UMR IRISA

Activity Report 2025

Team Shadoc

Systems for Hybrid Analysis of DOCuments

D6 – Signal, Image, Language

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1 Team composition

Researchers and faculty

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Associate members

Jean Camillerapp, Retired Professor, Volunteer Researcher, Univ. de Rennes, until March 2025
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2 Overall objectives

2.1 Overview

The Shadoc team focuses on *modelling man-made data for written communication*: handwriting, gesture (2D and 3D), and documents, under various aspects: analysis, recognition, composition, interpretation.

The objective is to achieve a continuum between paper and digital documents with a certain readability. We mainly focus on the following topics:

- Intelligent recognition of handwritten content: documents, writings, gestures;
- Analysis of the semantic/structural content: document structure, stages of production of diagrams, drawings, musical scores, sketches, architectural plans;
- Design of new AI, combining recognition and analysis: offer enriched experiences for digital humanities or e-education.

The roadmap of the Shadoc team is on the frontier of several research axes: Pattern Recognition, Machine Learning, Artificial Intelligence, Human-Machine Interaction, Uses and Digital Learning.

Our research is characterized by the hybridization of several AI approaches: two-dimensional grammars, deep learning, fuzzy inference systems... This hybridization aims at guaranteeing, beyond performance, important aspects such as: explicability, genericity, adaptability, data frugality.

Beyond hybridization, the originality of this research is to focus on user interaction. This strategy aims at answering the limits of the current approaches which are based on non-interactive treatments. The concept is to reinforce the decision processes by relying on the implicit validations or explicit corrections of a user to avoid the propagation of errors throughout the analysis. The notions of interpretation, adaptation and incremental learning are at the heart of this research, the objective being to design efficient, robust and self-evolving systems.

The studied data take two main aspects: image recognition and analysis of sequences (time series) in different forms, from sensor signals to document collections.

Image recognition The first field of interest is image recognition of documents. Nowadays, some commercial OCR (Optical Character Recognition) systems are available for automatic document recognition. However, those systems present their limits for the recognition of ancient, handwritten or heterogeneous documents. We work on scanned images of historical and recent documents with complex structures. We also consider digital native documents, such as PDFs, the structure of which is not always directly interpretable.

Analysis of Sequences / Time series The team works on time series and information sequences in the field of analysis, interpretation and recognition according to several granularities and modalities.

We consider first of all low-level time series associated with trajectories formed by handwritten traces or 2D/3D gestures. They come from different types of sensors: inertial, Pen-based and (Multi-)Touch Capture on touch screen, Motion capture, Kinect or Leap Motion sensor. The objective here is the reconstruction, analysis, synthesis or interpretation of these time series, like for on-line handwritten scripts recognition. Handwritten text recognition in document images are also processed sequentially and considered as time series.

At a higher level, time series are studied to provide context (temporal, spatial and semantic) and to develop evolutionary or incremental analysis and learning approaches. The objective is for instance to detect concept changes in a data stream (a sequence of documents, a sequence of gestures, or more generally a sequence of actions) in order to adapt recognition models to concept drift. Another concept is for example to design an on-the-fly analysis of a document composition (stroke by stroke).

We can also consider many sequences in collections of documents. Thus, with historical degraded documents, it is sometimes possible to improve the recognition using other pages of the document, when some information is repeated on different pages of the collection. We proposed to work in an original way by automatically transforming the different unit data (like text fields, titles, column widths...) found on the pages of a collection of documents, into different sequences of these unit data. These sequences are then analyzed for stabilities and breaks, in order to use the context of a collection of documents to improve the recognition quality.

2.2 Scientific foundations

2.2.1 Combination / Hybridization

In the field of document recognition, recent approaches based on deep learning have shown results that outperforms the state of the art. However, those approaches present two main limitations: first, they require a large amount of labeled data for training; second, the trained systems can be seen as black boxes, and the results are often difficult to interpret and correct.

On another hand, the previous Intuidoc team has been working for a long time on the development of two-dimensional grammars that enables a physical, syntactic, and semantic description of the contents. The interest of these syntactical approaches is that they do not require labeled data for training.

The originality of Shadoc team is to propose a combination between deep learning based systems and syntactical ones. We study different implementations of combination:

- The syntactical part brings contextual information to generative neural networks to make them able to converge [CCRZ19];
- Some low level elements can be extracted using deep learning systems: text-lines,

[CCRZ19] K.-Y. Choi, B. Couasnon, Y. Ricquebourg, R. Zanibbi, "CNN-Based Accidental Detection in Dense Printed Piano Scores", *in: 15th International Conference on Document Analysis and Recognition*, Sydney, Australia, September 2019, https://hal.archives-ouvertes.fr/hal-02430041.

simple gestures, symbols... They are then combined using two dimensional grammars. This type of combination builds hybrid systems with greater generalization capabilities than neural-only systems, while requiring a smaller amount of annotated data [LCCC18];

- Combination of document structure recognition and handwriting recognition;
- Combination of syntactical language models with transformers neural networks [TLCT21];
- Combination of handwriting recognition with explicit segmentation with Seq2Seq recognition [KCA+22].
- Strong combination of two dimensional grammars and transformers, where syntactical rules drives the transformer architecture.

This exploration of different mechanisms of combination between syntactic and neural models allows to reduce as much as possible the expression of a priori knowledge in syntactic form on elements that are difficult to learn for deep neural networks (or at the cost of very large amounts of annotated data), while taking advantage of the modeling capabilities of deep learning on elements that require less annotated data. This is a way to simplify the adaptation of a system to a new corpus, while increasing its generalization capabilities. Another interest of using combined approaches is to keep the systems interpretable. We can also formalize how the user interaction and the recognition system combine to keep the human in the loop.

2.2.2 Learning with few data

Deep learning methods become state-of-the-art approaches for many tasks. This is the case in the field of the Shadoc team for online and offline handwriting recognition and document image analysis. As discussed before, such methods are widely explored in many of ours works. However, such models require a lot of training examples to perform well.

Learning with few data is a regular limitation in our applications. On the one hand, works of the team are done with humans. Thus, data have to be acquired with users, which limits the amount of data that can be acquired. In particular, recently, several projects have been done in the team for students and doing data acquisition in schools

[LCCC18] A. Lemaitre, J. Camillerapp, C. Carton, B. Coüasnon, "A combined strategy of analysis for the localization of heterogeneous form fields in ancient pre-printed records", *International Journal on Document Analysis and Recognition 21(4)*, 269-282, July 2018, https://hal.inria.fr/hal-01858192.

[TLCT21] S. Tarride, A. Lemaitre, B. Coüasnon, S. Tardivel, "Combination of deep neural networks and logical rules for record segmentation in historical handwritten registers using few examples", *International Journal on Document Analysis and Recognition*, January 2021, https://hal.archives-ouvertes.fr/hal-03160212.

[KCA+22] O. Krichen, S. Corbille, E. Anquetil, N. Girard, E. Fromont, P. Nerdeux, "Combination of explicit segmentation with Seq2Seq recognition for fine analysis of children handwriting", *International Journal on Document Analysis and Recognition*, November 2022, https://hal.archives-ouvertes.fr/hal-03845144.

is not easy for various reasons. On the other hand, other works of the team are focused on historical documents such as register, journals, books ... Having labeled examples related to the document is difficult as it may be hard to annotate examples, even if the user is an expert of the domain. This may be due to the old language, the handwriting style, or degraded documents. Thus, one has to deal with only a limited amount of labeled examples.

Various approaches can be investigated to overcome this limitation. One way is to design network architectures which build a relevant latent representation of data, even if it is trained on a small training set [DGR+22]. Another way is to design a semi-supervised approach. These approaches allow to benefit of large set of unsupervised data when only a small amount of labeled examples is available. The users can be involved in the labeling process through a semi-automatic approach, called active learning, for which a model selects data examples of interest which will be manually labeled by the user [LAG21].

