

CHARLES N. CHRISTENSEN

PhD Candidate – Computer Vision & Deep Learning

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EDUCATION

University of Cambridge <i>PhD, Computational Imaging</i> Topic : Image Processing using Deep Learning for Microscopy	Cambridge, UK Est. March 2022
University of Cambridge <i>MRes, Image Processing and Sensing</i> Courses : Computer Vision, Deep Learning, Optical Microscopy	Cambridge, UK October 2018
Technical University of Denmark <i>MSc.Eng, Mathematical Modelling and Computation</i> GPA : 3.75	Lyngby, Denmark September 2017
Technical University of Denmark <i>BSc.Eng, Physics and Nanotechnology</i> GPA : 3.70	Lyngby, Denmark July 2015

EXPERIENCE

October 2021 July 2021	Data Scientist, TESCO TECHNOLOGY, London, UK Internship project in which I collaborated with Tesco's computer vision team on large-scale image classification for product recognition at the till to prevent theft. Metric learning Transformers Pytorch Pandas TensorRT
Present June 2018	Co-founder & Head of Data, OPEN-SENECA, Cambridge, UK Part-time involvement in non-profit organisation. Started as a research project doing my MRes and spun out in 2019 with five other PhD students. <ul style="list-style-type: none">• Open-source hardware design of air quality monitor.• Deployment of sensor networks in several countries across South America, Africa, Europe and Asia.• More information 🔗 https://open-seneca.org Big data Data visualisation Python Scikit-learn MongoDB
January 2019 July 2018	Research Associate, PHYSICAL COMPUTATION LABORATORY, Department of Engineering, Cambridge University, UK Project undertaken alongside my PhD in a different group supervised by Prof. Phillip Stanley-Marbell. <ul style="list-style-type: none">• Modelling human perception using artificial neural networks.• Reproducing lightness illusions known to occur in the human visual system. Deep neural networks Human perception Pytorch Tensorflow Mathematica
August 2017 May 2017	Research Assistant, DANISH FUNDAMENTAL METROLOGY, Lyngby, Denmark Researched and developed a machine learning system for a novel laser based fire detector. This involved optical engineering and signal processing using machine learning techniques. Signal processing Time-series classification Support vector machines
September 2017 December 2016	Data Consultant, VISIONTRACE, Lyngby, Denmark Alongside my MSc studies, I worked part-time on a number of consultant jobs including : <ul style="list-style-type: none">• Developed a system for image analysis of a continuous video feed at a production facility overseen by food industry technology provider GEA.• Performed data mining on a big dataset for Danish television broadcaster TV2 with results used in a program about fitness level. Video tracking Data mining
September 2015 July 2015	Research Assistant, DEPARTMENT OF PHOTONICS ENGINEERING, Technical University of Denmark Further researched the topic of my BSc thesis and wrote it up as a publication. Markov processes Quantum mechanics Algebraic computation Mathematica

PUBLICATIONS

1. Christensen, Charles N., Meng Lu, Edward N. Ward, Pietro Lio, and Clemens F. Kaminski. "Spatio-temporal Vision Transformer for Super-resolution Microscopy." *arXiv* (2022)
2. Christensen, Charles N., Edward N. Ward, Meng Lu, Pietro Lio, and Clemens F. Kaminski. "ML-SIM : universal reconstruction of structured illumination microscopy images using transfer learning." *Biomedical optics express* (2021)
doi.org/10.1364/BOE.414680
github.com/charlesnchr/ML-SIM
3. Christensen, Charles N., Yevgen Zainchkovskyy, Salvador Barrera-Figueroa, Antoni Torras-Rosell, Giorgio Marinelli, Kim Sommerlund-Thorsen, Jan Kleven, Mikael Lassen. "Simple and robust speckle detection method for fire and heat detection in harsh environments." *Applied optics* (2019)
doi.org/10.1364/AO.58.007760
4. Christensen, Charles N., Jake Iles-Smith, Torkil S. Petersen, Jesper Mørk, and Dara PS McCutcheon. "Driving-induced population trapping and linewidth narrowing via the quantum Zeno effect." *Physical Review A* (2018)
doi.org/10.1103/PhysRevA.97.063807

ACADEMIC PROJECTS

PHD PROJECT

OCTOBER 2018 - MARCH 2022

Thesis Computer Vision using Deep Learning for Bio-imaging
Supervisor 1 Prof. Clemens Kaminski, Laser Analytics Group, Cambridge University.
Supervisor 2 Prof. Pietro Lió, Computational Biology within Artificial Intelligence Group, Cambridge University.
Advisor Dr Jérôme Boulanger, Senior Research at Laboratory for Molecular Biology, MRC.

Imaging at high spatio-temporal resolution requires a trade-off with image quality leading to low signal-to-noise ratio in acquired data. This renders traditional image analysis methods to perform unreliably. In this thesis I propose methods for image reconstruction, denoising and segmentation using deep learning methods that are robust to noise.

MRES PROJECT

JANUARY 2018 - JUNE 2018

Thesis Three-dimensional Nanomagnetometry : A Computational Study
Supervisor Dr Amalio Fernández-Pacheco, Research Fellow in Cavendish Laboratory, Cambridge University.

