSCIRC2003, Lissabon, Portugal

### **Research policy and program formation activities**

- 1986-1990 Program coordinator (director), National Microelectronics Program of Finland (100 MFIM R&D program for creating the enabling infrastructure in microelectronics systems in Finland).
- 1988-1990 Director and organiser of the Finnish multichip service FINCHIP to academic users.
- 1987-1991 Co-proposer and initial organiser for International University Program on Digital Signal Processing (with prof. Yrjö Neuvo)
- 1990-1994 Initiative taker and propose organiser for EUREKA-JESSI subproject NorASIC-SMI for organisation of technology dissemination and SME support in ASIC area for Nordic Small and medium sized enterprices.
- 1993-1997 Initiative taker and organiser of NorESD (Nordic Program of Modern Electronic System Design) Continuing Education Program on modern electronic system design consisting over 20 different courses (each with 2-3 day program) both in Sweden (Stockholm) and Finland (Tampere). Total over 400

- participants making this, so far, the largest directed continuing education activity towards industries in these countries.
- 1995-1999 Initiative taker and proposal writer and project director for ESPRIT long term research proposal MEDIA
  - 1996-97 Co-proposer and co-planner for SSF graduate school proposal Computing&Communication (C&C), which was then realised as Personal Computing&Communication (PCC) program.
  - 1997-1998 Initiative taker and co-proposer for a new SSF graduate school in advanced electronics technology and production, EPROPER. National program started late fall 1999.
  - 1996-1999 Co-proposer for an industrial graduate school Electronic Design funded by SSF. First students started in Spring 2000.
  - 1994-1996 Initiative taker and first start-up workshop organiser for a joint Finnish-Swedish research program INWITE 1997-2000, funded by NUTEK and TEKES and Finnish and Swedish industries. This program will be followed by EXCITE program for 2001-2003 with additional funding partnership with Academy of Finland and Tekniskforskningsråd (TFR).
  - 1997-1998 Initiative taker and co-proposer for a High Speed Electronics program within Microelectronics and Photonics Graduate School financed by SSF. Member and KTH representative in the management board.
  - 1994-98 Co-proposer and member of the management board for Mobile Radio consortia (funded by NUTEK and SSF).
  - 1994-1996 Co-proposer and member of the management board for Advanced ASIC Design consortia (funded by NUTEK and SSF).
  - 1996-2001 Initiative taker and director of Swedish Institute (SI) Visby program project on Electronics for Information Technology education and research co-operation with Tallinn Technical University, Estonia (will be expanded towards Kaunas Technical University during 2000).
  - 1998-99 Initiative taker and one of the planners for new educational profile Competence Area Electronics (KELE) in KTH E-sektion study program
  - 1997 Initiative taker for national program on System-on-Chip in Sweden. This resulted to establishment of the national Socware program with total budget volume of 400 MSEK during time period 2000-2005
  - 1998-2000 Initiative taker (together with Prof. Landgren) and planner for the new electronics program which transformed later to the new IT-university study program and “pusher” and curriculum planner for System-on-Chip related track KK in the new IT educational program. Currently this program represents the largest and most aggressive educational initiative in Sweden with first 165 students starting in Fall 2000.
  - 1998-2002 Co-proposer and responsible researcher for SIDA sandwich program in electronics education and competence development with University of Peradeniya, Sri Lanka.
  - 1998-2000 Initiative taker and planner for the International Master Program on System-on-Chip Design at KTH with the first 30 students starting the program in Fall 2000. This is one of the first interdisciplinary SoC educational initiatives in the world.
  - 1999-2000 Initiative taker for profiling faculty development and new requirement of professors towards future Ubiquitous Communication Electronics at University of Turku. Four new professor chairs are and will be announced from devices to systems with this common focus. Co-propose for a regional R&D program in Turku area with 200 MFIM volume.
  - 2000 Initiative taker and co-proposer (with profs. J. Nurmi and J. Isoaho) to a new national System-on-Chip related research program ESCO (Enhancing System-

- on-Chip Competence and Opportunities) in Finland with 200 MFIM targeted research volume and 1250 new specialist trained over the next 5 year period.
- 2000 Initiative taker and co-proposer for a European Union ITS project in education to address the Microelectronics Skill Shortage area IV 8.9 in September 2000 call.
- 2000 Initiative taker and strategic planner for globalisation/internationalisation strategy for the IT-University in Kista
- 2001-2004 Strategic planning responsibility for the academic faculty expansion and education program expansion for the IT-University in Kista.
- 2000-2004 Project contractor, SoC-Mobinet EU IST program project of volume 4 MEuro
- 2002 Proposer and coordinator for EoI for networks of Excellence in Network-on-Chip. Co-proposer and founding partner for 3 other networks and 2 Integrated Project proposal.
- 2003 Key proposer, thematic area leader, and contractor for EU 6th framework Network-of-Excellence proposal EuroSOC
- 2003 Initiator for Nordic/Baltic NorFA network for in Network-on-Chip and Nanosystems
- 2002-2004 Holder of NorFA (Nordisk Forskarakademi) part-time visiting professor position at University of Turku.
- 2003 Initiator of KTH System-on-Chip joint education and research center in China in cooperation with Chinese national research program 863 and Zhejiang University and Fudan University
- 2005 Established Euro-Sino Centers for research and education in SOC
- 2005 Initiator behind Campus Sweden, a joint operation of KTH, Chalmers, and Karolinska Institutut in Beijing University and in fudan University.
- 2006 Initiator of close academic integration between universities in Turku and Stockholm region.
- 2007 Initiator of Turku Innovation Platform, a regional governance structure for knowledge and innovation community operation.
- 2007 Initiator a large scale Nordic Master School on Innovative ICT between Turku, Stockholm, Copenhagen and Tallinn.

**Professional Activities:**

- 1986-1987 President of Tampere section of Electronics Engineers in Finland Society
- 1986 Member of organizing committee for a professional postgraduate course: Design of Analog/Digital Application Specific Integrated Circuits
- 1986 Member of organizing committee for a professional postgraduate course: GaAs Integrated Circuits
- 1987 Member of organizing committee for a professional postgraduate course: Micropower Electronics
- 1987-1989 Organized “National IC Design Workshop” for research institutes and industry. May 1987, March 1988, April 1989, and April 1991
- 1987 Organized “Sigma/Delta Analog-to-Digital Converter Techniques” workshop. August 1987, August 1988
- 1987 Organized and designed a post-graduate full-term course “VLSI for Digital Signal Processing”
- 1987-1988 Course director for international “Advanced Course on MOS VLSI Design for Telecommunication (10 day course), June 1988 (together with Prof. Y. Tsvividis, Columbia University, USA)
- 1987 Member of a selection committee and a reviewer for IEEE International Circuits and Systems Conference (ISCAS -88)
- 1987-1891 Member of a steering committee for National Microelectronics Research and Development Program