Those approaches can be combined with syntactical methods that do not require label data. The syntactical methods can be used to model the need of interaction when content recognition requires the intervention of an expert. They can also give the contextual information needed by generative neural networks (like IsolatingGAN, see section 2.2.3) to automatically generate labeled data of symbols [CCRZ19].

2.2.3 Self-adaptive systems

Building self-adaptive systems which can automatically adapt themselves to a new corpus of document without any or with only few labeled data is a challenging objective. It can be reached by combining syntactic and unsupervised deep learning methods. We propose to first work on a self-adaptive system for Optical Music Recognition (OMR) capable of improving its performance on degraded old scores. This method will be built on the IsolatingGAN [CCRZ19] proposed in a previous PhD work of the team where the GAN generator is able to generate labeled data of musical symbols on real images using only unlabeled musical scores and examples of isolated symbols. With this data, the system will be able to adapt to the unlabeled corpus by successive unsupervised learning, producing annotated data with the IsolatingGAN. These automatically annotated data can then be used to adapt the musical symbol detectors.

The driving of these auto-adaptation mechanisms to a corpus is possible by using the ISICA method (Interactive Strategy for Iterative Collection Analysis), validated on

[DGR+22] M. Dornier, P.-H. Gosselin, C. Raymond, Y. Ricquebourg, B. Coüasnon, "SCAF: Skip-Connections in Auto-encoder for Face Alignment with Few Annotated Data", *in: ICIAP 2022 - International Conference on Image Analysis and Processing*, *Lecture Notes in Computer Science*, *13231*, Springer International Publishing, p. 425–437, Lecce, Italy, May 2022, https://hal.archives-ouvertes.fr/hal-03687091.

[LAG21] C. Leroy, E. Anquetil, N. Girard, "Drift anticipation with forgetting to improve evolving fuzzy system", *in: 25th International Conference on Pattern Recognition (ICPR2020)*, Milan, Italy, January 2021, https://hal.archives-ouvertes.fr/hal-02974253.

[CCRZ19] K.-Y. Choi, B. Couasnon, Y. Ricquebourg, R. Zanibbi, "CNN-Based Accidental Detection in Dense Printed Piano Scores", *in: 15th International Conference on Document Analysis and Recognition*, Sydney, Australia, September 2019, https://hal.archives-ouvertes.fr/hal-02430041.

the European project EurHisFirm and the HBDEX ANR project, on cross-validation mechanisms on a collection of documents, applied to stock exchange quotation lists of the 19th and 20th century [AAB+21]. Thus, at each iteration, a new set of automatically produced annotated data will be built for a subset of musical symbols. This dataset will be used to learn a new detector for this subset of musical symbols. Then this detector will be integrated into the parsing in the next iteration, thus producing the necessary data for a new subset of musical symbols that would not have been accessible in the previous iteration. This progressive iterative process will stop when all classes of musical symbols have been covered. This approach allows self-adaptation on symbols, detected by deep learning.

More and more data are being produced continuously. In order to analyze this data, it is necessary to integrate it continuously, which is often referred to as learning on data streams. The problem is that often the environment can be non-stationary, resulting in concept drifts, or the data stream is potentially infinite, which requires the system not to save the data. We explore different approaches of incremental learning based on evolutionary fuzzy inference systems that have the ability to develop both generative and discriminative modeling. This work will be applied to continuous gesture recognition allowing the user to evolve his gesture set on the fly [LAG21].

In our work, including those oriented to help learning writing and geometry, the production of feedback is an essential element [MAM20]. To be relevant, these feedbacks must be personalized, in fact the system must adapt to the current user. In the context of work on learning aid tools, the modeling of the process of solving a problem by knowledge graphs seems to us to be an avenue to explore in order to define new self-adaptive models.

2.2.4 Rejection capabilities

The construction of recognition systems with rejection capabilities is important both for the integration of these systems in interactive processes, with humans or other systems, but also to be able to exploit automatically generated annotations, and integrate them in semi-supervision processes. Indeed it is important to select through rejection, when a human expert will be solicited to answer questions in an interactive system. We will also study rejection capacities of deep neural networks to be able to select unsupervised annotated data to be used as new training data.

[AAB+21] S. Adam, J. Annaert, F. Buelens, B. Coüasnon, B. Cule, A. de Vicq, C. Guerry, P.-C. Hautcoeur, T. Paquet, A. R. Camacho, I. Le Floch, A. Lemaitre, P. Karapanagiotis, J. Poukens, A. Riva, "Data extraction and matching The EurHisFirm experience", *in : Methodological Advances in the Extraction and Analysis of Historical Data*, *Methodological Advances in the Extraction and Analysis of Historical Data*, Kellogg School of Management - Northwestern University, Chicago/Virtual, United States, December 2021, https://hal.archives-ouvertes.fr/hal-03828381.

[LAG21] C. Leroy, E. Anquetil, N. Girard, "Drift anticipation with forgetting to improve evolving fuzzy system", *in : 25th International Conference on Pattern Recognition (ICPR2020)*, Milan, Italy, January 2021, https://hal.archives-ouvertes.fr/hal-02974253.

[MAM20] N. Michinov, E. Anquetil, E. Michinov, "Guiding the use of collective feedback displayed on heatmaps to reduce group conformity and improve learning in Peer Instruction", *Journal of Computer Assisted Learning*, June 2020, https://hal.univ-rennes2.fr/hal-02875166.

For example we will work on rejection in the CollabScore project for building a self-adaptive OMR system and in the ANTAI project on license plate recognition. Rejection capabilities of deep neural networks are also important to build hybrid systems to make decisions at the interface between the syntactic and deep part. Rejection is also necessary for hybrid systems to explain their decisions.

2.3 Application domains

The application contexts are very numerous, which is important to access real and large datasets, with real applications which lead to strong scientific challenges, while studying generic solutions.

Among the different types of documents studied by the team, there are ancient documents. Thus, there are many possible applications with archive services and digital humanities. Depending on the field of application, the analysis can be made in cooperation with various experts: economists, historians, musicologists, geologists, geographers... to work on documents such as administrative archives, musical scores, old newspapers, stock exchange price lists, financial yearbooks, geological section plans... One difficulty for ancient document recognition is that the documents are often degraded, which complicates their recognition. The second limit is that the recognition is often difficult, even for humans, while few labeled data are generally available. The objective is then to design recognition systems for structure and writings, able to be trained with few annotated data and able to improve themselves by self-adaptive recognition mechanisms. Some applications to historical documents require a very high quality of information extraction which implies the development of methods able to reach the best recognition rates in very difficult contexts. One way to improve the recognition quality is to use the sequence of documents and their redundancies which can be found in collections of documents, like in serial documents such as statistical data registers (weather, population), financial documents, administrative records... The collection of documents can also help in reducing the number of user interactions while improving the recognition.

Another type of documents studied by the team are those produced online. For these documents, the objective is to design interpretation systems and intelligent tutors based on artificial intelligence. Some of the online documents studied by the team come from productions written in a school learning context, thus making it possible to innovate in the field of e-education. The work carried out in this area is part of educational innovation projects supported by the academy and the Ministry of Education. We rely on the scientific foundations acquired in the fields of artificial intelligence ("pattern recognition", "machine learning") and human-machine interaction. One of the challenges for education is to guarantee the transferability of the acquired knowledge via the digital solution (tablet) to the traditional use (paper/pencil) and vice versa. For this, we have focused our digital tablet interactions on "pen" interactions to allow the student to write and draw on the tablet as on paper. The objective is to design automated interpretation systems (intelligent tutor) of the students' productions: writing, arithmetic operations, geometric diagrams, etc.. This scientific know-how is the basis for the design of new "e-Learning" solutions that will allow more autonomy and personalization in the learning of each student.

