Nicolas Dufour

COMPUTER VISION PHD

Linkedin: nicolas-dufour
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27 years old

Languages spoken:
French (Bilingual)
Spanish (Bilingual)
English (990 points Toeic)
Portuguese (Beginner)

Software proficiency:
Google Cloud Computer, Photoshop, Inkscape, Premiere, Latex, SLURM.

Soft Skills:
Project Management, Fast Learner, Communication, Problem solving, Entrepreneurial spirit, Curious, Creative.

Programming language:
Python (Pandas, Numpy, Scikit-learn, Matplotlib, Seaborn, Plotly, Hadoop, Spark, Plotly), Javascript (React, AngularJS, NodeJS, Socket.io), HTML5/CSS3, Bash, SQL, Caml.

Deep Learning Stack:
Pytorch, Pytorch Lightning, Wandb, Hydra.

PROFESSIONAL EXPERIENCE

Meta (ex-Facebook) | Software Engineering Intern
July 2022-October 2022, London, UK
Supervised by Vincent Moens
Worked on integrating model based Reinforcement Learning to torchrl, a Pytorch domains library.

Ecole Nationale des Ponts et Chaussées (ENPC) and Ecole Polytechnique / Research Intern
April 2021-September 2021
Supervised by David PICARD and Vicky KALOGEITON.
Worked on subject transfer and conditional Generative Adversarial Networks (cGANs).
Designed a novel semantically conditioned GAN architecture improving the state of the art.
Joint internship between IMAGINE (ENPC) and GeoViC (Ecole Polytechnique) labs.

Upskills / Machine Learning Engineer Internship
February 2020-July 2020, Singapore
Worked on detecting fraudulent patterns between traders with anomaly detection for one of the largest Asian banks. Worked with Graph Neural Network in an unsupervised setting. Created a dataset from Murex trading data using Spark. Worked on novelty detection leveraging a Variational Auto-Encoder (VAE) architecture.

Boyce Thompson Institute - Cornell University / Research Internship
June 2018 / August 2018, Ithaca, NY, USA
Worked on a better way to store genotypic data. Tools such as Hadoop, Spark and the Parquet file format were used to optimize the storing performance. Developed some custom algorithms in Python to fit the data needs. Presented the results by a poster to a wide audience of researchers.

PROJECTS

Around the World in 80 Timesteps: A Generative Approach to Global Visual Geolocation
Nicolas Dufour, Vicky Kalogeiton, David Picard, Loic Landrieu.

Pioneered a probabilistic visual geolocation framework that leverages diffusion and Riemannian flow matching to predict image locations with improved accuracy and uncertainty quantification. Outperformed existing deterministic methods on major datasets, demonstrating a new approach to global image localization

PoM: Efficient Image and Video Generation with the Polynomial Mixer
David Picard, Nicolas Dufour.

Introduced the Polynomial Mixer (PoM), an innovative Multi-Head Attention replacement with linear computational complexity for image and video generation in diffusion models.

E.T. the Exceptional Trajectories: Text-to-camera-trajectory generation with character awareness / ECCV 2024
Robin Courant, Nicolas Dufour, Xi Wang, Marc Christie, Vicky Kalogeiton.

Proposed a novel dataset (Exceptional Trajectories, E.T.) and developed a diffusion-based approach (DIRECTOR) to generate complex camera trajectories from textual captions. Demonstrated the potential of this approach through training a language-trajectory feature representation model (CLaTr). Contributes to democratizing cinematography for common users.

Project page: **https://www.lix.polytechnique.fr/vista/projects/2024_et_courant/**

Analysis of Classifier-Free Guidance Weight Schedulers / TMLR 2024
Xi Wang, Nicolas Dufour, Nefeli Andreou, Marie-Paule Cani, Victoria Fernandez Abrevaya, David Picard, Vicky Kalogeiton

Conducted experiments to analyze classifier-free guidance weight schedulers, finding that simple, monotonically increasing weights consistently improve performance with minimal code changes.

Don't drop your samples! Coherence-aware training benefits Conditional diffusion / CVPR 2024 HIGHLIGHT (TOP 11%)
Nicolas Dufour, Victor Besnier, Vicky Kalogeiton, David Picard.

Proposed Coherence-Aware Diffusion (CAD) to integrate coherence in conditional information into diffusion models, allowing them to learn from noisy annotations without discarding data. Conditioned the model on both conditional information and coherence score, enabling it to ignore or discount poor quality conditioning. Demonstrated CAD's effectiveness on class conditional, semantic conditional and text-to-image.