- 1988 Course director and organizer for “Practical Silicon Compilation in Electronic System Design”, 5 day course (in English) in February 1988, Finland
- 1988 Course director and organizer for “Module Generator Based VLSI System Design”, 5 day course (in English) in March 1988, Finland
- 1988 Course director and organizer for “ASIC Design Workshop”, 8 day workshop (in English) in October 1988, Finland
- 1988-1990 Member of a organizing committee and course designer for “International University Program in Digital Signal Processing”
- 1988-1989 Member of a Department Board, Tampere University of Technology, Department of Electrical Engineering
- 1989 Organized (with Dr. Vainio) 2 day industrial seminar “DSP-ASIC Workshop”, February 1989
- 1989 Member of a organizing committee for industrial course “Custom Silicon Now!”, March 1989
- 1988-1989 Member of Technical Program Committee, IEEE European 1989 Solid State Circuits Conference (ESSIRC), Austria
- 1989-1992 Member of Technical Program Committee, IEEE ASIC Seminar & Exhibit, USA
- 1990-95 Member of Technical Program Committee, International Solid-State Circuits Conference, USA
- 1990 Conference Chairman, Scandinavian NORCHIP Seminar, Lund, Sweden, October 1990
- 1990 Member of the Steering Committee, Nordic NORSILC/NORCHIP Project funded by NIF
- 1990 Member of the Organizing Committee, INSKO courses “New Electronics Design Techniques” and “VHDL Course”
- 1989-91 Company Board Member, Kemi Technology Park Ltd.
- 1991-94 Member of the Steering Committee, Nordic NorASIC-SME project (a subproject in EUREKA JESSI (Joint European Submicron Silicon Initiative) project) funded by Nordisk Industrifond and Nordic governments
- 1990-91 Reviewer, International Journal of Computer Aided VLSI Design, and Analog Integrated Circuits and Signal Processing
- 1991 Conference Co-Chairman (with Prof. Olesen), Nordic NORCHIP Seminar, Copenhagen, Denmark, October 1991.
- 1991 Member of the Steering Committee for ASIC Design Methodologies and Tools (ASPI) Program (a part of Finnish National Electronic Design and Manufacturing Programme 1991-95)
- 1991 Member of the Steering Committee for Circuit Board Design and Testing Methods and Tools Program (a part of Finnish National Electronic Design and Manufacturing Programme 1991-95)
- 1991-92 Member of the Technical Program Committee, IEEE European Solid State Circuits Conference (ESSCIRC)
- 1992- Chairman, Nordic NORCHIP project with over 15 Scandinavian participating institutions. Duties to develop Scandinavian consortia and network for Centers-of-Excellence in microelectronics
- 1994- General chairman, IEEE NORCHIP conference (a Nordic/Baltic conference specializing to IC design and design methodologies. Best papers are published as a special issue of Journal of Analog Circuits and Signal Processing and Journal of VLSI Signal Processing).
- 1993-94 Member of the company board, Synthesia AB
- 1996, 1998 Member of Technical program Committee, IEEE European Solid State Circuits Conference (ESSCIRC)

1992-2001 Member of Technical Program Committee, IEEE International Solid-State Circuits Conference (ISSCC)

1994 Guest co-editor for special issue in Journal of Analog Circuits and Signal Processing

1997-1998 Executive Board Member, national graduate school Personal Computing and Communication (PCC).

1997- Member of Editorial Board, Journal of Analog Integrated Circuits and Signal Processing

1998 Technical program committee member, Design, Automation and Test in Europe Conference (DATE99)

1997 Guest co-editor for special issue in Journal of Analog Circuits and Signal Processing

1997-1998 Member of the company board, KTH Holding AB

1997-1998 Executive Board Member, national graduate school in Microelectronics and Photonics, high speed electronics.

1999-2000 Technical program committee member, Microelectronics System Education Conference (EWME2000), France, 2000

1998-2000 General Chairman, IEEE European Solid-State Conference in Stockholm in year 2000 in Stockholm

1999 Expert reviewer, EU ESPRIT PREST research project

1999 Expert reviewer, EU ITS programme proposal for the first call.

2000 Expert reviewer, EU ESPRIT PATMOS project

1999 Expert reviewer, Belgian Flamish National Research Program 1999-2001 on information technology

1999 Expert reviewer, Belgian evaluation of the Flemish participations in the European EUREKA-program MEDEA

1999 Technical program committee member, IFIP International Conference on Very Large Scale Integration

1999-2000 Vice chairman and Local organizing committee chairman, IEEJ Analog VLSI conference, Stockholm,

2000-2001 Technical Program Committee member for European Solid State Circuits conference (ESSCIRC) 2001

2000-2001 Technical Program Committee member for European Conference on Circuit Theory and Design (ECCTD) 2001

2000-2001 Technical Program Committee Member, IEEE International Conference on Electronics, Circuits and Systems

1999-2000 Technical Program Committee Member of Baltic Electronics Conference (BEC) 2000

1999-2000 Member of the management board for Industrial Graduate School in Electronic Design, funded by KK-foundation.

2000- Member of the management board for national System-on-Chip program Socware

2000- Director of KTH SoC research and education activities. Responsible director of International Master Program on System-on-Chip at KTH

1998-2003 Area manager in System-on-Chip area in national SSF funded INTELECT research program

2000 Guest co-editor for special issue in Journal of Analog Circuits and Signal Processing

2001 Guest co-editor for special issue in Journal of Analog Circuits and Signal Processing

2002 Guest co-editor for special issue in Journal of Analog Circuits and Signal Processing

- 2000- Member of the Academic Advisory board, Turku Center for Computer Science (TUCS).
- 2000- Member of the Advisory Board, Imsys AB (a Swedish high technology company with focus on innovative microprocessor ICs)
- 2000- Advisor, Spirea AB (a Swedish high technology company with focus on Bluetooth products).
- 1980 - Participated over 100 international conferences
- 2004
- 1999 Expert reviewer for Belgian Government on IMEC, Leuven, activities and future directions and organisational structure
- 2000 Technical program committee member of the European Solid State Circuit Conference
- 2001 Conference Chair and organiser, 19<sup>th</sup> IEEE Norchip Conference, Kista Sweden
- 1991- Chairman of the Executive Board of IEEE Norchip series of Nordic/Baltic conferences
- 2001 Conference organising committee member, DATE Conference 2002
- 2001 Technical program committee member, 4<sup>th</sup> European Workshop on Microelectronics Education (EWME02), 2002
- 2002 Technical program committee member of the Baltic Electronic Conference,
- 2002
- 2002 Technical program committee member, European Solid State Circuits Conference 2002 & 2003 & 2004 (Florence, Lissabon, Leuven)
- 2002 Guest editor Journal of Analog Circuits and Signal Processing
- 2003 Technical program committee member for ESSCIRC and special workshop organiser
- 2003 Expert reviewer for multi billion Euro Medea+ Eureka programme.
- 2003 Guest co-editor for special issue in IEEE Journal of Solid State Circuits
- 2003 Guest co-editor for special issue for Journal of System Architectures
- 2004 Technical program committee member, EWME 2004 (European Microelectronics Education Conference)
- 2004-2008 Vice-Chair of Multiprocessor SoC workshop (MPSOC2004)
- 2005 Technical program committee member, European Solid State Circuit Conference
- 2007 General Chairman, EWME 2006 in Stockholm, European Microelectronics Conference
- 2005 Steering Group member for ESSCIRC/ESSDERC conferences
- 2007 Steering Group member, IEEE Int Workshop for System-on-Chip
- 2008 Vice-Chair, IEEE COMPSAC Conference
- 2011 General Chair, ESSCIRC/ESSDERC 2011 conference

#### **Membership in Professional Organizations:**

IEEE, Electron Device, and Circuits and Systems, and Solid-State Circuits Societies  
 Electrochemical Society  
 Electronics Engineers in Finland Society  
 Finnish Technical Society  
 Finnish Physical Society

#### **Fellowships and Grants:**

Asla-Fulbright Fellowship 1983 - 84  
 Finnish Cultural Foundation Grant 1983 - 85  
 Wihuri Foundation Grant 1984  
 Foundation for Advancement of Technology Grant 1984



### **Teaching Experience:**

Lecturing and designing undergraduate and graduate courses (1980 - 2000) in the following topics (responsibility include course planning, material selection, additional course material development, lecturing and grading):

