Frederik Warburg

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Education

2020 - 2023   **PhD in Uncertainty Quantification in Deep Learning**   Technical University of Denmark
I focus on estimating uncertainties in deep learning for computer vision applications such as image retrieval. I am supervised by Søren Hauberg (Technical University of Denmark) and Javier Civera (University of Zaragoza). I was awarded the Danish Elite Research Travel Stipend in 2022. My current average grade is 12 / 12. Exp. date of PhD defends 1st Oct 2023.

2018 - 2020   **MSc in Mathematical Modelling and Computing**   Technical University of Denmark
I graduated from the honours program, which is an elite education with a more challenging course of study, with an average grade 11.9 / 12. During my studies I found a special interest in machine learning and computer vision. I received 12 / 12 for my master thesis.

Spring 2019   **MSc Computer Science**   University of California, Berkeley
I received Sparnord Fonden's FinTech Entrepreneurial Scholarship to study at UC Berkeley in the Spring 2019. I received a GPA 4.0 / 4. Besides my studies, I followed and won an entrepreneural track held by Innovation Center Denmark in Silicon Valley.

2015 - 2018   **BSc in Mathematics and Technology**   Technical University of Denmark
I have obtained a solid mathematical foundation and advanced programming skills. I achieved an average grade of 10.3 / 12. I completed my BSc half a year faster than the standard time.

2014 - 2015   **BSc in Mathematics**   Lindenwood University
After high school, I studied at Lindenwood University, MO, USA for one year. I was elected student senator, and as such I raised $7700 for an outdoor study area. I achieved an average grade of 3.8 / 4.

Publications

2022   **SparseFormer: Attention-based Depth Completion Network**   CVARVR
F. Warburg, *M. Ramamonjisoa, M. Antequera*
We introduce a transformer block that fuses 3D landmarks with deep visual features to complete a sparse depth map. In contrast to prior works, our method has a global receptive field, making it especially effective for depth completion with low-density and non-uniform landmarks commonly found in SfM pipelines.

2022   **Volumetric Disentanglement for 3D Scene Manipulation**   Submitted to ECCV
S. Benaim, **F. Warburg***, P. Christensen, S. Belongie*
We propose a volumetric framework for (i) disentangling or separating, the volumetric representation of a given foreground object from the background, and (ii) semantically manipulating the foreground object, as well as the background.

2022

Danish Airs and Grounds: A Dataset for Aerial-to-Street-Level Place Recognition and Localization RA-L (IROS)
A. Vallone*, **F. Warburg****, *H. Hansen, S. Hauberg, J. Civera*.
We present an aerial to street-level localization dataset covering both urban, suburban and rural areas. It contains street-level images with accurate 6 DoF poses and associated aerial images images from Denmark. https://arxiv.org/abs/2202.01821

2021

ACDC-Net: Self-supervised Depth Completion for Active Stereo RA-L (ICRA)
F. Warburg*, D. Hernández, U. Bonde, A. Vakhitov, P. Alcantarilla*.
Active stereo sensors are revolutionising computer vision applications that require 3D information about the world. However, these sensors are significantly limited. We present the first self-supervised depth completion method for active stereo that completes and refines the depth maps by closely integrating a visual-inertial SLAM system in the training and inference pipeline. https://arxiv.org/abs/2110.03234

2021

Bayesian Triplet Loss: Uncertainty Quantification for Image Retrieval ICCV
F. Warburg*, M. Jørgensen, J. Civera, S. Hauberg*.
Instead of modelling image embeddings as points, we propose to model image embeddings as isotropic Gaussians. We develop a novel Bayesian triplet loss that extend the traditional triplet loss to enforce the triplet constraint for Gaussian embeddings. This allow us to quantify uncertainty in the retrieval system, which can be important for downstream decision-making. https://arxiv.org/abs/2011.12663

2020

Probabilistic Spatial Transformer Network Preprint
P. Schwöbel, **F. Warburg***, M. Jørgensen, K. Madsen, S. Hauberg*.
We extended the Spatial Transformer Network to a probabilistic model enabling us to sample from a distribution of transformations. Thus, learning a suitable data augmentation for data of different modalities. https://arxiv.org/abs/2004.03637

2020

Mapillary Street-Level Sequences: A Dataset for Lifelong place recognition CVPR
F. Warburg*, S. Hauberg, M. Antequera, P. Gargallo, Y. Kuang, J. Civera*.
We curated and validated a large dataset using Mapillary images. The substantial size and diversity of the dataset makes it relevant for training of deep neural networks for place recognition. Paper accepted with oral presentation. https://research.mapillary.com/img/publications/CVPR20c.pdf