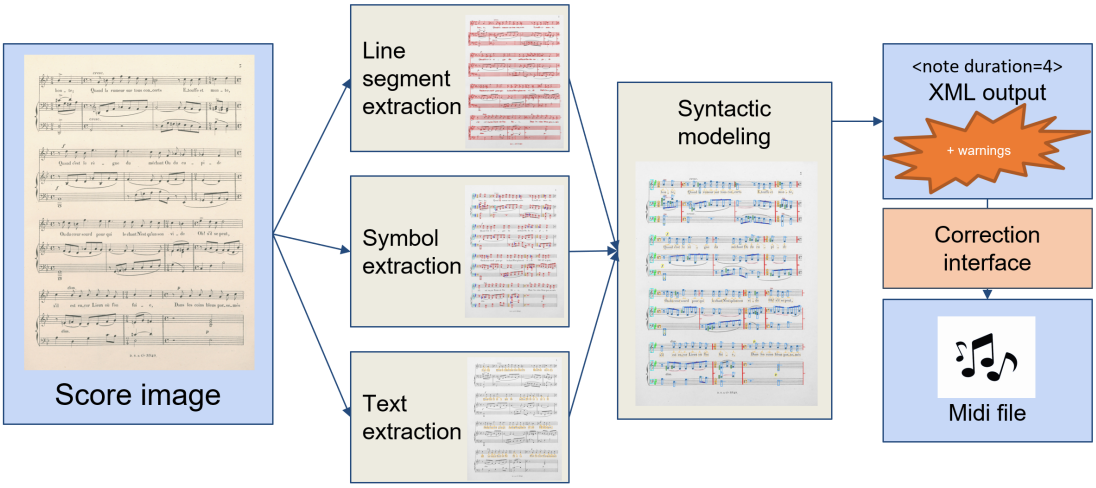

Figure 1: Hybrid OMR: combining object detectors with syntactical modeling to produce the recognition of a score.

The analysis of these online handwritten productions (2D gestures) makes it possible to imagine new gesture-interaction systems, and in particular 3D gesture-interactions. This other field of research interests the team, with the objective to obtain reactive and natural interactions with tactile devices as well as 3D sensor like Kinect. Gesture interaction allows the user to manipulate naturally the device, but they are today often limited to very basic functionalities like zooming, rotating and scrolling. The difficulty of adding new gestures is two folds: recognition accuracy and system reactivity. Increasing the number of gestures increases the probability of having gestures with common beginning. As a consequence, the system cannot predict the gesture from first traces without potentially executing undesirable commands. In this application domain, we design methods for the challenging task of early recognition of untrimmed gestures.

3 Scientific achievements

3.1 Optical Music Recognition of full-page orchestra scores recognition

Participants: Aurélie Lemaitre, Bertrand Coüasnon, Jean Camillerapp.

In the context of the ANR project Collabscore 5.2.1, we proposed several contributions. We develop an OMR (Optical Music Recognition) system, based on the combination of deep learning approaches, traditional image processing approaches, and grammatical syntactic rules.

This OMR addresses the problem of recognizing polyphonic musical scores spanning multiple pages and enables the generation of a MEI or MusicXML file from an input score. This is a hybrid OMR system based on the combination of AI techniques. The overview of them method is presented in figure 1. On the one hand, graphical elements

and musical symbols in the image are extracted using deep learning-based approaches. On the other hand, a syntactic rule description system allows the expression of musical composition rules. Thanks to these rules, the system can automatically detect inconsistencies in the recognition process and thus prompt the user only for specific points in the recognition.

3.2 IntuiSketch: Pen-Based Tutoring System for Anatomy Learning

Participants: Islam Barchouch, Eric Anquetil, Nathalie Girard.

Islam Barchouch's PhD work, defended on 3 December 2025 [1], is a part of the ANR SKETCH project (grant number 21-CE38-0009), see section 5.2.2. It focuses on the conception of an intelligent tutoring system for learning by drawing. The work adopts an active learning perspective, and more specifically learning by drawing in academic contexts where the produced sketches are complex. The application domain addressed in this thesis concerns health studies, with a particular emphasis on anatomical sketches. The objective is to design an intelligent tutoring system (ITS) capable of supporting students throughout the process of producing handwritten drawings, by providing relevant and personalized real-time feedback based on what they freely draw on a pen-based tablet.

To address the needs identified in the context of active learning by drawing, we designed an intelligent tutoring system named IntuiSketch, dedicated to the real-time interpretation and pedagogical supervision of freely drawn handwritten sketches on pen-based tablets. This work builds on research exploring the role of handwritten drawing in supporting knowledge construction in demanding domains such as anatomy. Our approach relies on a modular architecture inspired by IntuiGeo[KAG20], an intelligent tutoring system designed to support geometry learning through the construction of geometric figures.

The architecture of IntuiSketch is based on two main components: a recognition engine and a supervision engine. These two engines operate jointly within two distinct modes: an author mode and a student mode.

The author mode is intended for teachers who wish to create exercises related to a specific domain. It allows them to define the different steps of an exercise, associate explicit pedagogical instructions and draw the reference sketches expected at each step. The student mode, in contrast, is designed for students. It relies on online analysis of free-hand strokes, making it possible to identify recognized elements in real time and to assess their conformity with the expected structure of the exercise.

The recognition engine is the first core component of IntuiSketch. Its role is to automatically interpret, on the fly, the handwritten sketches produced by students, step by step, as they progress through the exercise. This recognition process is incremental: each new stroke is analyzed while taking into account the context of recognized elements.

[KAG20] O. Krichen, E. Anquetil, N. Girard, "IntuiGeo: Interactive tutor for online geometry problems resolution on pen-based tablets", *in : European Conference on Artificial Intelligence (ECAI) 2020*, p. 1842 – 1849, Santiago de compostela, Spain, August 2020, https://hal.archives-ouvertes.fr/hal-02544384.

This makes it possible to guide the student without interrupting the drawing process, by providing personalized feedback adapted to the learning contexts.

The supervision engine is the second core component of IntuiSketch. Its purpose is to supervise the student's activity throughout the drawing process, interpret the evolving structure with respect to pedagogical expectations, and deliver feedback adapted to each student's progression. This engine mainly relies on a knowledge graph representing the expected structure of the sketch, as defined by the teacher in the authoring mode.

In 2025, this work was published and presented at the ITS'25 [6] and IGS'25 [7] conferences.

3.3 IntuiGeo : an intelligent pen-based tutoring system for geometry learning in middle school - Triangle ANR Project

Participants: Eric Anquetil, Nathalie Girard, Sarah Bucquet, Erell Choulette.

Funded by the French National Research Agency (ANR) as part of the Monteil mission under the PIA2 program, the TRIANGLE project ("Working with Intelligent Feedback from a Digital Geometry Application to Foster Student Engagement") aims to improve the teaching and learning of geometry. The IntuiGeo application enables teachers to assign (or design) geometry exercises on tablets, and allows students to complete them using styluses. Relying on the automatic interpretation of shapes drawn by students, IntuiGeo provides real-time feedback and personalized guidance. The application has been tested in about twenty lower secondary schools across the Rennes and Poitiers school districts. This research project is coordinated by Rennes 2 University and involves five partners: INSA Rennes, the INSPE institutes of Brittany and Poitiers, and the Rennes and Poitiers school districts. A free, cross-platform version of the application is also planned for deployment in schools that wish to adopt it. To date, many actions have been carried out by project partners concerning (1) the design and development of the IntuiGeo application, (2) field studies and evaluation of the system, and (3) dissemination activities targeting INSPE trainers, academic trainers, and pre-service teachers.