- Semiconductor Physics (for EE students)
- Quantum Physics (for EE students)
- Computability Theory (teaching assistant)
- Theoretical Computer Science (teaching assistant)
- Discrete Components and Semiconductor Devices
- VLSI Design
- Integrated Circuits
- CAD/CAE Methods in Analog Electronics
- Commercial Electronic Components and Circuits
- Analog and Digital Electronic Circuit Structures and Design
- Analog Circuit Design on Silicon
- Electronics Laboratory Works and Special Projects
- Computer and Processor Architecture
- Digital Equipment Design
- Structured VLSI System Design
- VLSI Processor Architecture and Design
- VLSI for Digital Signal Processing
- High Speed Digital System Design
- Practical Packaging Technologies for Electronic System Design
- Low Power Electronic System Design
- Low Power IC Design
- Sigma-Delta A/D converters
- A/D and D/A conversion techniques
- Physical Architecture of VLSI/ULSI Systems
- Mixed Signal System Design
- VLSI Design
- LSI Design
- Digital System Engineering
- High Speed CMOS design
- Embedded Systems in SoC
- Digital Hardware organisation
- Digital Circuit Techniques for deep submicron CMOS
- Electrical Design of Digital Systems
- Nanoelectronic systems

Many (over 60) professional post-graduate and continuing education short courses and seminars (lectured/designed) including a Nordic co-operative program NorESD for continuing education.

New curriculum structure and course integration approach in electronics education at Royal Institute of Technology.

New specialised curriculum towards System-on-Chip integration from physical integration to functional integration.

New international M.Sc. educational program, SOC Masters, at KTH

New national and international B.Sc., M.Sc (Teknologie magister), Civ.ing. programs for IT-University in Kista. 750 students will enter on yearly basis to these programs, of which over 300 are international students.

### **Organization development experiences 1986-2003**

Organised a new electronics educational program at Tampere University of Technology 1985-86  
Created a current Microelectronics lab with focus on circuit design issues at Tampere University of Technology  
Organised national circuit related research activities as the coordinator of the national Microelectronics Program of Finland 1987-90  
Started and organised Digital hardware Laboratory (during that time part of Signal Processing Lab) 1989-1992. Currently a laboratory of 130 persons  
Worked as Head of Laboratory (prefekt) of Signal processing Laboratory being responsible on overall education and administrative issues. (1988-89)  
Contributed significantly to the creation of International Program of Signal Processing at Tampere University Technology (jointly with Prof. Yrjö Neuvo), 1988-89  
Created from scratch electronics design activities at Royal Institute of Technology (KTH) and Electronic System Design Laboratory, and establishing that as the recognised leading European research and education unit in this area comparable to the best US units.  
Organised multiple large-scale donations for creating competitive educational environment both at TUT and at KTH.  
Creation and support for activities towards technology dissemination and enhanced usage in SME sector in Nordic area, 1990-1994  
Contributed as initiator or co-propose to formation of multiple graduate schools and national research programs in Sweden, 1995-1998  
Initiated the process to create a national program and policy of System-on-Chip design issues (including education, research, and industrial activities), 1997-1999  
Contributed to the restructuring of education in electronics area at KTH and one of the early propagators and architects for the IT-university program at KTH, 1998-2000  
Leadership as dean for IT-University development with currently over 3500 full time students, 60 professors and associate professors and 520 MSEK yearly total budget.  
Definition of new professor areas and long-term educational strategies.  
Initiator and organiser for International Master Program on System-on-Chip Design (SoC Masters) at KTH, 1999-2003. Currently the most successful international master program at KTH with over 500 applicants each year.  
Member of KTH Executive Management Board (Ledningsgrup)  
Member of KTH Faculty Dean Council  
Member of KTH Faculty Promotion Council  
Member of KTH International Programs Council  
Chairman of Recruitment Board for IT-University  
Chairman of Educational Board for IT-University  
Director, Turku Centre of Computer Science

### **Research activities and program development experience 1987-2000**

#### **Research Projects in 1987:**

Digital Signal Processing and Application Specific Integrated Circuits (DSP-ASIC, system and circuit designs and design methodologies) co-principal investigator, funded by Technology Development Centre.

Hierarchical and Deterministic Modelling of IC structures and Fabrication Processes, Principal Investigator, Academy of Finland.

Advanced Microarchitectures for High Performance Digital Signal Processing, Matine, Principal Investigator.

Electronic Integration of High Energy Particle Detector for SOHO Satellite (by ESA), Principal Investigator.

Advanced Analog to Digital Conversion Techniques, Industry funded, Principal Investigator.

Program Coordination, National Microelectronics R&D Program

### **Research Projects in 1988:**

High Performance Microarchitectures for Adaptive Signal Processing, Principal Investigator

SMARTPOWER-Integrated Circuits for Power Electronics and Mechatronics, Co-investigator (circuit techniques)

A/D and D/A Conversion Techniques, Principal Investigator

Electronic Integration of High Energy Particle Detector for SOHO Satellite, Principal Investigator and co-investigator in international ERNE-project for ESA

Design of Testable and Verifiable Integrated Circuits and Electronic System for Avionics, Principal Investigator

DSP-ASIC, 2<sup>nd</sup> year, Co-investigator and project manager

Research co-operation with Integraph Corp. (Huntsville, USA) on advanced circuit design techniques and related tools. Integraph provides workstation and programs worth of over 1 million FIM to VLSI Research Group

Research co-operation with Silicon Compiler Systems (SCS) (San Jose, USA) on VLSI system design. SCS provides Generator Development Tools and module compiler software worth over 5 million FIM to VLSI Research Group in order enhance VLSI system design know-how in Finland

Program Coordination, National Microelectronic R&D program

- FINSILC-project: silicon compiler systems for Finnish universities

- FINCHIP - a commercial multichip project for industrial R&D, small scale production, and academic research and education

- monitoring and developing national research program on ASIC design

Training program on gate array and standard cell dig-ital system design for over 250 industrial designers, Principal Investigator

### **Research Projects in 1989:**

DSP-ASIC, 3<sup>rd</sup> year, co-investigator and project amanger

SMARTPOWER, 2<sup>nd</sup> year, co-investigator

DSP-CORE, 1<sup>st</sup> year, research on high resolution analog interfaces and core microprocessor and signal processor architectures and implementations for embedded system ASIC implementations in instrumentation and telecommunication. Principal investigator.

Digital Power Control. Research on digital ASIC based intelligent thermal overload relays and contactors for electric machines. Principal investigator.

Constant False Alarm Rate (CFAR) radar digital signal processing. Principal investigator.

Oversampled sigma/delta converters for telecommunication applications. Principal investigator.

ESPIRIT project Promotion of VLSI Design Skills. Co-investigator.

Research co-operation with Silicon Compiler Systems on VLSI tools for DSP-ASIC.

Program Coordination, National Microelectronics Program

- FINSILC; extending silicon compilation tools to technical colleges in Finland in order to initiate ASIC training in technical colleges and institutes.
- FINCHIP; integrating FINCHIP services with ESPIRIT project "Promotion of VLSI Design Skills" and provide high performance digital CMOS processing capabilities to Finnish research establishments.
- VLSINET; computer network for design information exchange and email between research organizations, industry and FINCHIP.
- Developing new research areas for the 2<sup>nd</sup> phase of National Microelectronics Program in 1990s.

### **Research Projects 1990:**

DSP-ASIC, 4<sup>th</sup> year, co-investigator

DSP-CORE, 2<sup>nd</sup> year, principal investigator

Digital Power Control, 2<sup>nd</sup> year, principal investigator

CFAR Radar signal processing and hardware implementations, 2<sup>nd</sup> year

Oversampled sigma/delta converters, industrial applications in process automation (sensors) and mobile communication (intermediate frequency signal processing), principal investigator

Digital Audio. Established and arranged funding for industrial consortia for pre-competitive R&D in digital audio and DSP based loudspeakers, principal investigator

Organized funding and coordinating for Technical Colleges in developing microelectronics and system design courses.

