Curriculum Vitae

Xavier PIC
PhD student

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Biography

I am a PhD student at CNRS since April 2021, under the direction of Marc Antonini, in the MediaCoding research team at I3S laboratory in Sophia Antipolis (France). My activites principally cover the field of image coding adapted to DNA data storage. I design constrained coders (entropy, fixed-length, arithmetic coders) that are adapted to the specificities of DNA data storage, and use them to modify or implement novel image coders adapted to DNA data storage. These image coders have to both be performant (rate distortion optimization) and robust to the noise generated by the biochemical operations of DNA data storage. As a member of the JPEG Group, I have contributed to the JPEG DNA Ad-hoc research group, for the definition of an image coding standard respecting the specificities of DNA data storage.

Education

Fall 2019	**Master's Degree in Computer Science, ENSEIRB**
	(Bordeaux Institute of Technology), Bordeaux, France
Summer 2016	**Preparatory scientific courses for engineering schools**
	College: Lycée Masséna, Nice, France
	Classes préparatoires de mathématiques supérieures
Summer 2015	English formation in Cambridge, United Kingdom
June 2014	**French High-School Degree with mathematics specilization**
	General High school: Lycée général Jean Moulin, Draguignan, France
	Baccalauréat scientifique spécialité mathématiques | **With Distinction**

Positions held in the past

Spring 2021 - present	**PhD in Image and Video Compression, I3S Laboratory**
	(Côte d'Azur University and CNRS - UMR 7271), Sophia Antipolis, France
	Joint CNRS/Imperial College of London funding
Spring-Summer 2019	**AILab, Università degli Studi di Firenze, Italy**
	Research internship in Deep Learning applied to the understanding of Handwritten Document Analysis.
Summer 2018	**SURYS, Bussy-Saint Georges, FRANCE**
	Research internship on Deep Learning and Image Processing methods to classify digital images of passports and find weak signals to authenticate them.

Other past projects

Fall 2018	Study of Deep Learning solutions for Super Resolution for the **Bordeaux Bioinformatics Center (CBIB)**
Fall 2017 - Spring 2018	Creation of performance and quality tests on Caffe models for the **Bordeaux Informatics Research Laboratory (LaBRI)**
Winter 2017-2018	Creation of a compiler for pseudocode C in LLVM code

Research

Key words Images, compression, multimedia, constrained coding, wavelets, compressive autoencoders, learning-base image compression, DNA data storage, analysis of DNA encoded data, oligo formatting

Main Activities My research activity focuses on the study of performant compression methods adapted to image coding. These compression methods are adapted to the field of DNA data storage, that requires coders that are both adatped to the coding constraints imposed by the DNA biochemical operations and robust to the noise occuring in these lossy biochemical operations. The main topics of this work are:

- **Image compression**
  - Rate distortion optimization
  - Noise robustness
  - DCT/DWT-based image coding methods (JPEG, JPEG200), Learning-based image coding methods (autoencoders, implicit neural representation)
- **Constrained coding**
  - Entropic, arithmetic, fixed length coders on incomplete quaternary codes
  - Close-to-balanced coders on incomplete quaternary codes
- **DNA data storage** - *(contributor to the JPEG DNA standardization group)*
  - Design coders that take into account the constraints imposed by the DNA biochemical processes of synthesis, storage and sequencing
  - Design of robust to noise quaternary codes (representing DNA sequences) using the A, T, C, G alphabet
  - Formatting the quaternary codes into oligos (short strands of DNA) of fixed lengths
  - Design codecs robust to errors occuring at the oligo level (oligo shuffling, oligo loss)

Publications The results obtained through my work have been published in one journal (Pattern Recognition Letters), and in various national and international congresses (IEEE ICIP, IEEE ICASSP, EUSIPCO, DSP...) and in various national and seminars and national workshops (GDR ISIS (CNRS), MMSP, MWCC...). I am currently finalizing the redaction of an article to be submitted in IEEE Transactions on Image Processing. I also have participated in the redaction of standardization document output by the JPEG DNA Ad-hoc group.