Regarding the design and development of IntuiGeo, the IRISA team continued to optimize the user interface and enhance the reliability of the application based on feedback from LP3C field deployments. They also strengthened the underlying analysis engine (an intelligent tutoring system offering multiple levels of assistance to students, configurable by teachers). Porting IntuiGeo toward a cross-platform solution (Android, iOS, and Windows) is well underway, leveraging the expertise of the company Wyatt Studio (specialists in Flutter).

In addition, several field studies and evaluations were carried out in lower secondary classrooms (6th grade, 7th grade, and ULIS special education units) by engineers from LP3C and the INSPE of the University of Poitiers. User tests involving teachers and approximately fifty 4th–5th grade pupils (CM1–CM2) were conducted. These studies allowed us to collect data on the acceptability and usability of IntuiGeo among the target audience (more than 930 students and 36 teachers across the Rennes and Poitiers school districts).

Finally, training sessions for teacher trainers, in-service teachers, and master's students (MEEF program) were organized thanks to the involvement of INSPE Bretagne and the University of Poitiers (Niort campus). Across these initiatives, we benefited from the engagement of digital education delegates, academic technical advisors, academic trainers, and mathematics inspectors (IPR), amounting to more than 130 practitioners.

Different publications discusse this works:

3.4 IntuiNaxe: Composing and Annotating Hand Drawn Plans

Participants: Eric Anquetil, Bruno Hortollary.

The IntuiNaxe software results from a collaborative research agreement between the company Inaxe and the Shadoc team of the IRISA laboratory. This collaboration, supported by several successive contracts with INSA Rennes since 2019, has enabled the establishment of a trusted partnership. It led to co-innovation through a technology transfer supported by SATT Ouest Valorisation.

The objective was to design an innovative, mobile-friendly solution to facilitate and secure sample reporting on building plans as part of on-site technical inspections. The IntuiNaxe application allows technicians to accurately record all sampling-related information directly onto building plans. The application relies on several AI-based approaches combined with a modelling system based on two-dimensional grammars—a language that describes the structural constraints of a drawing; for example, a door must necessarily be framed by two walls.

This highly innovative approach is generic and can be applied to any type of structured documents. It places a strong emphasis on user interaction, enabling intuitive content creation without the need for a keyboard, instead using a digital stylus and gesture-based commands.

Since January 2026, the application has been deployed in operational use and now enables simplification, increased reliability, time savings, and centralization of tasks for technicians within the Inaxe company.

3.5 External language models and rejection capabilities for text recognition in difficult conditions

Participants: Florent Meyer, Yann Soullard, Bertrand Coüasnon, Guillaume Gravier, Denis Coquenet, Laurent Guichard (ANTAI).

Effective license plate recognition systems are required to be resilient to constant change, as new license plates are released into traffic daily. While Transformer-based networks excel in their recognition at first sight, we observe significant performance drop over time which proves them unsuitable for tense production environments. Indeed, such systems obtain state-of-the-art results on plates whose syntax is seen during training. Yet, we show they perform similarly to random guessing on future plates where legible characters are wrongly recognized due to a shift in their syntax. After highlighting

the flows of positional and contextual information in Transformer encoder-decoders, we identify several causes for their over-reliance on past syntax. Following, we devise architectural cut-offs and replacements which we integrate into SaLT, an attempt at a Syntax-Less Transformer for syntax-agnostic modeling of license plate representations. Experiments on both real and synthetic datasets show that our approach reaches top accuracy on past syntax and most importantly nearly maintains performance on future license plates. We further demonstrate the robustness of our architecture enhancements by way of various ablations.

3.6 Projet AIR : Intuinote

Participants: Éric Anquetil, Bruno Hortollary, Pierre Beust, Nathalie Girard.

This project is part of the AMI initiative "Digital Demonstrators in Higher Education" / AIR Project – Increasing Interaction in Rennes, led by the University of Rennes.

Our objective is to finalize the design and conduct pilot testing of the "IntuiNote" solution: a digital environment for active learning in synchronous teaching contexts (both in-person and remote) involving the use of tablets in pedagogical settings. IntuiNote enables instructors, within a single tool, (1) to deliver presentations based on slides, documents, or images, (2) to annotate their materials by hand, and (3) to enrich the presentation on the fly through quiz-based interactions (both traditional and graphic).

The system was initially developed at INSA Rennes and subsequently served as a foundation for multiple research experiments conducted at the IRISA laboratory, in collaboration with the LP3C laboratory, which oversaw the experimental studies to assess its pedagogical potential.

In 2025, the project focused on developing a Flutter-based version of both the "student" and "teacher" clients in order to make the solution fully cross-platform.

3.7 DmosInDeep

Participants: Ali Yesilkanat, Bertrand Couäsnon.

This project is carried out within the CampuStart innovation and valorization scheme of Campus Innovation at the University of Rennes. It supports the maturation of research results with strong transfer potential toward academic and industrial applications.

Our objective is to finalize the DmosInDeep project: the integration of the DMOS method into the PyTorch ecosystem, together with a modern development environment based on Visual Studio Code. The project aims to make DMOS easier to install, test, and adopt by providing a Python-friendly packaging and build workflow, language support for EPF and Lambda Prolog, and debugging capabilities for development and experimentation.

DMOS is a software platform dedicated to the recognition and analysis of structured document images. It combines deep learning models with syntactic descriptions expressed in EPF, making it possible to design hybrid AI systems that require fewer annotated data while remaining effective on complex documents such as musical scores,

historical newspapers, archival records, and handwritten or printed administrative documents. The method has been developed through long-term research at IRISA and has already supported several collaborative projects and technology transfer initiatives.

In 2025, the project focused on refactoring the DMOS compilation and packaging chain, advancing the VS Code extension for EPF and Prolog Mali, and preparing the integration of DMOS capabilities into PyTorch in order to broaden access to the technology for both research and industrial users.

3.8 Self-Supervised learning for Handwritten Text Recognition

Participants: Noé Zhang, Yann Soullard, Bertrand Coüasnon, Denis Coquenet.

Handwritten Text Recognition (HTR) remains a challenging task due to the high variability in writing styles and the limited availability of labeled data. While self-supervised learning (SSL) mitigates annotation dependency, existing frameworks are largely restricted to word-level representations. This granular focus prioritizes local visual features at the expense of the global linguistic context vital for accurate transcription. Furthermore, while Vision Transformer (ViT) architectures offer superior feature extraction, their computational cost remains a barrier to scaling these SSL benefits to full-line processing. To address these challenges, we propose a novel self-supervised framework for line-level HTR based on a ConvNeXt-v2 architecture. Our approach first optimize the standard reconstruction objective by adapting the masking strategy and loss function to the specific constraints of handwritten text. We then leverage synthetic data to explicitly introduce linguistic features during pretraining, bridging the gap between visual patterns and language semantics. This two-stage strategy enables the model to learn more robust representation enhancing performance on downstream recognition tasks. We evaluate our model on standard HTR benchmarks (e.g, IAM, RIMES...), focusing on both Character Error Rate (CER) and Word Error Rate (WER) to demonstrate that this pretraining yields to better representation for downstream tasks compared to vision only baselines. This work provides a scalable pathway for enhancing HTR systems where labeled data is limited and serves as a step toward full-page self-supervised handwritten text recognition.

3.9 Automatic Grammar Extension for Multi-Stroke Recognition of Hand-Drawn Semi-Structured Sketches

Participants: Swan Serre, Eric Anquetil, Nathalie Girard.

Swan Serre's doctoral research focuses on the automatic extraction of grammars, or models, for analyzing and recognizing semi-structured sketches produced on a pen-based tablet. The model aims to analyze and subsequently guide the production of similar sketches. Within this framework, work has been carried out in collaboration with Islam Barchouch to improve IntuiSketch.