Established Digital and Computer System Design Laboratory in Signal processing Laboratory, TUT with help of 6.5 million FIM grant as hardware and software from industry.

Coordinator, National Microelectronics R&D Program of Finland , 4<sup>th</sup> year

- planning further activities after the end of Finnish NMP

### **Research Projects 1991**

Developing new application specific signal processor architectures with a European company (Austrian Microelectronics Systems, AMS), 3 researchers

Research in ASIC based smartpower applications (Smart Motor Controller), 4 researchers

Research in PCB/hybrid/MCM electrical and system level simulation techniques and tools to distribute simulations on computer network, 4 researchers (part of KOSTI Program in new National Electronics Programme)

Digital audio for loudspeakers, 2 researchers

ESPRIT EUROCHIP VLSI Design Skill Training Action

Sigma/delta data conversion research, 4 researchers  
EUREKA JESSI Application Project #42 and Nordisk Industrifond funded  
NorASIC-SMI project (part of ASPI program in Finland), 5 researchers  
-synthesis for DSP-ASIC  
-DSP cell libraries  
-simulation acceleration tools  
-innovative DSP integration applications  
Evaluation of Finnish Industry Needs and Requirements for Standardized  
Design Tool and Database Integration (ESKART, Part of new National  
Electronics Programme, cooperation with Research Institute for Information  
Technology, TUT), 1 researcher

### **Research projects in 1992**

Reusable macro library based design methodology at Tampere University of  
Technology. Close contact/supervising to earlier research projects at TUT.  
Research cooperation with CERN on data collection system in Large hadron  
Collider based on ATM switching technologies (KTH)  
Asynchronous design methodologies (KTH)  
NorASIC, a ASIC technology dissemination project as well as evaluation of  
ASIC technology adoption in industries. Initiating the activities at Institute of  
Microelectronics in Sweden.

### **Research projects 1993-94**

Walkstation, an interdisciplinary research project on future multimedia  
personal communication  
ATM switch fabrics for very high throughput and 10 Gbit/s building blocks.  
Self-timed asynchronous architectures and their applications to spread  
spectrum radio receivers.  
High level synthesis technologies for memory intensive telecommunication  
applications  
System level design toolbox, a collection of tools for early exploration and  
estimation of communication systems

### **Research program 1994-1997**

The main objectives of the research program at ESDlab is to: (i) conduct  
conceptual design and feasibility of new circuit architectures and design  
methods and concepts on selected area of telecommunication applications, (ii)  
explore long range technology and circuit options for VLSI/ULSI systems, and  
(iii) identifying critical design concepts which may provide paradigm shift in  
design methodology. This is achieved at ESDlab via a research program with 3  
focus 3 areas:

#### **i) VLSI/ULSI System Applications and Strategic Implementation Techniques**

Focus on new concepts and architectures in personal communication (CDMA)  
and high speed switching. On implementation side high speed sigma-delta  
methodology and asynchronous design techniques for low power and high  
performance are under study

## (ii) Design Methodology and Tools

Research focus on HW/SW codesign and co-verification issues and performance estimation, and on high level synthesis for telecommunication oriented applications.

## (iii) High Speed/High Performance Complex Circuits

Research focus on design and technology issues (on both Si- and III-V-semiconductor based substrates) for high speed (0.5-40 GHz) mixed-mode circuits for optical and wireless communication and ATM.

This program is realised via multiple smaller nationally and internationally funded research projects. Key aspects has been in establishing and starting up advanced and long term (5-10 years) graduate schools in the area as Personal Computing and Communication (PCC) and Microelectronics and Photonics (High Speed Electronics Track).

## Research program 1998-2001

The objective of the ESDlab is to do research and education in the design of complex electronic systems. The ESDlab mission is to

1. develop a new knowledge base and to do industrially relevant research in innovative design on VLSI/ULSI systems and technologies,
2. couple research to educational activities, and
3. provide state-of-the-art facilities for own work and to our industrial affiliates

The key research issues to improve design efficiency and design quality are:

**Functional design and validation:** Functional design for heterogeneous ASICs consisting of multiple DSP and RISC core processors, with embedded software integrated on chip memories resulting to much higher design abstraction and specification levels in the design process requiring new description languages and synthesis techniques.

**IP based design:** Significant improvement of reusability and enhanced reusable macro generation in all phases of the design, resulting to more efficient IP (intellectual property) encapsulation.

**Interconnection based design:** Design optimization strategies in an environment where the cost of an interconnection is much higher (for area, power consumption, speed and cost) than a cost of logic cells or transistors resulting in new design paradigms. Most of the current design paradigms and algorithms are based on research in early 1980s, where the situation was completely reversed. Chip and system level synchronization strategies for complex circuits consisting of complex building blocks resulting in high system performance and standardized way to integrate complex IP to designs.

**Physical system integration:** Low power design strategies for deep sub-micron design for orders of magnitude reduced power consumption resulting in efficient power management techniques as well as emphasis of codesign of system and implementations aspects. Mixed signal design strategies for integrating the analog interfaces to system circuits. The key issues is digital noise rejection techniques as well as robust analog circuit techniques for low voltage operation constraint resulting to high yield and robustness of the mixed signal system chips.

In **education** ESDlab covers the same areas of functional system design and physical system integration. A new type of competence and breed of system engineers and engineering scientists need to be created in order to help our

industries to meet the challenges of the near future. The system integration aspect must include both the traditional “oriented” system view as well as better understanding of the physical constraints and design issues at all levels from transistors to different substrate technologies and interconnection strategies. In several courses ESDlab addresses these concerns from different perspectives, ranging from mixed signal design and packaging technologies to requirements definition, system specification and concurrent engineering. In order to make this feasible all these topics are presented at proper abstraction levels to allow the students to comprehend the topics and make the connections between them.

These generic goals are pursued in multiple nationally and internationally funded research projects, where the long term strategic aspects are ensured via the national graduate school programs. The application domain for most projects is in area of 4<sup>th</sup> generation multimedia mobile systems, which will emerge as industrial products within next 10 years. As an example of such research project is European union financed ESPRIT Long Term Research project MEDIA with research focus on 4<sup>th</sup> generation mobile communication infrastructure, basestations. This project was initiated by us and we serve as the main contractor for the consortia.

These programs are carried out within the framework of the following graduate schools, which I am one of the founding members and proposal initiators. Other topics above are carried out by 3 associate professors at Electronic System Design Laboratory:

**Personal Communication and Computing.** In this program my research focus is on low power techniques and DSP integration for high data rate (10-100 Mbit/s) 4<sup>th</sup> generation mobile systems

**Microelectronics and Photonics.** In this program my research focus is in high speed electronics and new radio architectures suitable for deep submicron CMOS implementations. In the initial phase major effort is in area of wideband A/D interfaces.

**EPROPER** is a new program with focus on integration technologies and production techniques for future electronics systems. My own research focus is on Coin Radio, fundamental aspects on packaging technologies and design issues towards order of magnitude reduction of current radio terminals. Aim is to provide on 10 year perspective wearable personal electronics with wideband connectivity.

**Electronic Design** is also a new graduate school program with industries and focus on interdisciplinary design issues of complex electronic systems. My own research focus is on design methodologies and robustness aspects.

In addition of these above mentioned larger research programs, I contribute also on national microelectronics program with the following projects (as technical project leader and Ph.D. student supervisor):

- Wideband CDMA architectures and implementations for 3<sup>rd</sup> generation mobile systems. Research focus is on low power DSP implementations

- Substrate and signal couplings for mixed signal RF/analog/digital integration with research focus on noise margins studies, simulation and modelling techniques for mixers, oscillators, and sigma-delta noise shapers under substrate and interconnect mediated disturbances.