Non-planar structures with magnetic properties are of interest to development of future computing and storage units, but applications rely on accurate sensing techniques. In this work I investigate the magneto-optical Kerr effect as the measuring principle of magnetic properties in 3D nanostructures.

MSC PROJECT

JANUARY 2017 - SEPTEMBER 2017

Thesis High Average Power Mid-Infrared Supercontinuum Generation in Tapered Chalcogenide Fibers
Supervisor Prof. Ole Bang, Head of Fiber Sensors and Supercontinuum, Technical University of Denmark

Supercontinuum laser light in the mid-infrared regime is important for applications in optical coherence tomography of biological samples, but the generation of supercontinuum light is difficult. I propose an efficient method to simulate supercontinuum generation by modelling light propagation in soft-glass optical fibers based on the non-linear Schrödinger equation.

BSC PROJECT

JANUARY 2015 - JULY 2015

Thesis The Quantum Zeno Effect Applied to Quantum Dots
Supervisor Prof. Jesper Mørk, Head of Nanophotonics, Technical University of Denmark

The quantum Zeno effect is a phenomenon that slows down the evolution of a quantum system due to frequent measurements performed on it, thereby delaying decay. The effect is potentially useful for applications in quantum computing. In this project I derive different manifestations of the quantum Zeno effect and investigate their significance.

SOFTWARE CONTRIBUTIONS

github.com/charlesnchr/ML-SIM

ML-SIM is a method for reconstructing images acquired with structured illumination patterns. The reconstruction method is highly versatile, because it is trained on synthetic training data using a realistic image formation model.

ERNET : SEGMENTATION OF ENDOPLASMIC RETICULUM MICROSCOPY IMAGES

2019

github.com/charlesnchr/ERNET

Segmentation of Endoplasmic Reticulum microscopy images using a residual neural network architecture commonly used for image restoration.

EMBEDDED 3D RENDERING

2018

github.com/charlesnchr/embedded-3d-rendering

A light-weight CPU implementation of a 3D graphics pipeline for embedded systems written in C.

TEACHING AND MENTORING

October 2020 June 2021	Project Supervisor, Department of Chemical Engineering and Biotechnology, Cambridge University, UK Supervised students Bovey Zheng and Oscar Sauchelli for a BSc project. <ul style="list-style-type: none"> Project title : <i>"AI enhancement of fluorescein microscopy data"</i>.
November 2020 November 2021	Teaching Associate, NANODTC, Cambridge University, UK Lectured and instructed the 2020 and 2021 cohorts of MRes students in the NanoDTC PhD programme. The lectures and practicals covered optical super-resolution microscopy, structured illumination microscopy, image analysis for bio-imaging and machine learning techniques for computer vision problems.
March 2020	Course Instructor, CAMBIOSCIENCE, Homerton College, Cambridge, UK Organised and held workshop on image analysis methods for bio-imaging in collaboration with Dr Dari Kimanius. The workshop was part of a course on bio-imaging offered by CamBioScience.
October 2019 June 2020	Project Supervisor, Department of Chemical Engineering and Biotechnology, Cambridge University, UK Supervised students Edward Erelt and Max Barysevich for a BSc project. <ul style="list-style-type: none"> Project title : <i>"Machine learning for denoising in high-speed fluorescence microscopy"</i>.
September 2016 January 2017	Teaching Assistant, DTU COMPUTE, Technical University of Denmark Taught in the master's course Computational Discrete Mathematics. I held weekly 1-hour lectures in addition to being available for assistance in exercise sessions.

GRANTS & AWARDS

December 2021	Award , Outstanding Student Contribution to Education Awards, Awarded by Cambridge Centre for Teaching and Learning in acknowledgement of the open-seneca initiative.
December 2019	Research Grant , Postgraduate grant from the Augustinus Foundation, <i>20,000 DK</i> .
November 2019	Career Development Grant , University of Cambridge Nanoscience EPSRC CDT Associate Grant, <i>£2,500</i> .
October 2019	Award , University of Cambridge Vice-Chancellor's Research Impact and Engagement Award, <i>£1,000</i> .
November 2018	Research Grant , Postgraduate grant from the Augustinus Foundation, <i>20,000 DK</i> .
October 2017	MRes & PhD Scholarship , Funding from Centre for Doctoral Training under Engineering and Physical Sciences Research Council (EPSRC), Tuition fee and stipend for 4 years, <i>£120,000</i> .

TECHNICAL COMPETENCIES

Machine learning	Pytorch, Tensorflow, Pandas, TensorRT, Jax, Scikit-learn
Scientific Computing	C/C++, MPI, OpenMP, CUDA, Matlab, Numpy
Programming	Python, C/C++, Java, C#
Computer graphics	C++, OpenGL, WebGL, SDL, Unity 3D
Database systems	MySQL, MongoDB, PostgreSQL
Web technologies	Node.js, Javascript, PHP, HTML5, React.js
Development utilities	VIM, VS Code, Jupyter, git