IntuiSketch's recognition engine is based on the Context-Driven Constraint Multiset Grammar combined with fuzzy logic and the classifier Evolve, which learns from few examples, to recognize handwritten semi-structured sketches on the fly. However, in

real-world conditions, semi-structured sketches are often drawn using multiple strokes rather than a single one. Therefore the number of strokes composing an entity becomes unpredictable, especially since pen lifting is common when using pen-based tablets, and the shape of each stroke is variable.

To address these challenges, we propose a hybrid recognition approach that extends the CD-CMG formalism to support multi-stroke analysis. The refined IntuiSketch system is evaluated using anatomical sketches to demonstrate its ability to accurately interpret multi-stroke sketches. This work highlights the adaptability of IntuiSketch to the diverse drawing behaviours of students, reinforcing its applicability in real-world educational contexts.

Also added temporal feedback to the pedagogical engine, and presented the results at the IGS 2025 conference in Montreal [7], and the extended article was submitted in 2026.

4 Software development

4.1 Software development

In addition, the team contributed to the following pieces of software.

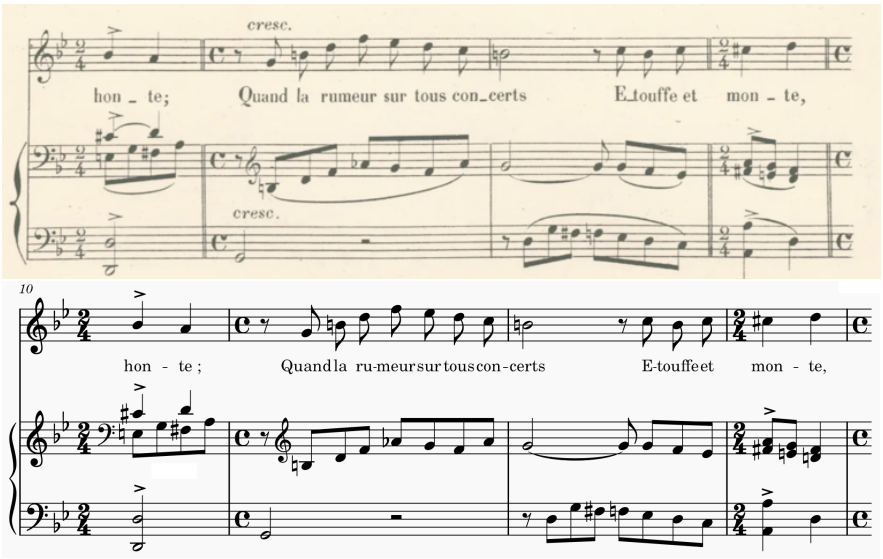

Figure 2: OMR Collabscore - example of recognition with frequent metric change: original image (Gallica link) and produced results. Note the new G Clef at the beginning of measure 2

4.1.1 Collabscore OMR

Participants: Aurélie Lemaitre, Bertrand Coüasnon, Jean Camillerapp.

The Collabscore Optical Music Recognition (OMR) system (see section 3.1) can rec-

ognize polyphonic music scores spanning multiple pages, and enables the generation of an editable document encoded in MEI or MusicXML. An example of recognition is presented in Figure 2.

4.1.2 IntuiNaxe application

The IntuiNaxe application allows technicians to accurately record all sampling-related information directly onto building plans. The application relies on several AI-based approaches combined with a modelling system based on two-dimensional grammars—a language that describes the structural constraints of a drawing; for example, a door must necessarily be framed by two walls.

This highly innovative approach is generic and can be applied to any type of structured documents. It places a strong emphasis on user interaction, enabling intuitive content creation without the need for a keyboard, instead using a digital stylus and gesture-based commands.

The IntuiNaxe software results from a collaborative research agreement between the company Inaxe and the Shadoc team of the IRISA laboratory.

Since January 2026, the application has been deployed in operational use and now enables simplification, increased reliability, time savings, and centralization of tasks for technicians within the Inaxe company.

It is available for free on the website of the Shadoc team[1], under agreement with the terms of the CLIC license.

4.1.3 Modular Light Transformer

The Modular Light Transformer (MLT) is a software dedicated to text recognition. The proposed software is a Python code using in particular the PyTorch library to train and evaluate models and to solve handwriting recognition tasks. The code includes: neural network architectures based on the Transformer model; pre-trained models for direct use and the associated code for performing data training and/or prediction. Models have been trained using both real data and synthetic textline images.

It is available for free on the website of the Shadoc team[2], under agreement with the terms of the CLIC license.

4.1.4 Synthetic Text line Image Generator

The Synthetic Text line Image Generator (STIG) is a software dedicated to handwritten textline generation. The Synthetic Text line Image Generator is a Python code dedicated to the generation of synthetic handwritten textline images. The software can generate textlines looking like modern or historical documents. It has been developed in parallel of The Modular Light Transformer. The proposed software is a Python code for generating synthetic handwriting with realistic deformations.

[1] `https://www-shadoc.irisa.fr/modular-light-transformer/#getMLT`
[2] `https://www-shadoc.irisa.fr/modular-light-transformer/#getMLT`

It is available for free on the website of the Shadoc team[3], under agreement with the terms of the CLIC license.

4.1.5 New public datasets

Several public datasets have been make available for free on the website of the Shadoc team[4]:

- LPR-MNIST dataset: a synthetic dataset replicating the key aspects of syntax evolution on vehicle license plates, as explored in the paper Relaxed syntax modeling in Transformers for future-proof license plate recognition. LPR-MNIST is a collection of 100,000 synthetic image-text pairs, generated by concatenating 5 black-and-white digits from MNIST, each padded to 32 x 32. 32 pixels of zero-padding are then randomly shared between the left and right sides of the assembled image to mimic the natural variability in the absolute position of characters on real plates. Thus, resulting images have a shape of 32 x 192. Labels are drawn from '00000' to '99999' such that each possible combination is represented once. For each digit in a given label, the MNIST image is then randomly picked among all instances of this digit. It is available under agreement with the terms Creative Commons Attribution-Share Alike 4.0 license.
- IRISA-KIHT-S and KIHT-public Datasets: two datasets for handwriting trace reconstruction from IMU sensors embedded in the digital pen called Digipen. These datasets are composed of 30 recordings for the IRISA-KIHT-S dataset and 149 recordings for the KIHT-Public datasets. Every recording session generates files from the data acquisition mobile app. The sensor signals file has 13 columns: milliseconds, accelerometer front (x, y, z), accelerometer rear (x, y, z), gyroscope (x, y, z), magnetometer (x, y, z), and force signals. Tablet signal files contain milliseconds, position coordinates (x, y, z), and pressure force signals. The transcription (labels) file contains labels and the start and stop time-stamps for every sample. Additional files concerning the sensor calibration and recording meta data are provided. It is available under agreement of using them for research purposes.

4.1.6 Automatic edition of Journals on 18th century soldiers

Participants: Ivan Leplumey, Yann Ricquebourg.

The "Revues sur les soldats du XVIII^{e} siècle" (Journals on 18th-century soldiers) project involves a direct collaboration with the "Mémoire des Hommes" website[5], the cultural portal of the French Ministry of the Armed Forces, and up to 60 departmental archives. We use manual annotations of old documents to create several types of digital journals able to evolve: the first of a geographical type for associations and departmental archives, the second of a regimental type for the "Mémoire des Hommes" website or for the ten annotators taking part in the project (see Figure 3).

