

Nitin Satpute

RESEARCHER AND DATA SCIENTIST

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Education

University of Córdoba (UCO)

Córdoba, Spain

PHD WITH HIGHEST DISTINCTION IN COMPUTER SCIENCE (FROM THE DEPT. OF ELECTRONIC AND COMPUTER ENGINEERING)

Jun. 2017 - Oct. 2020

- **European Research Project:** HiPerNav - High Performance soft tissue Navigation (<https://hipernav.eu/>).
- **Thesis :** GPU Acceleration for Liver Enhancement and Segmentation.
- **Award :** Conferred 2nd prize in the thesis pitch competition at the European Innovation Fest-EIF2020.
- **Norwegian University of Science and Technology (NTNU)**, Gjøvik, Norway — *Secondment, April-June 2019*
- **Oslo University Hospital**, Oslo, Norway — *Secondment, March-June 2018*

Birla Institute of Technology and Science (BITS)

Pilani, India

MASTER OF ENGINEERING IN EMBEDDED SYSTEMS, GPA: 7.92/10

Aug. 2011 - Jul. 2013

- **Thesis :** FPGA realization of H.264 Video Decoder.
- **Indian Institute of Science (IISc)**, Bangalore, India — *Thesis Semester, Jan-Jun 2013*

Yeshwantrao Chavan College of Engineering (YCCE)

Nagpur, India

BACHELOR OF ENGINEERING IN ELECTRONICS AND TELECOMMUNICATION, GPA: 74.5/100

Aug. 2007 - Jul. 2011

- **Thesis :** Segmentation and Classification of MRI Brain Images using Texture Features.

Skills

Job-related skills	Large Language Models (LLMs), Transformers, Multi-modal Generative Models, Distributed AI and HPC, Deep Learning, Python (NumPy, OpenCV, Pandas, Matplotlib, Tensorflow, Horovod, PyTorch), AzureML, Artificial Neural Networks, Decision Trees, Random Forest, Regression, Classification.
Digital skills	Linux, Windows, C, C++, CUDA, Docker containers, Kubernetes, OpenCL, OpenMP, MATLAB, Python, Open3D: A Modern Library for 3D Data Processing, Verilog, Bluespec System Verilog.
Other skills	Trekking, Travelling, Cooking, Listening Music, Gymnasium, Playing Chess and Volleyball.

Experience

Technology Innovation Institute (TII)

Abu Dhabi, UAE

SENIOR MACHINE LEARNING ENGINEER AT CRYPTOGRAPHY RESEARCH CENTRE

Apr. 2021 - Current

Large Language Models (LLMs)

- **Multi-modal Generative Models:** I am currently working on developing Multi-modal (Image+Video+Sound) generative Falcon model i.e. Video-Falcon (Reference: Video-LLaMA) using LangChain, Transformers, Hugging Face and Bitsandbytes.
- **Quantization of LLaMA and Falcon:** Currently, I am working on quantization of LLaMA (from META) and Falcon. The strategy helps to reduce the size of LLaMA-7B (7 billion) from 14GB (FP16) to 3.5GB (4-bit) (75% compression).

Deep Neural Networks

- "Polynomial Time Cryptanalytic Extraction of Neural Network Models" under the supervision of [Adi Shamir](#).
- Distributed Color and Spectral Matching Algorithms on NVIDIA GPUs.

Neuromorphic Computing

 in Collaboration with YALE University US:

- **Robustness:** Exploring defense mechanisms using **Quantization** and **Pruning** for Spiking Neural Networks (SNNs) against different attacks by reducing model complexity and promoting generalization.
- Explainability: Developing criteria for improving Interpretability using Explainable SNN.
- **Hardware Implementation:** Proposed and implementing Memristor-based Crossbar Arrays for hardware simulations in optimizing energy-area-latency of Robust and Explainable SNNs:
- **GPU4SNN:** Accelerating Spike Propagation for GPU-based Spiking Neural Network Simulations:
- GPU4SNN_MedIA: GPU-based Spiking Neural Networks for Medical Image Analysis:

Cryptography Applications

 in Collaboration with Radboud University Netherlands:

- Accelerating IID NIST Tests for random numbers using multi-core (CPU with OpenMP) and many-core (GPU with CUDA) optimizations:
- ACE-HoT: Accelerating an extreme amount of symmetric Cipher Evaluations for High-Order avalanche Tests: collaboration with [Joan Daemen](#)
- **Distributed High Performance Computing (HPC):** using Docker Containers, Horovod and Kubernetes

Aarhus University

Aarhus, Denmark

RESEARCHER IN [MACHINE LEARNING AND COMPUTATIONAL INTELLIGENCE](#)

Oct. 2020 - Mar. 2021

- EU Project: Multimodal Extreme Scale Data Analytics for Smart Cities Environments - MARVEL
- Efficient Deep Learning for Visual and Multimodal Data Analysis
- Fast Efficient Distributed Training for Deep Neural Networks on NVIDIA GPUs
- Deep Learning for Anomaly Detection and Classification in Production Line

University of Córdoba

Córdoba, Spain

MARIE CURIE RESEARCHER IN [GPU PERFORMANCE OPTIMIZATION](#)

Jun. 2017 - Aug. 2020

- Implemented GPU acceleration for Enhancement and Segmentation of Pre-operative and Intra-operative Images under the Innovative Training Network (ITN) project High Performance soft tissue Navigation (HiPerNav - <https://hipernav.eu>).
- Environments and Platforms: Linux, C++, CUDA, OpenCL, Python, and NVIDIA GPUs GeForce GTX 1050, RTX 2070 and 2080 Ti.

Other Activities:

- Submitted Deliverable "Optimized parallel implementations of algorithms" for liver enhancement and segmentation and Deliverable D6.2 "Study of Parallelizable Codes" for liver enhancement, segmentation and registration for the project HiPerNav (722068).
- Attended HiPerNav training school in Delft University of Technology, Netherlands (4-6 Feb 2020).
- Attended ECALSS (European Computer Assisted Liver Surgery Society) Conference 2019 and HiPerNav School at Insepspital (Bern University Hospital), ARTORG Center and CASCINATION, Bern Switzerland (14-19 Oct, 2019)- <https://hipernav.eu/hipernav-week-bern-oct-2019/>.
- Presented a talk on "GPU Acceleration of Seeded Region Growing" at NTNU Gjøvik (16 Apr 2019) and Participated in pre-clinical experiment on 4 Apr 2019 at The Intervention Centre, Oslo University Hospital, Norway.
- Attended HiPerNav Training Event in INRIA (10-12 Dec, 2018) and Université Paris 13 (6-7 Dec, 2018), France-<https://hipernav.eu/training/>.
- Participated in Third Training Event of HiPerNav "High Performance soft-tissue Navigation" at CAScination and ARTORG Center, University of Bern, Switzerland (12-16 Mar, 2018).

Norwegian University of Science and Technology (NTNU)

Gjøvik, Norway

VISITING RESEARCHER

Apr. 2019 - Jun. 2019

- Proposed and implemented high performance cross modality based liver contrast enhancement in CUDA 10.0 and ITK 4.12.0.
- Explored and implemented GAN based PIX2PIX for multi organ segmentation using LITS and 3DIRACDb dataset

Oslo University Hospital (OUH)

Oslo, Norway

VISITING RESEARCHER

Mar. 2018 - Jun. 2018

- Proposed and implemented high performance GPU optimization strategies for region growing based liver segmentation in OpenCL 1.2 and CUDA 10.0 (integrated in ITK)
- Explored and implemented U-Net for liver segmentation using LITS and 3DIRACDb dataset

Paramonus Systems Private Limited

Nagpur, India

CUDA DEVELOPER

Jul. 2014 - May. 2017

- Parallel implementation of Deep Neural Networks in CUDA
- I have started working with the company since July 2014 and we registered the company in February 2016. The job role was to develop fast parallel implementation of CNN functions such as 2D or 3D convolution, activation functions and backward propagation in CUDA.

Visvesvaraya National Institute of Technology (VNIT)

Nagpur, India

RESEARCH SCHOLAR

Jan. 2016 - May. 2017

- Convolutional Deep Neural Network (CNN) for Breast Cancer Detection.