-Single level integration/packaging technologies and optimal interconnect strategies or deep submicron digital and mixed signal systems

In addition, I am currently preparing a new research program on circuit analysis and design approaches towards multiple giga transistor circuits based on completely different circuit level abstraction as used today.

### **Research program 2001-2005**

Currently multiple new projects have been defined and new applications have been submitted to the funding agencies for projects to be started sometime 2001. The key focus in ESDlab research programs will be in three areas

- Platform based gigascale integration. Focus is on reconfigurable and programmable large scale chip architectures and their supporting design methodologies
- Communication architectures and circuit techniques for low energy and robust/error free on chip communication. Earlier integration work is integrated to high level design methodology
- Mixed signal issues towards gigascale integration including signal integrity, power distribution and analog/RF integration aspects in very compact systems
- Fundamental research in new logic design paradigms and circuit technologies beyond the current industrial roadmaps

### **Research program 2007-2012**

Currently multiple new projects initiated, under progress or in application phase for autonomous operation of complex systems including autonomic monitoring, healing and dynamic reconfiguration. The key driving issues is both software and hardware integration for efficiency and design and performance constraints. The key technological challenge is exploring the limits of nanoscale CMOS.

New technology directions has been initiated with very large scale Excellence centre for Intelligent Paper and Packaging. The forest, electronics, and biomedical industries are three of the most important industries in Nordic area. In a global perspective, Norden has a leading position in these areas. Today there is an untapped opportunity for sustainable growth in the realm of ubiquitous intelligence, which aims to embed tiny and intelligent systems in almost everything including artifacts, the human body, paper and packaging. Due to resident competences, it is likely that Norden will have a high chance to succeed in some areas such as intelligent pharmaceutical packaging, smart foods packaging, hospital logistics and patient care.

However, due to the pressure of global competition, our industries have focused their internal R&D on existing core products. In order to capture this opportunity, the forest industry, electronics industry and the bio-medical industry must work together, jointly developing the necessary technologies such as integrating biomedical sensors, energy and battery cells, and wireless links on paper and packaging. This proposed center is therefore a hub and a research platform required for such a multi-disciplinary collaboration Here electronics, nanotechnologies, and traditional processing technologies will meet and melt with new system concepts and application domains.



### **Supervised and defended Ph.D Theses.**

- Jouni Isoaho, "DSP System Development and Optimization with FPGAs", 1994, Professor, University of Turku
- Jari Nurmi, "Application Specific Digital Signal Processors: Architecture and Transferable Layout Design", 1994, Professor, Tampere University of Technology
- Teppo Karema, "Oversampling A/D and D/A Converters Using One-Bit Sigma-Delta Modulation Techniques", 1994, Director of Technology (CTO), VLSI Solutions Inc
- Tawfiq Lazraq, "Design Techniques and Structures for ATM Switches", 1995, senior expert, Ericsson AB
- Bengt Jonsson, "Switched-Current Circuits: From Building Blocks to Mixed Analog-Digital Systems", 1999, senior expert, Ericsson AB
- Bengt Oelmann, "Asynchronous and Mixed Synchronous/Asynchronous Design Techniques for Low Power", 2000, Professor, Mitthögskolan, Sundsvall, Sweden
- Henrik Olson, "Algorithm-to-Architecture Refinement for Digital baseband Radio Receiver" 2000, technical expert, Ericsson AB
- Peeter Ellervee, "High-Level Synthesis of Control and Memory Intensive Applications", 2000, professor, Tallinn Technical University
- Matias O'Nils, "Soecification, synthesis and validation of HW/SW interfaces", 1999, Professor, Mitthögskolan(Sunsvall).
- Kalle Tammemäe, 1999 (joint student with TTU, defence in TTU), rector (president) IT-College, and adjunct professor at Tallinn Technical University, Tallinn, Estonia. Currently vice-president of Tallinn Technical University.
- Yonghong Gao, "Architecture and Implementation of Comb Filters and Digital Modulators for Oversampling A/D and D/A Converters", 2001, managing director, ZTE Communication, Kista
- Li-Rong Zheng, "Design and Analysis and Integration of Mixed-Signal Systems for Signal and Power Integrity" 2001, professor, KTH, Dean at fudan University, Shanghai
- Imed ben Dahou, "Low Power Design Techniques for Deep Submicron technology with Application to Wireless Transceiver Design", 2002, Associate Professor in Saudi-Arabia,
- Andreas Gothenberg, "Analysis and Design of Low Oversampling Sigma-Delta Modulators for RF Front-Ends", 2002. Managing director of STINT, Swedish foundation for International Cooperation in Research and Higher Education.
- Li Li, "Noise analysis for RF mixers", 2004. Associate professor, Harbin University, China, currently senior engineer Catena Wireless AB
- Li Bingxin, "Design of sigma-delta modulators for wireless receivers", 2003, post-doctoral fellow, Tokyo University, Japan. Currently at Hi Silicon (Huawei) AB, Kista, Sweden
- Dinesh Pamunuwa, "Modelling and Analysis of Interconnects for Deep Submicron System-on-Chip", 2003, Senior Lecture (associate professor), University of Peradeniya, Sri Lanka. senior reader at University of Lancaster, UK and currently Senior Reader at University of Bristol, 2013
- Steffen Albrecht, "Sigma-Delta Techniques for Multi-Band Multi-Standard Radio", 2005. Strategy Director, Philips Lightning, Shanghai
- Xinzhong Duo, "System-on-Package Solutions for Multi-Band Multi-Standard Radio", 2005. Technical manager, Semiconductor Manufacture Internation Corp (SMIC), Shanghai

- Meigen Shen, "Concurrent Chip-Package Design for Radio and Mixed-Signal Systems", 2005. Xanadu Wireless Corp, Netherlands. Currently director of Fudan Innovation Center at Wuxi, China
- Maxim Teslenko, "All around Logic Synthesis", 2008, senior expert Ericsson AB
- Adam Strak, "Timing Uncertainty in Sigma-Delta Analog-to-Digital Converters", 2006, Infineon Semiconductors
- Roshan Weerasekera, "System Interconnection design trade-offs in 3-D integrated circuits", 2008, Senior Scientist at A-STAR, Singapore, 2013
- Majid Baghaei-Nejad, Impulse radio ultrawideband for wireless sensing and identification, 2008, Associate Professor, Dean, Sabzevar University, Iran
- Ethiopia Nigussie, "Exploration and Design of High-Performance Variation Tolerant On-Chip Interconnects", 2010, University teacher, University of Turku
- Sampo Tuuna, "Modeling and Analysis of Noise and Interconnects for On-Chip Communication Link Design", 2011
- Masoud Daneshtab, "Exploring Adaptive Implementations of On-Chip Networks", 2011. Post-doc at University of Turku
- Zou Zhuo, "Impulse Radio UWB for the Internet-of-Things – A Study on UHF/UWB Hybrid Solution", 2012. Senior researcher at KTH
- Thomas Canhao Xu. "Hardware/Software Co-Design for Multicore Architectures", September 2012. Post-doc at UTU
- Amir Rahmani, "Exploration and Design of Power-Efficient Networked Many-Core Systems", 2012.
- Liang Guang, "Hierarchical Agent-based Adaptation for Self-Aware Embedded Computing Systems", 2012.
- Alexander Wei Yin, "On Energy Efficient Computing Platforms", 2012.
- Geng Yang, Biomedical Electronics for Wearable Healthcare Devices", 2013
- Waqar Ahmad, Core Switching Noise for On-Chip 3D Power Distribution Networks", 2013
- Yasar Amar, "Printed Antennas for Ubiquitous Sensors", 2013
- Liang Rong, "All Digital Polar Transmitter Design for Software Defined Radio Architecture and Low Power Circuit Implementations", 2013
- Moazzam Fareed Niazi, "Modeling and Verification for Platform-Based Design", 2013
- Khalid Latif, "Design Methodology for Scalable and Application independent MPSoC platforms", 2013
- Masoumeh Ebrahimi, "Adaptive Routing Approaches for Networked Many-Core Systems", 2013