[3] https://www-shadoc.irisa.fr/synthetic-textline-image-generator/#getSTG
[4] https://www-shadoc.irisa.fr/synthetic-textline-image-generator/#getSTG
[5] https://www.memoiredeshommes.defense.gouv.fr

Figure 3: (a) Cover of the Aindinians soldiers under the Ancien Régime journal produced with the Ain departmental archives, (b) Cover of the Colonel-Général regiment journal, (c) Cover of the Bretillian soldiers under the Ancien Régime journal produced with the Cercle Généalogique d'Ille-et-Vilaine, (d) Cover of the Troop control and matriculation registers

These reviews, produced in LaTeX, mainly contain ordered lists of soldiers linked to their original image on the web by hypertext links. Regimental histories, statistics and indexes complete the content of these journals. To date, the project has produced 130 journals, 42 of them geographical, totaling 40,000 pages.

5 Contracts and collaborations

5.1 International Initiatives

5.1.1 French-German bilateral ANR project in artificial intelligence (KIHT - Kaligo-based Intelligent Handwriting Teacher)

Participant: Éric Anquetil, Yann Soullard, Florent Imbert.

- Project type: French-German bilateral ANR project KIHT - Kaligo-based Intelligent Handwriting Teacher
- Dates: 2021–2025
- Role : We are the project leader of the french part.
- PI institution: IRISA (French part - ANR) and Stabilo (German Part - BMBF)
- Other partners: STABILO International GmbH, Karlsruher Institut für Technologie Institut für Technik der Informations verarbeitung, LearnAndGo company, Romain Tavenard (IRISA).

In this project, we design a new intelligent device to help learning handwriting in classrooms. The originality of the project consists in designing a new handwriting capture device developed by the company STABILO which embedded AI technologies to get the digital trace of handwriting.

The Stabilo company has the task of designing the digital pen, equipped with kinematic sensors (inertia measurement units (IMUs)), that allows writing on any surface (screen and paper). The German laboratory KIT is responsible for hardware developments to embed the AI algorithms developed. On our side, we are working, through a thesis and a post-doc, on the design of an original and powerful deep neural network architecture to automatically synthesize the online handwriting from the kinematic signals produced by the digital pen sensors.

Our work has resulted in several publications in peer-reviewed international conferences and journals, including two in common with the German partners.

5.2 National Initiatives

5.2.1 ANR CollabScore: Shared spaces for digital music scores

Participant: Bertrand Coüasnon, Aurélie Lemaitre, Yann Soullard, Ali Yesilkanat, Jean Camillerapp, Nathalie Girard, Denis Coquenet.

- Project type: ANR CollabScore

- PI institution: CNAM
- Other partners: Cnam, INSA, BnF, Antescofo, IReMus, Fondation Royaumont
- 56 months (2021–2025)
- Contract: INSA

The project is dedicated to the collaborative digitization of music scores currently available only as images in museum collections. It will combine OMR (Optical Music Recognition) and a crowdsourcing correction phase of remaining recognition errors. A reconciliation step of the different versions will be automated with specifically developed software, to obtain a reference score. This fulcrum notation will then be used in conjunction with several sources, to enhance the user experience. For instance, listening could be assisted by the synchronized scrolling of the score, and augmented with musicological annotations. The project aims at solving some scientific challenge, first by guiding and controlling an OMR process with musical knowledge, then by elaborating an automated crowdsourcing process.

5.2.2 ANR SKETCH : Sketches analysis and interpretation for the design of an intelligent tutorial system for medical studies

Participant: Éric Anquetil, Nathalie Girard, Islam Barchouch.

- Role : LP3C is the project leader, we are scientific leader of the AI part.
- Partner: *LP3C*, *IFPS*, *IFPEK*, *INSA*
- 42 months (2022-2026).
- Contract: INSA

Several recent studies have demonstrated that educational activities based on drawing can have positive effects on the learning of scientific concepts. The advent of innovative devices such as pen-based tablets means that new types of scaffolding involving artificial intelligence can now be designed and assessed. This opens up interesting avenues of research, as these devices make it possible to provide learners not only with support that can be parameterized by the instructor, but also with automatic and personalized realtime feedback during the drawing task.

The twofold aim of the SKETCH project is to 1) collaboratively design an intelligent tutoring system (ITS) that can analyze learners' actions in real time during the freehand production of a complex scientific drawing on a tablet, and 2) assess and optimize the effects of this system and the feedback it provides on learning. This project will be carried out jointly by two research teams in Rennes (France): the Psychology, Cognition, Behavior & Communication Laboratory (LP3C), and the ShaDoc (IntuiDoc) team at the Computer Science Laboratory (IRISA). It will focus on drawing activities intended to enhance learning about anatomy. Two of the partners in the project are paramedical colleges: IFPEK and IFPS. This will allow instructors and students to be involved in the project.

5.2.3 ANR(e-Fran) TRIANGLE : Working with Intelligent Feedback from a Digital Geometry Application for Student Engagement

Participant: Éric Anquetil, Nathalie Girard, Sarah Bucquet, Erell Choulette.

- Role: LP3C is the project leader, we are scientific leader of the AI part.
- Partner: *LP3C*, *Rennes and Poitiers academies*, *Rennes and Niort INSPE*, *INSA*
- 2022-2025.
- Contract: INSA

The objective of the TRIANGLE project is to consolidate the IntuiGéo application (intelligent tutorial system for geometry learning assistance on a tablet with a pen) by improving the impact of correction and guidance feedbacks, notably by adding a virtual pedagogical agent. We will also study the effects of this type of assistance on students' performance and engagement. Finally, in terms of dissemination, evaluation studies will be conducted in two academies. The deployment of a free multi-platform version in schools is planned at the end of the project. The consortium is made up of a research team in computer science (ShaDoc (IntuiDoc)/IRISA, Rennes), a research team in psychology and ergonomics of learning (LP3C, Rennes), two INSPEs in close collaboration with the Academic Delegations for Digital Education (DANe) in two academies (Rennes and Poitiers).

5.2.4 AMI "Digital demonstrators in higher education" / AIR project-Increasing Interaction in Rennes

Participant: Éric Anquetil, Nathalie Girard, Bruno Hortollary.

- Role : Univ Rennes is the project leader, we are member of the consortium
- Partners: Univ. Rennes, INSA, Univ. Rennes 2
- 2022-2025
- Contract: INSA

In this project we will consolidate and experiment in collaboration with the LP3C (UR2) and the University of Rennes, the KASSIS software suite which is a digital device we designed for pen based tablets to support synchronous active learning in class and remotely.

5.2.5 PEPR IA Adapting

Participant: Denis Coquenet, Bertrand Coüasnon, Yann Soullard, Noé Zhang.

- Project type: PEPR IA
- 36 months (2025–2028)
- Contract: University of Rennes

PhD of Noé Zhang funded by the PEPR IA Adapting on "Self-adaptive handwriting recognition using self-supervised learning".

Current activities are described in section 3.8.

5.3 Regional Initiatives

5.3.1 Maturation project DmosInDeep

Participant: Ali Yesilkanat, Bertrand Coüasnon.

- Funding: *CampuStart - Campus Innovation of the University of Rennes*
- 12 months (2025-2026)
- Contract: INSA

Development of a complete development environment for the DMOS method in Visual Studio Code and integration into the PyTorch deep learning framework, in order to simplify the combination of syntactic and deep learning methods and facilitate the adoption of the DMOS method. CampuStart project funded by Campus Innovation of the University of Rennes.

Current activities are described in section 3.7.

5.4 Bilateral industry grants

5.4.1 Research contract Inaxe company

Participant: Éric Anquetil, Bruno Hortollary.

- Partners: *Inaxe company*
- 2023-2025
- Contract: INSA Rennes

Following on from a 1st transfer with the company Inaxe in 2018, we have launched a new research and transfer contract with the same company in 2023 and 2025. The aim is to design a new pen-based application on a Windows tablet based on AI Technologies of our research Team (DALI, Evolve...) for freehand transfer (gesture recognition) of asbestos and lead surveys on building plans. This transfer work led in 2023 and 2025 to an APP registration and a licence with the company. The software was enhanced in 2024 and 2025 with new interpretation features and is used daily in the field by 25 INAXE technicians as part of 8,000 building inspections per year

5.4.2 Research contract ANTAI (CIFRE)

Participant: Yann Soullard, Bertrand Coüasnon, Guillaume Gravier, Denis Coquenet.