Softwares

- Goldman Transcoder – *JPEG contribution (JPEG DNA compression and coding Anchor 1)*
- JPEG DNA Benchmark Codec – *JPEG contribution (JPEG DNA compression and coding Anchor 2)* : DNA Image codec provided to the JPEG DNA Ad-hoc group as an Anchor to compare the results of the proponents in the JPEG DNA Call for Proposals
- DNAAutoenc : Compressive Autoencoder encoding images into DNA
- OligoAnalyzer – *JPEG contribution (JPEG DNA Metrics)* : Software analyzing the quality of the encoded oligos with regard to the biochemical constraints, provided to the JPEG DNA Ad-hoc group as an evaluating software for the JPEG DNA Call for Proposals
- OligoChecker – *JPEG contribution (JPEG DNA Metrics)* : Software checking the validity of the DNA encoded files, provided to the JPEG DNA Ad-hoc group as an evaluating software for the JPEG DNA Call for Proposals
- JPEG DNA SFC4 – *JPEG contribution (Answer to the JPEG DNA Call for Proposals, October 2023)* : JPEG Based image codec adapted to DNA, improvement over the JPEG DNA Benchmark Codec, submitted to the JPEG DNA Call for Proposals. Several options were available: a source coding (raw input) and a transcoding (binary jpeg input) were provided, with the possibility to add randomization to the encoded data
- HiDNA v1 – *JPEG contribution (Answer to the JPEG DNA Call for Proposals, October 2023)* and v2 : Implicit Neural Representation for Image coding adapted to DNA, the v1 was submitted to the JPEG DNA Call for Proposals

Supervisions

- 2 co-supervised interns:
  - Aditya Nair: master's trainee from Polytech Nice, co-supervised with Michel Barlaud, Professor at I3S

– Jérémy Mateos: master's trainee from Université Côte d'Azur, co-supervised with Marc Antonini, Director of research CNRS at I3S

International activities

- Congresses : I have attended 8 congresses during my PhD:
EUSIPCO 2022 (Belgrade, Serbia), MWCC 2022 (Munich, Germany), ICASSP 2023 (Rhodes, Greece), DSP 2023 (Rhodes, Greece), GDR ISIS (CNRS) on DNA data storage (Paris, France), JPEG 100th Meeting (Covilha, Portugal), MMSP 2023 (Poitiers, France), ICIP 2023 (Kuala Lumpur, Malaysia)

- I have done 4 stays abroad: a six month research internship in Florence, Italy, in the AILab of Università degli Studi di Firenze, 3 one-week stays in Amsterdam, London (Imperial College) and Cambridge (UK)

Teaching

I have taught lab sessions of the course RS205 of Frédéric Payan at the Réseaux et Télécommunications department of IUT Université Côte d'Azur

Publication List

Publications in peer-reviewed journals

[1]   Z. Ziran, X. Pic, S. Undri Innocenti, D. Mugnai, and S. Marinai. "Text alignment in early printed books combining deep learning and dynamic programming". In: *Pattern Recognition Letters* 133 (2020), pp. 109–115.

Papers in refereed conferences

[2]   T. H. Le, X. Pic, J. Mateos, and M. Antonini. "Implicit neural multiple description for DNA-based data storage". In: *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP 2024)* (2024).

[3]   T. H. Le, X. Pic, and M. Antonini. "INR-MDSQC: Implicit Neural Representation Multiple Description Scalar Quantization for Robust Image Coding". In: *2023 IEEE 25th International Workshop on Multimedia Signal Processing (MMSP)* (2023), pp. 1–6.

[4]   X. Pic, E. G. S. Antonio, M. Dimopoulou, and M. Antonini. In: *2023 IEEE 25th International Workshop on Multimedia Signal Processing (MMSP)*. 2023, pp. 1–6.

[5]   X. Pic, E. G. S. Antonio, M. Dimopoulou, and M. Antonini. "Rotating labeling of entropy coders for synthetic DNA data storage". In: *IEEE International Conference on Digital Signal Processing (DSP)* (2023).

[6]   I. Mitrica, E. Gil San Antonio, M. Dimopoulou, X. Pic, and M. Antonini. "Efficient classification of DNA reads for robust decoding of data stored in synthetic DNA Main objective". In: *Munich Workshop on Coding and Cryptography (MWCC 2022)* (2022). Poster.

[7]   X. Pic and M. Antonini. "A constrained Shannon-Fano entropy coder for image storage in synthetic DNA". In: *European Signal Processing Conference (EUSIPCO)* (2022).

[8]   X. Pic and M. Antonini. "Image coding algorithm for DNA data storage combining JPEG and autoencoders". In: *Munich Workshop on Coding and Cryptography (MWCC 2022)* (2022). Poster.

References

Available upon request