

Ultra Lightweight Dehaze Methods for Robot Vision Using High-Level Synthesis

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11463154 劉祐睿

演講者: 台北大學電機系 宋啟嘉 特
聘教授

內容從下一頁開始

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Using High-Level Synthesis

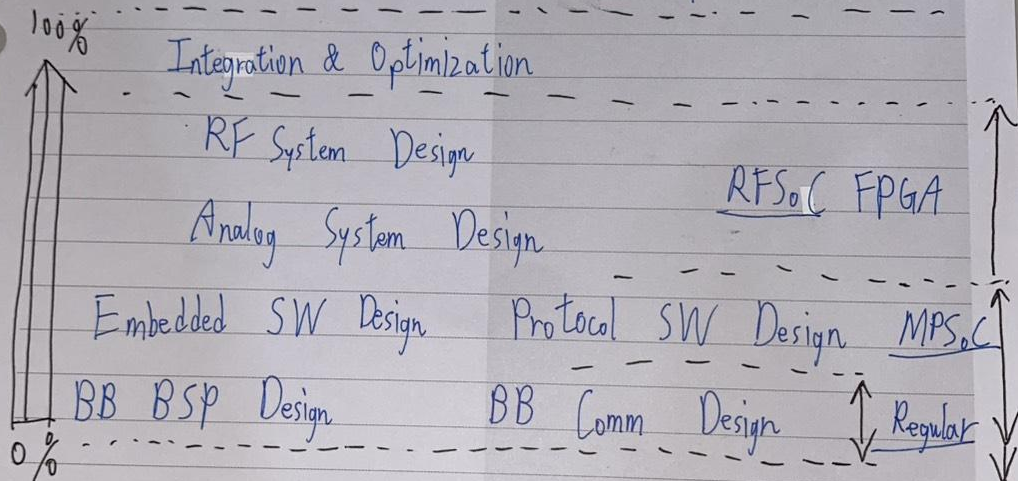
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劉柏睿

No.:
Date: 2025.12.23

演講者: Chi-Chia Sun 教授
啟 嘉 宋

FPGA \Rightarrow SOPC \Rightarrow SoC FPGA \Rightarrow Cloud FPGA \Rightarrow RFSoc
since 1980 \downarrow 2012 ~ 2017 \downarrow 2017 ~ Today
2004 ~ 2012 2019 ~ Today



Dehaze Method

- ① Dark channel extraction
- ② Bright channel extraction
- ③ Transmission map estimation
- ④ Scene recovery