- Partners: *ANTAI*
- Since 2023
- Contract: INSA

Shadoc team works with the ANTAI national agency on text recognition by reducing syntactic bias modeling and integrating knowledge into models. This work is applied to license plates and handwritten documents. This collaboration is based on a CIFRE grant for the PhD of Florent Meyer.

Current activities are described in section 3.5.

6 Dissemination

6.1 Promoting scientific activities

6.1.1 Scientific Events Organization

General Chair, Scientific Chair

- A. Lemaitre organized the Artist&Scientist seminar, at IRISA, on December11$^{\text{th}}$ 2025.

6.1.2 Scientific Events Selection

Member of Conference Program Committees

- B. Coüasnon is senior member of the program committee of the International Conference on Document Analysis and Recognition (ICDAR 2025)
- A. Lemaitre is member of the program committee of the International Conference on Document Analysis and Recognition (ICDAR 2025)
- E. Anquetil and N. Girard are members of the program committee of the International Conference of the International Graphonomics Society (IGS 2025)
- D. Coquenet is member of the program committee of the 28th European Conference on Artificial Intelligence (ECAI 2025).

Reviewer

- D. Coquenet is reviewer for the Workshop on Machine Learning of the International Conference on Document Analysis and Recognition (WML@ICDAR) in 2025.
- N. Girard is reviewer for the International Conference of the International Graphonomics Society (IGS 2025)

6.1.3 Journal

Reviewer - Reviewing Activities

- A. Lemaitre, D. Coquenet, B. Coüasnon and Y. Soullard are reviewers for the International Journal on Document Analysis and Recognition (IJDAR) in 2025.
- D. Coquenet is reviewer for the Image and Vision Computing (IMAVIS) journal in 2025.
- D. Coquenet is reviewer for IEEE Transactions on Image Processing (TIP) in 2025.
- D. Coquenet is reviewer for IEEE Transactions on Multimedia (TMM) in 2025.
- D. Coquenet is reviewer for IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI) in 2025.
- Y. Soullard is reviewer for Neural Processing Letters (NPL) in 2025.
- Y. Soullard is reviewer for Neurocomputing in 2025.

6.1.4 Invited Talks

- E. Anquetil, November 2025: invited to the e-FRAN-Transfert Symposium, Paris, 'Working with Intelligent Feedback from a Digital Geometry Application for Student Engagement'.
- P. Beust, 11/03/2025, invited to Forum des interconnectés, Couvent des Jacobins (Rennes), "Mise en place d'une IA de confiance par l'université de Rennes".
- P. Beust, 06/03/2025, Formation des nouveaux maitres de conférences, PNRB (Rennes), "IA générative".
- P. Beust, 20/03/2025, invited to Séminaire AREN "Actualité de la Recherche en Éducation sur le Numérique", PNRB (Rennes), "RAGaRenn : pour une IA souveraine et maîtrisée".
- P. Beust, 27/05/2025, invited to Séminaire DRANE, Quimper (Finistère), "L'IA pour les étudiants ; expérimentations dans l'ESR".

- P. Beust, 03/06/2025, invited to Séminaire MEGALIS, Pont-l'Abbé (Finistère), "IA souveraine. Mise en place à l'université de Rennes".
- P. Beust, 04/06/2025, invited to Séminaire PIA BRIO, Campus Beaulieu (Rennes), "Quelles intégrations des IA génératives dans les parcours de lycéens et d'étudiants ?".
- P. Beust, 05/06/2025, invited to Séminaire Pépites, Campus Beaulieu (Rennes), "L'IA générative à l'université de Rennes".
- P. Beust, 16/06/2025, invited to EducWeek EDUC, Campus Beaulieu (Rennes), "Higher Education in the advent of AI".
- P. Beust, 18/06/2025, invited to Rencontres annuelles du collége des pathologistes, Hopital Saint Antoine AP-HP (Paris), "IA et pratiques pédagogiques".
- P. Beust, 18/06/2025, invited to Séminaire des directeurs de services de l'EPE U. de Rennes, Campus Beaulieu (Rennes), "L'IA générative pour les personnels".
- P. Beust, 24/06/2025, invited to Seminaire CIFCB, IUT de Rennes, "RAGARENN et l'IA par l'Université de Rennes".
- P. Beust, 25/06/2025, invited to Journée "IA et Pédagogie" ISTIC, Campus Beaulieu (Rennes), "IA et pédagogie. Pistes pour éclairer le débat".
- P. Beust, 26/06/2025, invited to Journée pédagogique de l'ISTIC, Campus Villejean (Rennes), "L'IA générative pour les étudiants".
- P. Beust, 03/07/2025, invited to Colloque ADGS, U. de Montpellier, "Atelier IA".
- P. Beust, 28/08/2025, invited to Journée rentrée ENSCR, Campus Villejean (Rennes), "L'IA pour les enseignants".
- P. Beust, 01/10/2025, invited to Journée de la donnée territoriale, Lycee agricole de Pontivy, "IA de confiance".
- P. Beust, 13/10/2025, invited to Journées IRISA DYLISS Team Seminar, "Utiliser L'IA et le RAG".
- P. Beust, 21/10/2025, invited to Journées EAFC, Académie de Rennes, "L'IA dans le domaine de la formation".
- P. Beust, 16/10/2025, invited to Formation des nouveaux maitres de conférences, PNRB (Rennes), "L'IA à l'université de Rennes".
- P. Beust, 27/11/2025, Talk to teachers of IUT of Lannion, IUT de Lannion, "L'IA dans la pédagogie".
- P. Beust, 04/12/2025, invited to round table "Créer, se developper, se transformer à l'heure de l'IA" at the Imagine Summit, Couvent des Jacobins (Rennes), "L'IA à l'université de Rennes".
- P. Beust, 05/12/2025, invited talk, Lycée Assomption Rennes, "IA et pédagogie".

- B. Coüasnon, 10/10/2025, invited talk, "DMOS : une plateforme hybride Deep-Syntaxique pour la reconnaissance de documents" in the webinar "De la vision par ordinateur aux LLM : que vaut vraiment l'OCR aujourd'hui", organized by Institut Louis Bachelier.

6.1.5 Leadership within the Scientific Community

6.1.6 Scientific Expertise

- A. Lemaitre was a member of a recruitment committee of full professor at La Rochelle Université (June 2025).

6.1.7 Research Administration

- Shadoc members are members of the AFRIF (Association Française pour la Reconnaissance et l'Interprétation des Formes) and IAPR (International Association for Pattern Recognition) associations.
- E. Anquetil is a member of the educational committee of the "DIGISPORT" University Research School (EUR).
- E. Anquetil is project manager for "Innovation and Entrepreneurship" at INSA Rennes.
- E. Anquetil is the manager of the incubator for innovative projects at INSA Rennes.
- E. Anquetil is the co-manager of the inter-institutional student incubator for innovative projects from 10 higher education institutions in Rennes: Station Rennes Innovation.
- E. Anquetil is an elected member of the administration council of INSA Rennes.
- E. Anquetil is a member of the administration council of INSA Group Foundation.
- E. Anquetil is a member of the « Science-Society committee » of TISSAGE Project.
- B. Coüasnon is the head of the computer science lab of INSA Rennes (INSA component of IRISA) until August 2025 (about 65 scientists, including 21 faculty members).
- B. Coüasnon is an elected member of the scientific council of INSA Rennes until August 2025.
- B. Coüasnon is an elected member of the computer science lab council of INSA Rennes (INSA component of IRISA) until August 2025.
- B. Coüasnon is member of the laboratory council of IRISA until August 2025.
- B. Coüasnon and N. Girard are members of the Gender Equality Commission of IRISA.
- B. Coüasnon is member of the board of Valconum (Centre Européen de Valorisation Numérique).
- D. Coquenet is vice-president of the society GRCE : " Groupe de Recherche en Communication Écrite ".
- N. Girard, A. Lemaitre and Y. Soullard are elected members of the executive committee of the society GRCE : " Groupe de Recherche en Communication Écrite ".
- N. Girard is an elected member of the administration council of UFR ISTIC, Univ. of Rennes.

