

# Hatim Kanchwala

BORN ON 7<sup>TH</sup> 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

Apr. 2019 – 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 national rank of 4997 (99.6156<sup>th</sup> percentile) in Common Merit List of Joint Entrance Exam (JEE) from among 1.36 million students to secure study place at Indian Institute of Technology Patna

Bihta (Patna), India

July 2014 – 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

Aachen, Germany

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

Apr. 2021 – Dec. 2021

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

### STUDENT INTERN

### IEK-10, Forschungszentrum Jülich

Remote

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

Oct. 2020 – Feb. 2021

- Implemented power system models using open-source code-generation tool ORTiS targeted towards High-Level Synthesis for real-time simulation on an FPGA. Extended HLS models with memory-mapped AXI4 register interface. Verified hardware models on Xilinx Virtex-7 VC707 FPGA board using remote debugging.
- Developed Makefile pipeline on Linux for 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 VILLAS co-simulation platform by designing an architecture built on top of Aurora 8B/10B serial protocol from Xilinx, thereby providing a consistent interface between CPU, over PCIe, and real-time simulators, over physical fibre link.
- Engineered 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 memory-mapped AXI4 register interface wrapper around Aurora 8B/10B by extending corresponding Xilinx Baremetal drivers in C/C++.

### SENIOR RESEARCH FELLOW

Control and Instrumentation

### "Underwater Target Motion Analysis with Passive Sensors"

Lab, IIT Patna, India

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

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 performance of these filters on actual field manoeuvres provided by sponsor, and prepared 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 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 parallel routine for Cholesky decomposition 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 parallel architectures using Verilog HDL and Xilinx Vivado on Xilinx Zynq-7000 ZC702 and Digilent Nexys4 DDR FPGA boards, making use of open-source floating-point IPs and Xilinx Vivado IPs.
- Presented final work product to the professors of the department and was one of only two students to receive unanimous 10 / 10 grade from 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 &amp; 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<sup>A</sup>T<sub>E</sub>X, 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****Faiz al-Mawaid al-Burhaniyah**

Aachen, Germany

Volunteer

June 2021 - Apr. 2022

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**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.