上課手寫筆記

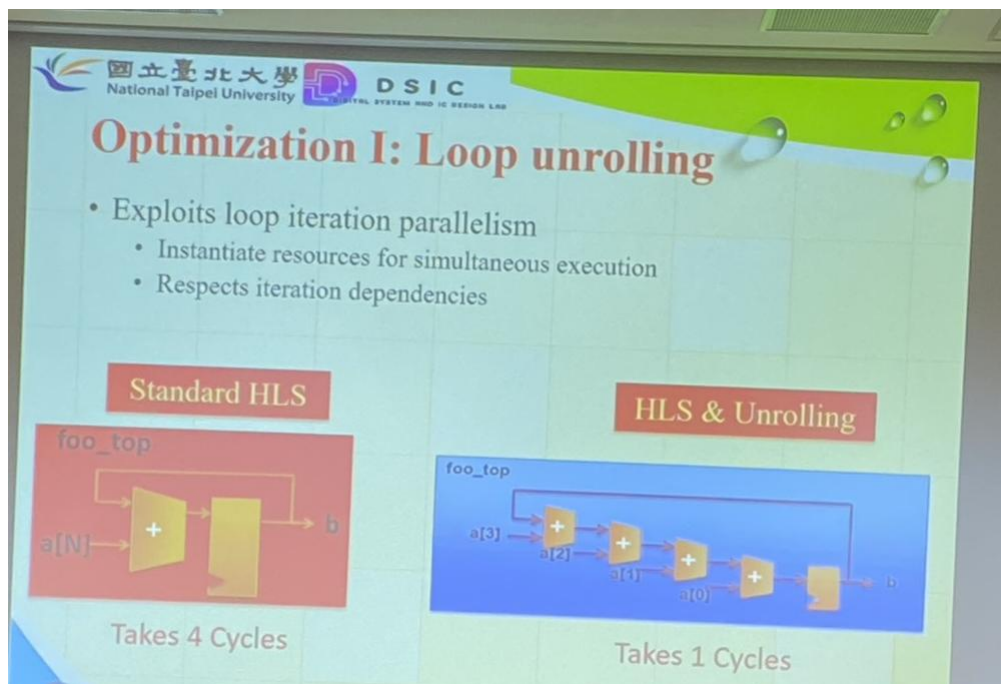


圖 1、迴圈運作示意圖

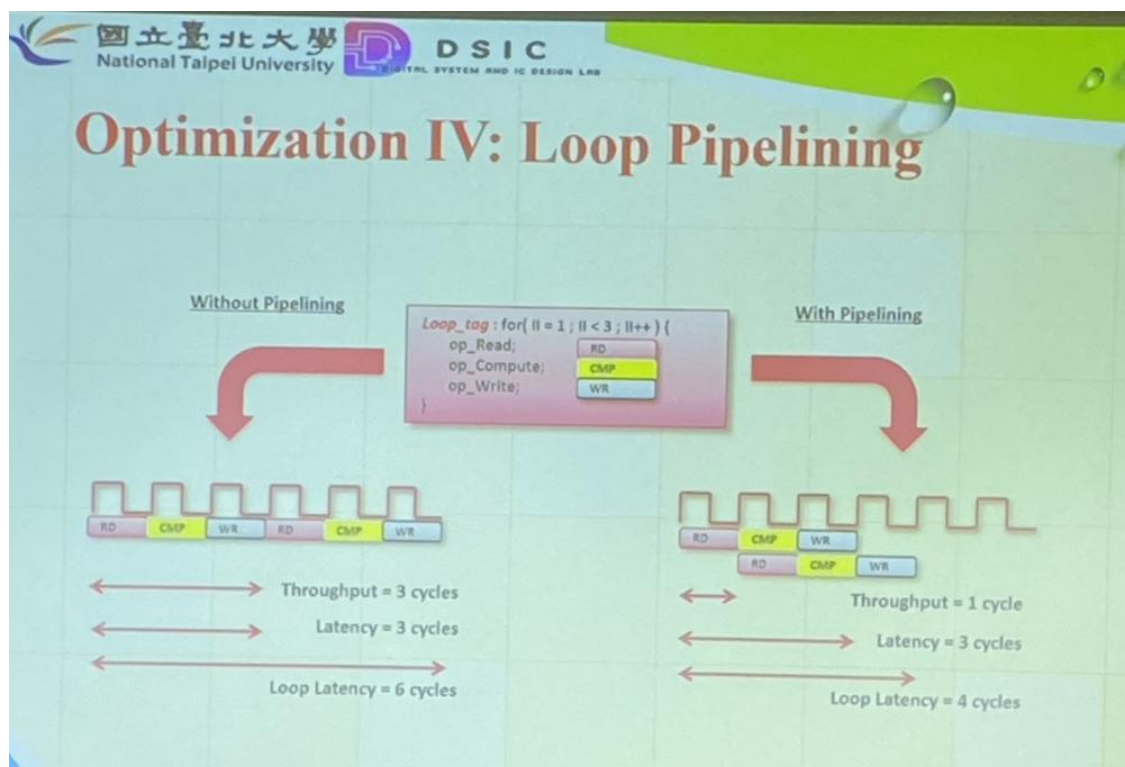


圖 2、指令管線化迴圈運作示意圖

Multiple Core FPGA

- Multiple Core Processor + FPGA for advanced data processing such as AI, Machine learning, Pattern Recognition, ADAS, SDR
- Xilinx + ARM => MPSOC vs. Intel + Altera => Xeon Phi
- Xilinx + ARM + ADC => RFSoc vs. Intel RF FPGA