University of Siena

Siena, Italy

RESEARCH STUDENT

Nov. 2014 - Oct. 2015

- **European Research Project:** AXIOM - A Hardware-Software Platform for Cyber Physical Systems.
- Matrix Multiplication Performance Characterization on GPUs with a Single Point.
- Comparing and Evaluating GPU Platforms with a Single Point under AXIOM.

Indian Institute of Science

Bangalore, India

PROJECT ASSOCIATE

Jul. 2013 - Jun. 2014

- Implemented a Flexible Scalable Hardware Architecture for Radial Basis Function Neural Networks (RBFNN).
- Explored bulk synchronous parallel computing (BSPC) and H.265 video decoder.

Honours and Awards

1. Awarded Marie Skodowska-Curie grant from the project High Performance Soft-tissue Navigation (HiPerNav - H2020-MSCA-ITN-2016) in an Innovative Training Network (ITN).
2. Conferred funding from Ministry of Electronics and Information Technology (MeitY), India (Year 2016-2017) and funded acceptance from PUMPS 2015, Spain and ACACES 2015, Italy Summer Schools.
3. Received GATE scholarship (Aug 2011 - July 2013) at BITS Pilani and full fee waiver at YCCE Nagpur for securing one of the top five ranks in the State Engineering Entrance Examination (Aug, 2007 - June, 2011).
4. Invited as a Guest for 72nd Independence Day at South Point School, Nagpur, India (15 Aug 2018).

Other Activities

1. Delivered a talk on “**Deep Learning for IoT**” as an expert for the Faculty Development Program on “System Engineering with Applications of Internet of Things” sponsored by AICTE Training and Learning (ATAL) from 4th January 2020 to 8th January 2020 conducted by COEP Pune, India (07 Jan 2021).
2. Delivered expert sessions on “**Parallel Computing and Deep Learning for Medical Image Analysis**” in AICTE sponsored one week virtual STTP on research methodology and computational techniques (RMCT-2020) Phase1, 2, and 3 in association with IEEE WIE Affinity group bombay section Dt. 7th-12th, 14th-19th, 21th-26th Dec 2020.
3. Delivered expert lecture on “**Accelerating Cancer Diagnosis and Treatment using AI and HPC**” as a resource person during the 5-day FDP on Internet of Things: Hardware, Software and Applications, sponsored by AICTE-ATAL and organized by IIIT Kottayam, India on 10th Dec 2020.
4. Delivered a talk on “**U-Net and YOLO for Liver Cancer Diagnosis**” at The Faculty Development Program (FDP) conducted by COEP Pune and MTU Imphal, India (17 Jul 2020).
5. Reviewed 5 papers for the MDPI journal (“4-Energies, IF 2.707” and “1-Applied Sciences, IF 2.474”).
6. Conducted Student Development Program (SDP) on “**Deep Learning: Industry Requirements and Applications**” at YCCE, Nagpur, India (10-11 Aug 2019).
7. Conducted SDP on “**Machine Learning and Artificial Intelligence, Industry Requirements and Applications**” at YCCE, Nagpur, India (22-23 Dec 2018).
8. Conducted SDP on “**Development of Embedded Processors using ARM Cortex M0+ Processors**” at Global Academy of Technology, Bangalore, India (Jul 2018).
9. Attended a) MIT GSW at Novotel Hyderabad Convention Centre (Mar 2016) b) Deep Learning Training program presented by Deep Learning Institute, nVIDIA and hosted by GPU Center of Excellence, IIT Bombay on Dec 05, 2016 c) “The 2015 LOFAR Surveys Meeting” held at Leiden, Netherlands (Sept, 2015) d) “AXIOM Face to Face Meet” held at BSC, Spain (Jun, 2015) e) Summer training program at 3-Base Repair Depot, Indian Air Force, Chandigarh (May-Jun 2010).
10. Assisted Prof. Donald Reay from Heriot-Watt University, UK in conducting Faculty Development Program on DSP for Educators at IIIT Bangalore, VNIT Nagpur and NIT Patna (Mar and Sep 2016).
11. Delivered a talk on Technology and Opportunities (Mar 2016) and conducted a workshop on “**Image and Video Processing using Linux, Python and Opencv on Raspberry Pi**” at Sir MVIT College, Bangalore, India (Apr 2016).