**Post-docs starting in my laboratory after their PhD and who have reached docent or professor level positions:**

- Prof. Doc. Ahmed Hemani (KTH),
- Prof. Doc. Elena Dubrova (KTH),
- Prof. Doc. Axel Jantsch (KTH),
- Prof.Doc. Ana Rusu (KTH),
- Prof. Doc. Li-Rong Zheng (Dean at Fudan University),
- Prof. Adam Postula (Univ. of Brisbane),
- Doc. Assoc.Prof. Juha Plosila (UTU),
- Doc. Adj.Prof Tiberiu Seceleanu (Principal Scientist, ABB Corporate Research and Mälardalen Högskolan).
- Doc. Ass.Prof. Pasi Liljeberg (UTU),

- Prof. Sashi Kumar (Jonköping University)

## **LIST OF PUBLICATIONS, PRESENTATIONS AND PATENTS 1982-2008**

Prof. Tenhunen's research interest and publications activities have been in areas:

- Interconnect centric and robust/interference free design of electronic systems, architectures and methods
- Design of embedded and integrated systems towards signal processing, communication, and internet-of-things applications
- Flexible electronic systems and intelligent integration to paper and pulp based substrates and packages
- 3D integration technologies and modelling & design of 3D circuits and systems using through-silicon-via (TSV)
- VLSI applications in personal communication and fundamental design constraints and future paradigms necessary to harvest the technology potential
- Platform based design methods and architectures based network-on-chip architectures
- Embedded dependable systems based on agent controlled autonomic systemic architectures (HW/SW)
- VLSI Design and Circuits, especially towards DSP
- IC Mixed Signal Circuits and Systems including sigma-delta A/D and D/A
- Integrated Heterogeneous Sensible Systems
- Technology policies and educational strategies in area of rapidly evolving ICT technology.

### **Thesis:**

1. Anomalous Properties of Silicondioxide and Chalcogenide Glasses, Master of Science Thesis (in Finnish), Helsinki University of Technology, August 1982, 151 p.
2. Formation of Anodic Porous Silicon for Silicon-on-Insulator VLSI Structures, Ph.D. Thesis, Cornell University, September 1985, 206 p

### **International granted patents in multiple countries:**

3. T. Lazraq, P. Bergstedt, H. Tenhunen, and M. Mikhtari. Atm switch core, 1997. Granted patent US6091728. Patent number in other countries: AU5784896, CA2220514, EP0826293, JP11505089T, SE504985, SE9501720, WO9636196.
4. T. Ritoniemi, T. Karema, and H. Tenhunen. Cascaded Nth order ( $N > 2$ ) feedforward sigma-delta modulators, 1997. Granted patent US5629701. Patent number in other countries: DE69314939D, DE69314939T, EP0624290, FI90296B, FI90296C, FI920378, JP3113277B2, JP7503346T, WO9315557.
5. M. Renfors, Y. Neuvo, J. Makinen, H. Tenhunen, and J. Rapeli. Noise elimination method, 1994. Granted patent US5285165.
6. T. Karema, H. Tenhunen, and T. Ritoniemi. Sigma-delta modulator for a D/A converter with pseudorandom jitter signal insertion, 1993. Granted patent US5191331. Patent number in other countries: DE69212337D, DE69212337T, FI88980B, FI88980C, FI910116, JP3130105B2, JP4317224.
7. T. Karema, H. Tenhunen, and T. Ritoniemi. Delta-sigma analog-to-digital converter with overload dependent modulator order, 1993. Granted patent US5191331. Patent

- number in other countries: DE69214996D, DE69214996T, FI88765B, FI88765C, FI911694, JP3142946B2, JP5110442.
8. T. Karema, T. Ritoniemi, and H. Tenhunen. System and method of scaling error signals of caseload second order modulators, 1991. Granted patent US5061928. Patent number in other countries: CA2002359, DE368610T, DE68915700D, DE68915700T, ES2064459T, FI80548B, FI80548C.
  9. T. Karema, H. Tenhunen, and T. Ritonieme. A method of cascading two or more sigma-delta modulators and a sigma-delta modulator system, 1990. Granted patent EP0368610. Patent number in other countries: CA2002359, DE368610T, DE68915700D, DE68915700T, ES2064459T, FI80548B, FI80548C.
  10. P. Solanti, H. Tenhunen, and E. Kiiskinen. Digitally controlled contactor and method for controlling a contactor, 1990. Granted patent EP0402455. Patent number in other countries: AU4816890, FI81217B, FI81925B, FI81925C, WO9007787.
  11. P. Solanti, J. Suutari, E. Kiiskinen, M. Siikonen, and H. Tenhunen. Apparatus and method for measuring electric current in conditions of high interference, 1990. Granted patent EP0464076. Patent number in other countries: AU5282090, DE69009053D, DE69009053T, FI87117B, FI87117C, FI894792.