- A. Lemaitre is responsible for the Arts, Culture and Heritage transversal theme at IRISA.
- Y. Ricquebourg is an elected member of the scientific council of INSA Rennes.

6.2 Teaching, supervision

6.2.1 Teaching

The team is mainly made up of teachers who are very implied in activities of teaching. But a majority of lectures are not attached to this research topic, so they are not mentioned here.

- E. Anquetil is program manager of the MASTER OF SCIENCE *"Innovation and Entrepreunership"* of INSA and Rennes School of Business (RSB).
- E. Anquetil, N. Girard and D. Coquenet give lectures at *Research in Computer Science (SIF)* MASTER of University of Rennes, University of Southern Brittany, ENS Rennes, INSA Rennes and CentraleSupélec.
- E. Anquetil is in charge of the module "Analysis, Interpretation and Recognition of 2D (touch) and 3D Gestures for New Man-Machine Interactions" (AIR) of the *Research in Computer Science (SIF)* MASTER of University of Rennes, University of Southern Brittany, ENS Rennes, INSA Rennes and CentraleSupélec.
- E. Anquetil is in charge of the module "Motion Analysis and Gesture Recognition (2D / 3D)" (AMRG) of the COMPUTER SCIENCE DEPT. of INSA Rennes.
- B. Coüasnon is program manager of the *International EIT Data Science* MASTER 1 of EIT Digital Master School, ISTIC, University of Rennes.
- B. Coüasnon is in charge (with M. Babel) of the module "Image & Video Analysis" (TIV) of the COMPUTER SCIENCE DEPT. *(Medias & Interactions section)* of INSA Rennes.
- B. Coüasnon is in charge of the module "Symbolic Data Mining" (FSY) of the *MIAGE and EIT* MASTER of ISTIC, University of Rennes.
- N. Girard is in charge (with L. Guého - PEMI, MSHB) of the module "Graphical User Interaction" (GUI) of the *Software Engineering* MASTER of ISTIC, University of Rennes.
- N. Girard is in charge (with A. Termier) of the module "Machine Learning Formel – Data mining" (MLF) of the *Artificial Intelligence* MASTER of ISTIC, University of Rennes.
- N. Girard is in charge of the module "Analyse Descriptive et Exploratoire de Données" (ASED) of the *Artificial Intelligence* MASTER of ISTIC, University of Rennes.
- Y. Ricquebourg and E. Anquetil are in charge of the module "Recognition and Interpretation of Images & Videos" (RIV) of the COMPUTER SCIENCE DEPT. *(Medias & Interactions section)* of INSA Rennes.
- Y. Soullard is in charge of the part "Text Mining and Deep Learning" of the module "Introduction to the Text Mining" at MASTER MAS *(Applied Mathematics, Statistics (Data Science))* of Rennes 2 University.
- Y. Soullard is in charge of the part "Deep Learning for Sequential Analysis" of the module "Deep Learning" of the SNS MASTER *(Sciences du Numérique et du Sport)* of the University Research School (EUR) DIGISPORT (Digital and Sport Sciences).

- Y. Soullard is in charge of the module "Data Mining & Clustering" of the SNS MASTER *(Sciences du Numérique et du Sport)* of the University Research School (EUR) DIGISPORT (Digital and Sport Sciences).
- P. Beust is Director of the SUPTICE : pedagogical support service at the University of Rennes (https://suptice.univ-rennes.fr/).

6.2.2 Supervision

- PhD in progress: N. Zhang, Self-adaptive Handwriting Recognition using Self-Supervised Learning, B. Coüasnon, Y. Soullard, D. Coquenet, started February 2025.
- PhD in progress: S. Serre, Semi-supervised learning of an intelligent tutorial system for e-education through the production of drawings/sketches, E. Anquetil, N. Girard, started October 2024.
- PhD in progress: I. Barchouch, Intelligent tutorial system for sketch-based learning (SKETCH), E. Anquetil, N. Girard, defended December 2025.
- PhD in progress: F. Meyer, External language models and rejection capabilities for text recognition in difficult conditions, B. Coüasnon, G. Gravier, Y. Soullard, L. Guichard (ANTAI), INSA Rennes, started June 2023.

6.2.3 Juries

- E. Anquetil was member in the thesis committee of Yejing XIE's PhD, Handwritten Mathematical Expression Recognition with Graph Neural Networks and Tree-based Language Models, Nantes Unniversity, December 2025.
- A. Lemaitre was president in the thesis committee of Lydia Rodriguez de la Nava, Automatic music transcription of symbolic and polyphonic performances, CNAM, Paris, Septembre 2025.
- A. Lemaitre was member of the thesis committee of Benno Uthayasooriyar's PhD, Insurance Document Understanding with Transformers based Language Models, Université de Bretagne occidentale, November 2025.
- P. Beust was examinator (Dir of research) of the PhD committe of A. N. E. Sahbi, Peuplement automatique d'ontologies à partir d'approches hybrides (LLM et sémantiques), University of Caen Normandy, 18 november 2022.
- P. Beust was president in the thesis committee of Mathieu Risy, Scenario authoring model for Virtual Reality Training Systemes with variability : A pedagogy-oriented approach, INSA de Rennes, 8 december 2025.
- B. Coüasnon is member of mid-term evaluation committee of the PhD candidate: Koffi Amezouwui (ENSAI, CREST).
- B. Coüasnon is member of mid-term evaluation committee of the PhD candidate: François Wieckowiak (INSA Lyon, LIRIS).
- B. Coüasnon is member of mid-term evaluation committee of the PhD candidate: Eliott Thomas (La Rochelle University, L3i).

6.2.4 Patent and Deposit of digital creations (APP)

- E. Anquetil, B. Hortollary deposited (APP) the IntuInaxe App V3.1 in octobre 2025: IntuiNaxe - IDDN.FR.001.410025.000.S.A.2025.000.10000.

6.3 Popularization

- B. Coüasnon, 02/12/2025, invited micro-talk "Comment les IA hybrides facilitent la lecture de partitions anciennes ?" in Échappées Inattendues du CNRS « Sciences en musique ».
- A. Lemaitre and B. Coüasnon were interviewed in december 2025 for the magazine "Opera magazine" : "L'opéra frappe les trois coups de l'IA", Jean-Marc Proust.

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[3] P. Beust, "Lieux, évaluations, intelligence artificielle : Trois questions pour penser les environnements de formation de demain.", *Distances et Médiations des Savoirs 52*, 2025, https://hal.science/hal-05413501.

[4] F. Imbert, E. Anquetil, Y. Soullard, R. Tavenard, "Mixture-of-experts for handwriting trajectory reconstruction from IMU sensors", *Pattern Recognition 161*, 2025, p. 111231, https://hal.science/hal-04811975.

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[8] F. Imbert, Y. Soullard, E. Anquetil, T. Harbaum, A. Serdyuk, F. Kress, T. Hamann, P. Kämpf, "Write on Paper and Get the Online Digital Trace: A New Era for Handwriting", *in : IGS 2025 - 22nd Conference of the International Graphonomics Society*, Montréal (Québec), Canada, June 2025, https://hal.science/hal-05251666.

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Miscellaneous

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