Publications

JOURNALS

1. R Yin, Y Kim, Y Li, A Moitra, **Nitin Satpute**, A Hambitzer, P Panda “Workload-Balanced Pruning for Sparse Spiking Neural Networks” published in arXiv preprint arXiv:2302.06746, 2023.
2. **Nitin Satpute**, A. Hambitzer, S. Aljaberi and Najwa Aaraj “GPU4SNN: Accelerating Spike Propagation for GPU-based SNN Simulations” in Springer Nature and International Conference on Parallel Processing and Applied Mathematics, 2022.
3. R. Naseem, Z. A. Khan, **Nitin Satpute**, A. Beghdadi, O. J. Elle, J. Gomez-Luna, J. Olivares, and F. A. Cheikh “Cross Modality Guided Liver CT Enhancement for Improved Tumor Segmentation” published in IEEE Access, vol. 9, pp. 118154-118167, 2021, doi: 10.1109/ACCESS.2021.3107473 (Q1, IF 3.367).
4. Lotlikar VS, **Nitin Satpute**, Gupta A. Brain Tumor Detection Using Machine Learning and Deep Learning: A Review. Current Medical Imaging. 2021 Sep. DOI: 10.2174/1573405617666210923144739. PMID: 34561990.
5. S. Shekar, A. Gupta, **Nitin Satpute**, “Review on diabetic retinopathy with deep learning methods” in Journal of Medical Imaging (2021). https://caps.luminad.com:8443/stockage/stock/SPIE/LDL-SPIE-JMI-21117VR/JMI-21117VR_online.pdf
6. **Nitin Satpute**, R. Naseem, E. Pelanis, J. Gomez-Luna, F. A. Cheikh, O. J. Elle, and J. Olivares, “GPU acceleration of liver enhancement for tumor segmentation”, published in Computer Methods and Programs in Biomedicine 184 (2020) 105285, DOI: <https://doi.org/10.1016/j.cmpb.2019.105285> (CMPB-Q1, IF 3.632).
7. **Nitin Satpute**, J. Gomez-Luna, and J. Olivares, “Accelerating Chan-Vese Model with Cross-Modality Guided Contrast Enhancement for Liver Segmentation”, published in Computers in Biology and Medicine 124 (2020) 103930, DOI: <https://doi.org/10.1016/j.compbio.2020.103930>. (Q1, IF 3.434).
8. **Nitin Satpute**, R. Naseem, R. Palomar, O. Zachariadis, J. Gomez-Luna, F. A. Cheikh, J. Olivares, “Fast Parallel Vessel Segmentation” Computer Methods and Programs in Biomedicine 192 (2020) 105430, DOI: <https://doi.org/10.1016/j.cmpb.2020.105430>. (Q1, IF 3.632).
9. O. Zachariadis, A. Teatini, **Nitin Satpute**, J. Gomez-Luna, Onur Mutlu, O. J. Elle, and J. Olivares, “Accelerating B-spline Interpolation on GPUs: Application to Medical Image Registration”, published in Computer Methods and Programs in Biomedicine 193 (2020) 105431, DOI: <https://doi.org/10.1016/j.cmpb.2020.105431>. (Q1, IF 3.632).
10. O. Zachariadis, **Nitin Satpute**, J. Gomez-Luna, and J. Olivares, “Accelerating Sparse Matrix-Matrix Multiplication with GPU Tensor Cores” published in Computers and Electrical Engineering, Volume 88, 2020, 106848, ISSN 0045-7906, <https://doi.org/10.1016/j.compeleceng.2020.106848>. (Q2, IF 2.663).
11. **Nitin Satpute**, J. Gomez-Luna, and J. Olivares, “Fast Parallel Cropping for Liver Segmentation and Volume Assessment” under internal review (2020).
12. A. Shriram, N. Dhabekar, M. Hussain, P. Jumle and **Nitin Satpute**, “Segmentation and Classification of MRI Brain Images using Texture Features” published in the International Journal of Machine Intelligence and Applications (2011).