### **Reviewed Journal Articles, Books, and Book Chapters**

12. Amir-Mohammad Rahmani, Pasi Liljeberg, Juha Plosila, Hannu Tenhunen (Eds.), Special Section on Advances in Methods for Adaptive Multicore Systems. *Journal of Supercomputing* 68(3), 2014.
13. Masoumeh Ebrahimi, Masoud Daneshtalab, Pasi Liljeberg, Juha Plosila, Hannu Tenhunen, Path-Based Multicast Routing Algorithms for 2D and 3D Mesh Networks. In: Masoud Daneshtalab, Maurizio Palesi (Eds.), *Routing Algorithms in Networks-on-Chip*, 161–189, Springer, 2014.
14. Liang Guang, Juha Plosila, Hannu Tenhunen, Self-Adaptive SoCs for Dependability: Review and Prospects. In: Seppo Virtanen (Ed.), *Advancing Embedded Systems and Real-Time Communications with Emerging Technologies, Advances in Systems Analysis, Software Engineering, and High Performance Computing*, 1–21, IGI Global, 2014.
15. Masoumeh Ebrahimi, Masoud Daneshtalab, Pasi Liljeberg, Juha Plosila, Hannu Tenhunen, Path-Based Multicast Routing Algorithms for 2D and 3D Mesh Networks. In: Masoud Daneshtalab, Maurizio Palesi (Eds.), *Routing Algorithms in Networks-on-Chip*, 161–189, Springer, 2014.
16. Fahimeh Farahnakian, Adnan Ashraf, Pasi Liljeberg, Tapio Pahikkala, Juha Plosila, Ivan Porres, Hannu Tenhunen, Energy-Aware Dynamic VM Consolidation in Cloud Data Centers Using Ant Colony System. In: Carl Kesselman (Ed.), *7th IEEE International Conference on Cloud Computing*, 104–111, IEEE, 2014.
17. Mohammad Fattah, Amir-Mohammad Rahmani, Thomas Canhao Xu, Anil Kanduri, Pasi Liljeberg, Juha Plosila, Hannu Tenhunen, Mixed-Criticality Run-Time Task Mapping for NoC-Based Many-Core Systems. In: Marco Aldinucci (Ed.), *IEEE/Euromicro International Conference on Parallel, Distributed, and Network-Based Processing*, 458–465, Euromicro, IEEE, 2014.
18. Mohammad Fattah, Pasi Liljeberg, Juha Plosila, Hannu Tenhunen, Adjustable Contiguity of Run-Time Task Allocation in Networked Many-Core Systems. In: *Design Automation Conference (ASP-DAC), 2014 19th Asia and South Pacific*, 349–354, IEEE, 2014.
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21. Liang Guang, Juha Plosila, Hannu Tenhunen, From Self-Aware Building Blocks to Self-Organizing Systems with Hierarchical Agent-Based Adaptation. In: Radu Marculescu, Gabriela Nicolescu (Eds.), Proceedings of the 2014 International Conference on Hardware/Software Codesign and System Synthesis, 1–3, ACM, 2014.
22. Mohammad-Hashem Haghbayan, Bijan Alizadeh, Amir-Mohammad Rahmani, Pasi Liljeberg, Hannu Tenhunen, Automated Formal Approach for Debugging Dividers Using Dynamic Specification. In: Said Hamdioui, Marco Ottavi (Eds.), International Symposium on Defect and Fault Tolerance in VLSI and Nanotechnology Systems, 263–268, IEEE, 2014.
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24. Mohammad-Hashem Haghbayan, Amir-Mohammad Rahmani, Pasi Liljeberg, Juha Plosila, Hannu Tenhunen, Distributed BIST Approach for Power Constrained Many-Core Systems. In: Marco Ottavi, Giorgio Di Natale (Eds.), Joint MEDIAN–TRUDEVICE Open Forum Co-Located with IEEE 17th International Symposium on Design and Diagnostics of Electronic Circuits & Systems, 1–1, Median, 2014.
25. Mohammad-Hashem Haghbayan, Amir-Mohammad Rahmani, Pasi Liljeberg, Juha Plosila, Hannu Tenhunen, Online Testing of Many-Core Systems in the Dark Silicon Era. In: Witold Pleskacz (Ed.), International Symposium on Design and Diagnostics of Electronic Circuits & Systems, 141–146, IEEE, 2014.
26. Syed M. A. H. Jafri, Masoud Daneshtalab, Muhammad Adeel Tajammul, Kolin Paul, Ahmed Hemani, Peeter Ellervee, Juha Plosila, Hannu Tenhunen, Morphable Compression Architecture for Efficient Configuration in CGRAs. In: Francesco Loporati, Jose Silva Matos (Eds.), Euromicro conference on Digital System Design, 1–8, IEEE, 2014.
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44. Yasar Amin, Botao Shao, Qiang Chen, Li-Rong Zheng, Hannu Tenhunen, Electromagnetic Analysis of Radio Frequency Identification Antennas for Green

Electronics, Journal of Electromagnetics Volume 33, Issue 4, (ISSN 0272-6343)(EISSN 1532-527X) 2013

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### **List of International Reviewed Conference Papers and Presentations**

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750. J. Isoaho, J. Pasanen & H. Tenhunen; Fast Prototyping in DSP-ASIC Research and Development, in Proc. 6th NORSILC/NORCHIP Seminar, Copenhagen, October 1991.
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800. T. Saramäki, H. Palomäki & H. Tenhunen: Multiplier-Free Decimators with Efficient VLSI Implementation for Sigma-Delta A/D Converters, presented in IEEE Workshop on VLSI Signal Processing, USA 1988
801. H. Tenhunen: Finnish National Microelectronics Program and FINCHIP services, presentation in Nordic NORCHIP/NORSILC Meeting, Copenhagen, Denmark, October 1988

802. H. Tenhunen & O. Vainio: VLSI Signal Processing, invited presentation in Nordic NORSILC/NORCHIP Meeting, Copenhagen, Denmark, October 1988
803. H. Tenhunen: ASIC Approach Towards Digital Signal Processing, presentation in 7th Int. Kobe Symposium on Information Technology, Japan, November 1988
804. H. Tenhunen & J. P. Krusius: Modelling of Anodic Silicon Growth for Dielectric VLSI Structures, reviewed presentation in Spring Meeting of the Electrochemical Society Boston, MA, USA, Extended Abstracts Volume 86-1, No. 264, May 1986
805. H. Tenhunen & J. P. Krusius: Modelling and Characterization of the Dielectric Isolation Process Based on Oxidized Porous Silicon, reviewed presentation in 2nd International Symposium on Very Large Scale Integration Science and Technology, Cincinnati, Ohio, USA, May 1984
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807. H. Tenhunen and T. Salakoski; New Global Strategies for Higher Education in Electronics and Information Technologies, invited keynote talk in 19th EAEEIE (European Association for Education in Electrical and information technology) Annual Conference, July 2008
808. H. Tenhunen, innovation Platform: Local governance for Knowledge and Innovation Community Node, invited keynote talk in Complex EIT Workshop, June 2008
809. H. Tenhunen, Nanoelectronics Roadmap Influencies to Education, invited keynote talk in 7th European Workshop on Microelectronics Education (EWME 2008), May 2008
810. H. Tenhunen, Autonomous NoC, short invited keynote talk in MPSOC06, Denver, USA, 2006.
811. H. Tenhunen & A. Jatsch, Design Issues for Nanoscale CMOS, invited keynote talk at EuroMicro Conference, Portugal, 2005
812. H. Tenhunen, Electrical Design for NoC, invited opening keynote talk in Honk Kong Science Park Workshop on SOC Design, Honk Kong, 2005
813. H. Tenhunen, Electrical Scaling to Nanoscale, invited keynote talk in Int. MIXDES Conference, Krakow, Poland, 2005
814. H. Tenhunen, Communication Platforms for Nanoscale CMOS, invited presentation on MPSOC05 workshop in France, 2005.
815. H. Tenhunen; Educational challenges and strategies in electronics, invited keynote talk in Baltc Electronic Conference, October 2004, Talinn, Estonia
816. H. Tenhunen, System-on-Chip Curriculum Challenges, invited keynote presentation in 5th European Workshop on Microelectronics Education, Lausanne, Switzerland. April 2004.
817. H. Tenhunen, S. Virtanen, J. Isoaho, T. Salakoski; Information Security Education in Knowledge Triangle , invited presentation in EU Security Research Conference, Stockholm, October 2009.
818. Erwin Ofner, Jari Nurmi, Jan Madsen, Jouni Isoaho, and Hannu Tenhunen, SoC-Mobinet, R&D and Education in System-on-Chip Design, invited key note presentation at International Symposium at System-on-Chip, Tampere, Finland, November 2004