Zynq UltraScale+ MPSoC Feature Summary

Cloud Example: Data Center FPGA Acceleration
Up to 1/3 of Cloud Service Provider Nodes to Use FPGAs by 2020

圖 3、多核心之 FPGA

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National Taipei University

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HLS (Autopilot) Results: Sphere Decoder

- Wireless MIMO Sphere Decoder
 - ~4000 lines of C code
 - Xilinx Virtex-5 at 225MHz
- Compared to optimized IP
 - 11-31% better resource usage

TCAD April 2011 (keynote paper)
"High-Level Synthesis for FPGAs: From Prototyping to Deployment"

Metric	RTL Expert	AutoPilot Expert	Diff (%)
LUTs	32,708	29,060	-11%
Registers	44,885	31,000	-31%
DSP46s	225	201	-11%
BRAMs	128	99	-26%

圖 4、Sphere Decoder

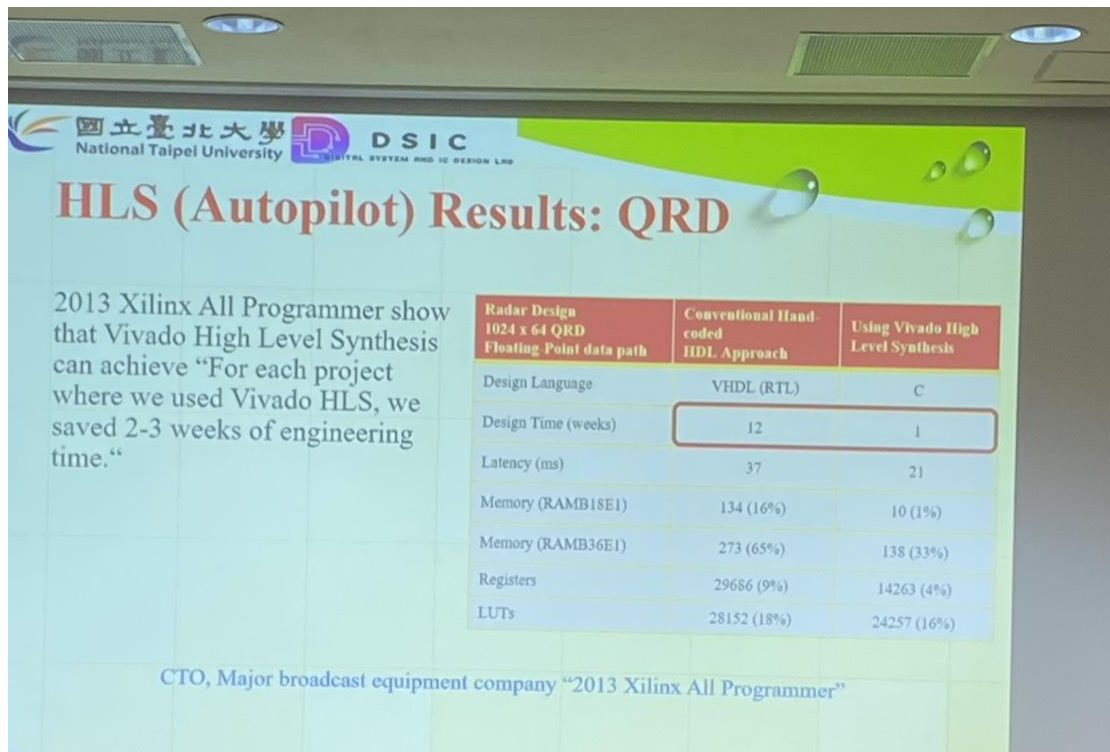


圖 5、QRD

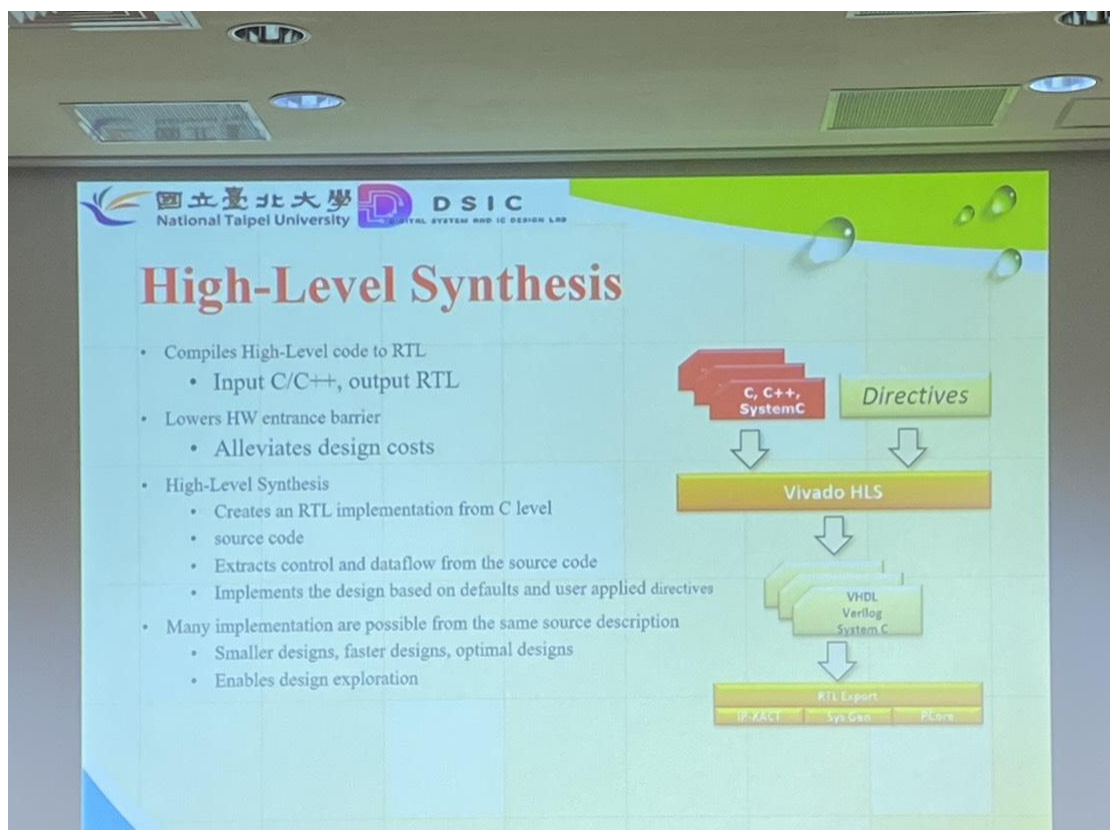


圖 6、C/C++語言與 FPGA 之關係

表 1、BenchMark 圖表

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Under Water Benchmark

- Dataset : UIEB dataset (890 images)(620x460)
- Acceptable PSNR in ~19db but ultra fast

Reference		MSE	PSNR	SSIM	FPS
RAW		1749.9235	17.4217	0.7696	
FE	2012 CVPR	908.2741	22.7601	0.8459	5.165
DILH	2016 TIP	1632.7069	19.9316	0.7905	1.406
HFM	2023 EAAI	1432.4021	17.9271	0.8203	1.590
WWPF	2024 TCSVT	1207.9993	18.3705	0.7931	2.016
FUNIE_GAN	2020 RA-L	1512.4454	17.5479	0.6745	23.204
TACL_GAN	2022 TIP	595.1137	21.8242	0.7551	0.889
CCL-Net	2025 TMM	1110.7707	19.3194	0.7943	0.346
ours		975.3020	19.5485	0.8597	92.827