2018

Intensity Mapping for Mask Projection based Photopolymerization ASPE, Berkeley
F. Warburg*, M. Ribo, A. Luongo, A. Danielak, D. Pedersen*.
We presented a method for mapping the intensity field of the projected light in a photopolymerization system. We showed that the de-facto assumption about uniformly distributed light is invalid and we implemented a method for making the projection more uniform. https://www.researchgate.net/publication/339787809_Intensity_Mapping_for_Mask_Projection_based_Photopolymerization

Experience

Fall 2021   **Research Engineer Intern in Depth Completion**   Facebook

Worked on depth completion as part of a four month research internship at Facebook. The internship resulted in a workshop paper submitted at CVARVR22.

2020 - 2021   **Research Intern in Depth Completion**   SLAMcore

Under supervision of Pablo Alcantarilla, I developed the first self-supervised depth completion method for active stereo sensors that completes and refines the initial hardware optimized depth maps of the active depth sensor.

2019 - 2020   **Research Intern in Place Recognition**   Mapillary

I comprised the largest dataset for lifelong place recognition using images from Mapillary's crowds source image database. I benchmarked state-of-the-art deep learning place recognition methods on this and competing datasets.

Summer 2019   **Research Fellow in Deep Learning**   ETH Zurich

I received ETH's Computer Science Summer Research Fellowship. I worked at Marc Pollefeys' Visual Computing lab at ETH. Under the supervision of Martin Oswald, Viktor Larsson and Mihai Dusmanu, I investigated a novel k-max pooling technique in several computer vision domains, including 3D reconstruction and super resolution.

2018 - 2019   **Machine Learning Engineer**   Beep Analytics

We use machine learning to create a predictive tool that delivers data driven insights about repair parts for airplanes. The tool will provide improved maintenance and cost savings for airplane companies.

Summer 2018   **Research Assistant in SLAM**   University of Zaragoza

Under the supervision of professor Javier Civera, I worked with lifelong place recognition in SLAM. I comprised a large dataset for lifelong place recognition using images from Google Street View. I used state-of-the-art deep convolutional neural networks to post-process the data and to test the difficulty of the dataset.

2017 - 2018   **Data Scientist and App Developer**   Technical University of Denmark

We scraped, cleaned, analyzed and presented data in an app that provides key-insights about the university's company collaborations. One feature of the app was an interactive graph representation where professors and companies were nodes and collaborations were edges.

Summer 2017   **Software Developer Summer Intern**   AutoDesk

I developed the data structure and the interface of a template selector that will radically change the work-flow of AutoDesk Fusion that has more than 100.000 users.

2016 - 2017   **Student Ambassador**   IBM

I was responsible for the relationship between IBM and DTU. I facilitated guest lectures and hackathons while communicating technical content about IBM products to DTU students and professors.

Teaching Experience

2020 - Now   **Project Supervision**   Technical University of Denmark
I have supervised 8 Master, 2 Bachelor, and 4 special course projects on topics range from place recognition to applied robotics to generative adversarial networks.

Spring 2018/20 **Teaching Assistant in Machine Learning and Data Mining**   Technical University of Denmark
I taught DTU students about machine learning concepts and methods within both supervised and unsupervised learning.

Fall 2019   **Teaching Assistant in Software Startup Studio**   Technical University of Denmark
I taught DTU students about Google's 5 days SPRINT methodology and methods within modern software development.

Honors, Awards & Certifications

2022   **Elite Research Travel Stipend (DKK 200.000)**   Danish Ministry of Higher Education and Science
The grant is awarded to the top 20 Danish PhD students across all branches of science each year. The grant was presented by the Crown Princess and the science minister.

2018-2020   **Honors program**   Technical University of Denmark
I graduated from the honours program, which is an elite education that offers a more challenging course of study, individual tutoring and ambitious research affiliation. The program is offered to the top 10 % students at the university.

Nov. 2018   **Venture Cup Idea Hunt (SEK 5.000)**   Venture Cup
We presented an innovative method for sowing wheat.

Oct. 2016   **3'rd place winner of OI-X Big Data competition (DKK 10 000)**   DTU Skylab
We developed a big data solution for wind turbine parks to optimizes the total energy production of the park.

2014 - 2015 **Dean Honours**   Lindenwood University
Achieved a GPA above 3.5 both semesters at LU.