

Hatim Kanchwala

BORN ON 7TH FEBRUARY 1995 IN INDORE, INDIA

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EDUCATION

RWTH Aachen University

M.Sc. ELECTRICAL ENGINEERING, INFORMATION TECHNOLOGY AND COMPUTER ENGINEERING

Thesis: "Field-Programmable Gate Array based Real-Time Control and Simulation"

Aachen, Germany

Sept. 2022

Final Grade 2,1

Indian Institute of Technology Patna

B.Tech. ELECTRICAL ENGINEERING

Thesis: "Hardware Architecture of a Family of Sigma-Point Kalman Filters for Bayesian Estimation"

Achieved a national rank of 4997 (99.6156th percentile) in the Common Merit List of the Joint Entrance Exam (JEE) from among 1.36 million students to secure a study place at the Indian Institute of Technology Patna

Bihta (Patna), India

May 2018

Final Grade 7.32 / 10

EXPERIENCE

M.Sc. THESIS "FIELD-PROGRAMMABLE GATE ARRAY BASED REAL-TIME CONTROL AND SIMULATION"

IEK-10, Forschungszentrum Jülich & Institute for Automation of Complex Power Systems

Supervisors: Univ.-Prof. Dr.-Ing. Andrea Benigni, Steffen Vogel, M. Sc., Dr.-Ing. Lukas Razik

Aachen, Germany

Apr. 2021 – Dec. 2021

- Developed a design using soft-core microprocessors to rapidly prototype control-loop algorithms for FPGA-based real-time simulations of power systems and to allow the independent formulation of the power system and control-loop models.
- Introduced a *control* and *data-logger* soft-cores, each based on the MicroBlaze soft-core microprocessor from Xilinx and implemented on the Xilinx Virtex Ultrascale+ VCU118 board, respectively dedicated to running control algorithms at the switching frequency and logging simulation data at each time step.
- Conceptualised a heterogenous architecture using multiple and dedicated soft-core microprocessors, enabling hierarchical control-loop systems and fine-grained administration of the real-time simulation.
- Assembled the final work product using a combination of proprietary Xilinx IPs from Vivado IP Integrator, HLS modules of the power system generated from ORTiS, self-authored Verilog modules and binaries for the soft-core microprocessor using Xilinx SDK.

STUDENT INTERN

IEK-10, Forschungszentrum Jülich

Supervisor: Dr.-Ing. Lukas Razik, Head, HPC Department, IEK-10

Remote

Oct. 2020 – Feb. 2021

- Implemented power system models using the open-source code-generation tool ORTiS targeted towards High-Level Synthesis for real-time simulation on an FPGA. Extended the HLS models with a memory-mapped AXI4 register interface. Verified the hardware models on the Xilinx Virtex-7 VC707 FPGA board using remote debugging.
- Developed a Makefile pipeline on Linux for the ORTiS code generation, Vivado High-Level Synthesis, Vivado IP Integrator and FPGA bitstream generation stages.

STUDENT ASSISTANT

Institute for Automation of Complex Power Systems, E.ON Energy Research Centre

Aachen, Germany

Supervisor: Steffen Vogel, M. Sc.

May 2019 – Sept. 2020

- Integrated Xilinx FPGA development boards into the VILLAS co-simulation platform by designing an architecture built on top of the Aurora 8B/10B serial protocol from Xilinx, thereby providing a consistent interface between the CPU, over PCIe, and the real-time simulators, over a physical fibre link.
- Engineered a Tcl-Makefile system of scripts to simplify file management of multiple source types and binary files and streamline project management using revision control systems. Developers could utilise the system to collaborate on version-agnostic local toolchains and to significantly reduce commit and check-out sizes.
- Implemented a memory-mapped AXI4 register interface wrapper around the Aurora 8B/10B by extending the respective Xilinx Baremetal drivers.

SENIOR RESEARCH FELLOW

"Underwater Target Motion Analysis with Passive Sensors"

Supervisor: Dr Shovan Bhaumik, Sponsor: Naval Physical & Oceanographic Laboratory (DRDO)

Control and Instrumentation

Lab, IIT Patna, India

May 2018 – Nov. 2018

- Implemented advanced filters, like Distributed Extended Kalman Filter, Shifted Rayleigh Filter, Particle Filter with compound proposals, Particle Filter with MCMC, and Regularised Particle Filter, for the Bearings-only Tracking problem in MATLAB.
- Simulated the performance of these filters on actual field manoeuvres provided by the sponsor, and prepared a comparative study as measured by time, resource and computational complexities, and target tracking accuracy. Concluded that Shifted Rayleigh Filter outperforms other filters in terms of computational complexity while still being superior at tracking the target.