CONFERENCES

1. Isaac A. Canales-Martínez and Jorge Chávez-Saab and Anna Hambitzer and Francisco Rodríguez-Henríquez and **Nitin Satpute**, and Adi Shamir, "Polynomial Time Cryptanalytic Extraction of Neural Network Models" Accepted at Eurocrypt, Switzerland, May 26-30, 2024.
2. Emanuele Bellini, **Nitin Satpute**, Juan Grados, Mohamed Rachidi, Joan Daemen and Solane El Hirsch, "ACE-HoT: Accelerating an extreme amount of symmetric Cipher Evaluations for High-Order avalanche Tests" at LATINCRYPT, Quito, Ecuador, October 4-6, 2023.
3. N. B. Gaikwad, S. K. Khare, **Nitin Satpute**, Avinash G Keskar "Hardware Implementation of High-performance Classifiers for Edge Gateway of Smart Automobile", presented in 1st International Conference on the Paradigm Shifts in Communication, Embedded Systems, Machine Learning and Signal Processing (PCEMS) 2022.
4. J. Olivares, O. Zachariadis, **Nitin Satpute**, J. Gómez-Luna "Optimum Vessel Segmentation", presented in 17th Iberian Conference on Information Systems and Technologies (CISTI) 2022.
5. **Nitin Satpute**, Zachariadis O., Gómez-Luna J., Olivares J. Fast Parallel Cropping for Liver Segmentation. 33rd Annual SMIT Conference, Oslo, Norway. Jan, 2022.
6. Olivares J., **Nitin Satpute**, Zachariadis O., Gómez-Luna J. How High Performance Computing will revolutionize next generation surgery. 33rd Annual SMIT Conference, Oslo, Norway. Jan, 2022.
7. M. Mohammadi, **Nitin Satpute**, R. Rongge, J. Chandiramani, S K Nandy, A. Raihan, T. Verma, R. Narayan and S. Bhattacharya, "A Flexible Scalable Hardware Architecture for Radial Basis Function Neural Networks" published in the International Conference on VLSI Design and Embedded Systems 2015, DOI: 10.1109/VLSID.2015.91.
8. B. Kumar Koorra, **Nitin Satpute** and A. Adiga, "Tabu Search based implementation of object tracking using Joint Colour Texture Histogram" published in the International Conference on Industrial and Information Systems, IIT Chennai, IEEE Explore, August 6, 2012, pp. 1-6, DOI: 10.1109/ICIINFS.2012.6304829.
9. **Nitin Satpute**, J. Gomez-Luna, and J. Olivares, "GPU based Liver Image Segmentation" published at VII Congreso Científico de Investigadores en Formación de la Universidad de Córdoba, Feb 2019.
10. **Nitin Satpute**, Juan Gomez-Luna, and Joaquin Olivares, "Evaluation of GPU Region Growing Methods on NVIDIA GPUs" published in JAI (III Jornadas Andaluzas de Informática) 2017, Malaga, Spain.
11. **Nitin Satpute**, R. Giorgi, "Comparing and Evaluating GPU Platforms with a Single Point" published in the Eleventh International Summer School on Advanced Computer Architecture and Compilation for High-Performance and Embedded Systems-2015.

POSTERS

1. **Nitin Satpute**, J. Gomez-Luna, and J. Olivares, "Fast Parallel Liver Segmentation", presented a poster at the 7th Annual Meeting of the European Computer Assisted Liver Surgery Society (ECALSS), Bern, Switzerland (www.ecalss.org), Oct 2019.
2. **Nitin Satpute**, J. Gomez-Luna, and J. Olivares, "GPU based Liver Image Segmentation", presented a poster at the VII Congreso Científico de Investigadores en Formación de la Universidad de Córdoba, Feb 2019.
3. **Nitin Satpute**, J. Gomez-Luna, and J. Olivares, "Fast Parallel Seeded Region Growing for Liver Segmentation", presented a poster in the HiPerNav Training Event at the University of Cordoba, Spain, Sept 2018.
4. **Nitin Satpute**, "Matrix Multiplication Performance Characterization on GPUs with a Single Point" presented a poster in Programming and Tuning Massively Parallel Systems – PUMPS 2015 at the Barcelona Supercomputing Center (BSC), Spain.
5. **Nitin Satpute**, and R. Giorgi, "Comparing and Evaluating GPU Platforms with a Single Point", presented a poster in the Eleventh International Summer School on Advanced Computer Architecture and Compilation for High-Performance and Embedded Systems-2015.