### List of Unreviewed Papers/Posters and Local Presentations

819. H. Tenhunen & J. P. Krusius: Modelling of Anodic Silicon Growth for Dielectric VLSI Structures, Proceedings of the XX Annual Conference of the Finnish Physical Society, (1986) 7:11
820. H. Tenhunen: A Critical Survey of Isolation Techniques for VLSI Structures, Research Report No. 1/86, Tampere University of Technology, Electronics Laboratory, 1986, 54 p.
821. T. C. Mele & H. Tenhunen: Cornell University Static RAM: CUSRAM, Internal Memorandum, Cornell University, USA, 1984
822. H. Tenhunen: Limits of Microelectronics (in Finnish), invited presentation in HITECH - seminar, Tampere, Finland, February 1986
823. H. Tenhunen: VLSI Design on Silicon (in Finnish), presentation in seminar organized by Technical Research Center of Finland, Tampere, February 1986
824. H. Tenhunen: VLSI Metrology: Probeless Testing for VLSI, invited presentation in Physica Colloquium, Physics Department, Tampere University of Technology, March 1986
825. C. Vargas, K. Kaski & H. Tenhunen: VLSI Layout Design with CAESAR on SUN Workstation, Research Report No 3/86, Tampere University of Technology, Electronics Laboratory, 1986, 44 p.
826. T. Korpiharju, H. Tenhunen, J. Tomberg & K. Kaski: Design of Fast Pipelined Arithmetic for Digital Median Hybrid Filter, Research Report 4/86, Tampere University of Technology, Electronics Laboratory, 1986, 38 p.
827. J. Tomberg, H. Tenhunen, T. Korpiharju & K. Kaski: Architecture of High Performance Pipelined Median Hybrid Filter, Research Report No 5/86, Tampere University of Technology, Electronics Laboratory, 1986, 37 p.
828. H. Tenhunen: Basic Analog MOS Building Blocks, invited lecture in Design of Analog/Digital ASIC's, November 1986 and March 1987, INSKO 270-86, IV, 27 p.
829. H. Tenhunen: Microelectronic Revolution (in Finnish), invited presentation in Technical Education Seminar, October 1986.
830. H. Tenhunen: Switched Capacitor Circuit Development using Personal Computer, invited presentation in Electronics 87, March 1987
831. H. Tenhunen: Switched Capacitor Filter Design, DSP Specialist Workshop, May 1987, INSKO 114-87, VIII, 22 p.
832. M. Lindell & H. Tenhunen: ASIC Circuits for Intelligent Sensors, Sensor Technology, April 1987, INSKO 94-87, III, 12 p.
833. P. Kotilainen & H. Tenhunen: Digital Multipliers: Architecture, Algorithms and Design, Research Report 2/87, Tampere University of Technology, Electronics Laboratory, 1987, 75 p.
834. T. Korpiharju, H. Tenhunen & K. Kaski: Interactive Design of Analog Circuits, reviewed presentation in IEEE/URSI XIII National Convention on Radio Science, 1987, P15
835. P. Kotilainen & H. Tenhunen: Digital Multipliers for VLSI Signal Processing Applications, reviewed presentation in IEEE/URSI XIII National Convention on Radio Science, 1987, P12
836. P. Ojala, H. Tenhunen & K. Kankaala: Circuit Parameter Extraction for Accurate VLSI Design, reviewed presentation in IEEE/URSI XIII National Convention on Radio Science, 1987, B3.3
837. H. Rantalainen, K. Ahola & H. Tenhunen: Advanced Interface Electronics for Silicon Particle Detectors, reviewed presentation in IEEE/URSI National Convention on Radio Science, 1987, B3.2
838. J. Tomberg, H. Tenhunen & T. Korpiharju: Design of High Performance CMOS FIR Median Hybrid Filter, reviewed presentation in IEEE/URSI National Convention on Radio Science, 1987, P13

839. T. Ritoniemi, H. Tenhunen, M. Lindell, C. Vargas & T. Saramäki: Oversampled Sigma-Delta Modulation for Efficient Analog to Digital Conversion in VLSI Systems, reviewed presentation in IEEE/URSI National Convention on Radio Science, 1987, B2.3
840. J. Nurmi & H. Tenhunen: Architecture and Design of VLSI Signal Processors, Research Report, Tampere University of Technology, 1988, 80 p.
841. T-P. Lassila, M. Majaniemi & H. Tenhunen: TUTFORTH-Stack Architecture, Based 16 Bit RISC Processor, URSI/IEEE XIV National Convention on Radio Science, 1988
842. J. Torsti, A. Aurela, M. Nieminen, J. Peltonen, E. Valtonen, V. Kelhä, I. Liede, R. Pellinen, H. Tenhunen, R. Julin, J. Äystö, S. Urpo, H. Saarikko, F. Ashton, J. L. Osborne, M. G. Thompson & A. W. Wolfendale: ERNE - A Finnish - British - Proposal for SOHO - mission. Proc. of XXII Annual Conference of the Finnish Physical Society 1988
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844. H. Tenhunen: Trends in Analog Circuit Design, presentation in Micropower Electronics Continuing Education course, April 1988, INSKO
845. P. Ojala, K. Kankaala, H. Tenhunen & K. Kaski: Advanced Techniques for Circuit Parameter Extraction, Research Report 5/88, Tampere University of Technology, Electronics Laboratory, 1988, 76 p.
846. H. Palomäki, T. Saramäki & H. Tenhunen: Multistage Digital Decimators for VLSI Signal Processing, in IEEE/URSI XIV National Convention on Radio Science, 1988, p. 11/4
847. H. Tenhunen: Silicon Compilation, Blanko-88 (workshop for embedded system design), invited presentation, 1988
848. P. Ojala, K. Kankaala, T. Korpiharju, H. Tenhunen & K. Kaski: Advanced Circuit Level SPICE Models for a Molybdenum Gate CMOS Process, Industrial Physics Symposium 28. - 29. September 1988, Finland, pp. 148 - 154
849. O. Vainio, H. Tenhunen, T. Jarske, T. Korpiharju & Y. Neuvo: Comparison of IC Technologies for a Class of Signal Processing Circuits, Industrial Physics Symposium, 28. - 29. September 1988, Finland, pp. 161 -166
850. T-P. Lassila, M. Majaniemi & H. Tenhunen: 16 Bit RISC Processor TUTFORTH, Industrial Physics Symposium, 28. - 29. September 1988, Finland, pp. 155 - 160
851. P. Kotilainen, J. Nurmi & H. Tenhunen: A Bit-Serial Transversal Filter Processor-TUTSP, Industrial Physics Symposium, 28. - 29. September 1988, Finland, pp. 129 - 134
852. J. Niittylahti & H. Tenhunen: A 1.5 kbit SRAM Using Four-Transistor Memory Cell, Industrial Physics Symposium, 28. - 29. September, 1988, Finland, pp. 139 - 142
853. J. Nurmi, P. Kotilainen & H. Tenhunen: VLSI Digital Signal Processing at Video Rates, Industrial Physics Symposium, 28. - 29. September, 1988, Finland, pp. 142 - 147
854. K. Saarinen, H. Tenhunen, Y. Neuvo & T. Yli-Pietilä: An Interpolation Based VLSI Realizable Beamsteering Method, Industrial Physics Symposium, 28. - 29. September, 1988, Finland, pp. 85 - 90
855. K. Ahola, H. Rantalainen, J. Suutari & H. Tenhunen: An Analog/Digital VLSI Circuit for an Advanced Particle Detector, Industrial Physics Symposium, 28. - 29. September 1988, Finland, pp. 75 - 80
856. K. Ahola, T. Koivunen, H. Tenhunen & A. Vähätalo: VLSI Circuit Design for Harsh Environments, Industrial Physics Symposium, 28. - 29. September 1988, Finland, pp. 69 - 74

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858. P. Ojala, K. Kankaala, T. Korpiharju, H. Tenhunen & K. Kaski: Advanced Circuit Level SPICE Models for a Molybdenum Gate CMOS Process, in IEEE/URSI XIV National Convention on Radio Science, 1988, p. I1/1
859. T. Ritoniemi, T. Korpiharju, T. Husu & H. Tenhunen: High Performance Differential Amplifier for Low Noise SC Circuits, in IEEE/URSI XIV National Convention on Radio Science, 1988, p. P19
860. T. Karema, A. Ylä-Jääski, H. Raittinen, H. Venehsalo, T. Ritoniemi & H. Tenhunen: Computationally Efficient Digital IIR-Filter for Sigma-Delta A/D-Converter, in IEEE/URSI XIV National Convention on Radio Science, 1988, p. P24
861. J. Suutari, H. Rantalainen & H. Tenhunen: Measuring Current with Galvanic Isolation, IEEE/URSI XIV National Convention on Radio Science, 1988, p. P29
862. M. Antila, T. Aaltonen & H. Tenhunen: VLSI Signal Processing for UPS, IEEE/URSI XIV National Convention on Radio Science, 1988, p. P21
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