"Hardware Architecture of a Family of Sigma-Point Kalman Filters for Bayesian Estimation"

IIT Patna, India

Supervisor: Dr Shovan Bhaumik, Assistant Professor, IIT Patna

Aug. 2017 – May 2018

- Designed and implemented a parallel architecture of Sigma-point Kalman filtering algorithms on an FPGA by independently conceptualised a parallel routine to the Cholesky decomposition of a positive-definite matrix in $\mathcal{O}(N)$ time complexity.
- Further optimised resource usage of parallel Cholesky decomposition architecture for maximum processor utilisation to achieve $\mathcal{O}(\frac{1}{4}N^2)$ resource complexity, as compared to $\mathcal{O}(\frac{1}{2}N^2)$ resource complexity of state-of-the-art.
- Implemented the parallel architectures using Verilog HDL and Xilinx Vivado on the Xilinx Zynq-7000 ZC702 and Digilent Nexys4 DDR FPGA boards, making use of open-source floating-point IPs and Xilinx Vivado IPs.
- Presented the final work product to the professors of the department and was one of the only two students to receive a unanimous 10 / 10 grade out of a cohort of 50 candidates.

STUDENT DEVELOPER, "EDSAC MUSEUM ON FPGA" | PRESENTED AT ORCONF 2017 DIGITAL DESIGN CONFERENCE**Free and Open Source Silicon Foundation**

Google Summer of Code 2017

Mentor: Dr Jeremy Bennett, Founder & Chief Executive, Embecosm Ltd

May 2017 – Aug. 2017

- Built a Verilog model of the historic EDSAC computer from original but incomplete documentation in collaboration with members of "The EDSAC Replica Project" team (TNMOC, Bletchley Park, UK).
- Programmed and simulated the EDSAC architecture and ISA on the myStorm Lattice iCE FPGA board using open-source toolchains, like Yosys and iverilog.
- Coordinated with a team of younger students in the UK to build a hardware imitation of the EDSAC memory delay line, teleprinter and paper tape reader.
- Demonstrated the final work product at the ChipHack 2017 workshop and presented at the ORConf 2017 digital design conference in Hebden Bridge, UK, for which full sponsorship was received.

STUDENT DEVELOPER, "READ/WRITE MULTIPLE STATUS REGISTERS AND LOCK/UNLOCK MEMORY ON SPI CHIPS"

Google Summer of Code 2016

Coreboot (Flashrom)

Feb. 2016 – Aug. 2016

- Designed a unified abstraction of multiple status registers in an SPI Flash-memory chip to provide a consistent interface between flashrom and diverse chip manufacturers.
- Programmed routines to lock/unlock memory space governed by status registers, handle configuration bits, access/lock OTP memory areas, and automatically generate memory protection maps for a selection of chips. Developed a CLI to expose these features, and finally tested the infrastructure using a Raspberry Pi and a Teensy development board.
- Liaised with a Sales Executive of GigaDevie from China to arrange for engineering samples and add support for GigaDevice SPI chips.

SKILLS**Programming** Verilog, C/C++, Python, Assembly, JavaScript, Java, Shell, HTML/CSS**Software** Xilinx Vivado & HLS, MATLAB, Simulink, RSCAD, NI LabVIEW, GNU/Linux, git/GitHub, gdb, Verilator, L^AT_EX, gnuplot**Hardware** Xilinx Virtex & Zynq SoC, Digilent Nexys4 DDR, RTDS NovaCor, Raspberry Pi, Arduino, PIC Microcontroller**Languages** English (TOEFL 114/120), German (B1), Hindi (native)**EXTRACURRICULAR ACTIVITIES****Startup Relations, Entrepreneurship Club**

IIT Patna

Coordinator

Apr. 2016 - Apr. 2017

- Served as on-campus mentor to early stage startups, helped develop business plan, choose investor strategy and network with advisers.
- Part of Core Committee for Entrepreneurship Club's annual event, E-Week. Organised guest talks and In-house sessions.
- Delivered presentations as part of In-house Lecture series conducted by Entrepreneurship Club.

Task Manager

Apr. 2015 - Apr. 2016

- Worked towards building connections with startups and investors with vision to form investor panel for on-campus startups.
- Part of Organising Committee for Entrepreneurship Club's annual event, E-Week. Organised guest talks, workshops and pitching event.