Adaptive streaming applications: analysis and implementation models
Zhai, J.T.

Citation

Version: Not Applicable (or Unknown)
License: Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden
Downloaded from: https://hdl.handle.net/1887/32963

Note: To cite this publication please use the final published version (if applicable).
The handle http://hdl.handle.net/1887/32963 holds various files of this Leiden University dissertation

Author: Zhai, Jiali Teddy
Title: Adaptive streaming applications : analysis and implementation models
Issue Date: 2015-05-13
Acknowledgments

First, I really appreciate that all professors in the defence committee carefully read this thesis and provide many valuable comments. In particular, I would like to thank Professor Twan Basten. He has spotted even small inconsistencies between images and text. His effort has greatly improved the quality of this thesis.

The idea of working towards this thesis started in 2007 when I was still at Institute of Hardware-Software-Co-Design under the guidance of Professor Jügen Teich and Dr. Frank Hannig. That was the first time I saw FPGA and hardware acceleration for high throughput imaging processing. With the courage of Professor Teich and Frank, I made the first step into this fantastic world of embedded system design. I can still remember Professor Teich and Frank’s always-smiley face when we had discussions. I also learnt a lot from their research attitude. When we worked on my first international publication, Professor Teich and Frank spent one weekend right when I needed feedback urgently.

Finishing this thesis without help from colleagues would certainly be impossible. Since I started at Leiden Embedded Research Center, I have had luck to work closely with Sjoerd Meijer, Hristo Nikolov, Sven van Haastregt, Mohamed Bamakhrama. We have had countless discussions that truly broaden my horizon. Lately I have also worked with Jelena Spasic and Di Liu, which was great pleasure. In addition, I would not have had so much fun in the past 4 years in Leiden without colleague/friend/flatmate/wingman Emanuele Cannella. Both the discussion on work and sharing the life outside of the office has been precious memory to me. Among all students I have supervised, I would like to thank Frank van Smeden for his contribution to Daedalus\textsuperscript{RT}. Luckily we are finally colleagues at different place.

Outside of office hours, I shared most of my life with brothers and sisters at International Church of Leiden led by Pastor Andy and Helen. In particular, I have had so much fun with Emma, Dirk, Jerome, and Paulina. Not to mention the new little members, Andrew, Mark Jan, and Pippa. All of you bring so much joy to me. Thank you very much!

Finally I want to thank my beloved Shanshan, mam, and dad for their unconditional support. That has been the major source of encouragement to overcome all.
difficulties in my life. Although they do not exactly understand what I am working on, only one question they ask me from time to time “Teddy, when can you finish your PhD?”.

Jiali Teddy Zhai  
December, 2013  
Leiden, The Netherlands
Curriculum Vitae

Jiali Teddy Zhai was born on 16\textsuperscript{th} of October, 1982. In September 2009, he received Diplom Informatik (Master Degree in Computer Science) from Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany. During his study, Teddy worked at Institute for Hardware-Software-Co-Design headed by Prof. Jürgen Teich with the focus on designing high-level synthesis tools targeting high-performance computing systems based on FPGA platforms. In October 2009, Teddy joined the Leiden Embedded Research Center (LERC) which is part of the Leiden Institute of Advanced Computer Science (LIACS) at Leiden University. He was appointed as a research and teaching assistant (Ph.D. student). He was involved in the NEtherlands STreaming (NEST) project in collaboration with NXP semiconductor, Philips Healthcare, etc. The research work culminated in the writing of this Ph.D. dissertation in 2013.
List of Publications

Journal Article


Peer-Reviewed Conference Proceedings

• Jiali Teddy Zhai, Mohamed A. Bamakhrama, Todor Stefanov, “Exploiting Just-enough Parallelism when Mapping Streaming Applications in Hard Real-time Systems”, In the Proceedings of the 50th IEEE/ACM Design Automation Conference (DAC’13), pp. 170:1–170:8, Austin, TX, USA, June 2 - 6, 2013. WINNER of the 2013 HiPEAC Paper Award!


Peer-Reviewed Workshop Proceeding


Publications not Covered in this Thesis


Index

Daedalus$^\text{RT}$ design flow, 12  
Cyclo-Static Data Flow (CSDF), 32  
Data-Level Parallelism (DLP), 5  
Electronic System Level (ESL), 9  
Hard Real Time (HRT), 4  
implicit deadline, 34  
iteration period ($H$), 35, 124  
Kahn Process Network (KPN), 28  
Maximum-Overlap Offset (MOO), 128  
Mode-Aware Data Flow (MADF), 118  
model-based design, 9  
Multi-Processor System-on-Chip (MPSoC), 7  
period ($T$), 34  
Pipeline-Level Parallelism (PLP), 5  
Polyhedral Process Networks (PPN), 27  
repetition vector, 31, 32  
Static Affine Nested Loop Programs (SANLP), 26  
streaming applications, 1  
Strictly Periodic Schedule (SPS), 33  
Synchronous Data Flow (SDF), 30  
system throughput, 3  
Task-Level Parallelism (TLP), 5  
Transition delay, 126  
utilization, 36  
workload ($W$), 34  
Worst Case Execution Time (WCET), 35
List of Abbreviations

CPU      Central Processing Unit
CSDF     Cyclo-Static Data Flow
DLP      Data-Level Parallelism
DSP      Digital Signal Processing
EDF      Earliest Deadline First
ESL      Electronic System Level
FFD      First-Fit Decreasing
Gbps     Giga-bit per second
GPU      Graphic Processing Unit
HRT      Hard Real Time
Kbps     Kilo-bit per second
MADF     Mode-Aware Data Flow
Mbps     Mega-bit per second
MoC      Models of Computation
MPSoC    Multi-Processor System-on-Chip
NoC      Network-on-Chip
PE       Processing Element
PLP      Pipeline-Level Parallelism
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM</td>
<td>Rate Monotonic</td>
</tr>
<tr>
<td>SDR</td>
<td>Software-Defined Radio</td>
</tr>
<tr>
<td>SIMD</td>
<td>Single Instruction Multiple Data</td>
</tr>
<tr>
<td>TLP</td>
<td>Task-Level Parallelism</td>
</tr>
<tr>
<td>WCDMA</td>
<td>Wideband Code Division Multiple Access</td>
</tr>
<tr>
<td>WCET</td>
<td>Worst Case Execution Time</td>
</tr>
</tbody>
</table>