Project page: **https://nicolas-dufour.github.io/cad**

OpenStreetView-5M: The Many Roads to Global Visual Geolocation / CVPR 2024
Guillaume Astruc, Nicolas Dufour*, Ioannis Siglidis*,*
Constantin Aronssohn, Nacim Bouia, Stephanie Fu, Romain Loiseau, Van Nguyen Nguyen, Charles Raude, Elliot Vincent, Lintao XU, Hongyu Zhou, Loic Landrieu

Introduced OpenStreetView-5M, a large-scale, open-access dataset of 5.1 million geo-referenced street view images from 225 countries/territories. Conducted benchmarking of state-of-the-art image encoders, spatial representations, and training strategies

Project page: **https://osv5m.github.io/**

SCAM! Transferring humans between images with Semantic Cross Attention Modulation / ECCV 2022
Nicolas Dufour, David Picard, Vicky Kalogeiton

Introduced SCAM (Semantic Cross Attention Modulation) for semantically conditioned image generation, focusing on subject transfer (pose, appearance, background). Utilized Semantic Attention Transformer Encoder to extract multiple latent vectors per semantic region and generator for precise generation with emphasis on fine details. Achieved state-of-the-art results on iDesigner and CelebAMask-HD datasets.

Project page: **https://nicolas-dufour.github.io/scam**

For older projects see https://github.com/nicolas-dufour

EDUCATION

Ecole Nationale des Ponts et Chaussées (ENPC) and Ecole Polytechnique / Computer Vision PhD Student
October 2021-September 2024, Paris, France
Supervised by David PICARD, Vicky KALOGEITON and Loic LANDRIEU
Working on generation and comprehension of dynamic scenes.
Joint PhD between IMAGINE (ENPC) and GeoViC (Ecole Polytechnique) labs.

ENS Paris Saclay / MVA Master (Mathematics, Vision and Learning)
October 2020 to September 2021, Paris, France
Master of Science specialized in computer vision, applied mathematics and machine learning.
Relevant courses:
Deep Learning V.LEPETIT
Image denoising: the human machine competition J.-M. MOREL, G.FACCIOLO, P.ARIAS
Object recognition and computer vision I. LAPTEV, J. PONCE, C. SCHMID, J. SIVIC,
(Kaggle Competition: 1st / 167)
Introduction to Numerical Imaging J. DELON,Y. GOUSSEAU
Sparse Representation S. MALLAT
Deep Learning In Practice G. CHARPIAT
Kernel Methods for Machine Learning J. MAIRAL, J.P VERT
Machine Learning for Time Series L. OUDRE
Algorithms for speech and natural language processing E.DUPOUX, B.SAGOT

Télécom SudParis - Institut Polytechnique de Paris / Engineering diploma
September 2017 to September 2020, Evry, France
One of the top French Engineering Schools. Followed the MSA speciality (Modelisation, Statistics and Applications) which teaches the intricacies of statistical learning. Relevant Courses: Stochastic Processes, Machine Learning, Bayesian statistics, Graphical Models for image processing, Biostatistics and high dimensional data, Deep Learning, Economic modeling, Polls theory, Queuing theory, Convex optimization, Signal theory, Communication and information theory.

CPGE Joffre MPSI / MP speciality Computer Science
September 2014 to July 2017, Montpellier, France
Intensive preparation in Math and Physics for the highly competitive entrance exams to the French Grandes écoles. CPGE stands for Classes Préparatoires aux Grandes Écoles.

Lycée Français Paul Valéry de Cali / Baccalauréat with High Honors
September 2006 to July 2014, Cali, Colombia
Lived 8 years in Cali, Colombia and attend French School, a trilingual school (French, Spanish and English). Activities: UN Model (I was President of the International Penal Court), Creation of School Journal, Vice-President of the Student Council.

OPEN-SOURCE CONTRIBUTIONS

TorchRL: Worked on the model based aspect of the library

Torchmetrics: Improved the FID metric to work online, avoiding storing features.

Huggingface/diffusers: Implemented the sampling for K-LMS sampler

REVIEWS

Reviewer at AAAI 2024, ECCV 2024, CVPR 2024, WACV 2024, ICCV 2023, ACCV 2022.

AWARDS

Outstanding reviewer at ACCV 2022.

SCAN ME !