

Research internship

Title : *Generative Model for multivariate time series. Application on aircraft engine*

Keywords: Generative Models; Deep Learning; Multivariate Time Series

1 Context

In this research internship, we aim to test the feasibility of a modern neural methodology based on the generative model, which has been successfully applied to text/image processing. The field of video generation technology has seen significant advancements, with modern models capable of producing highly realistic videos [1, 4, 5]. Drawing an analogy to this, studying the life cycle of an aircraft engine can be viewed similarly to creating a video. In this analogy, each frame represents a distinct flight undertaken by the aircraft, during which multiple continuous parameters forming multivariate time series data. Each multivariate time series can be compared to a frame in a video, reflecting the dynamic states of the aircraft engine during the respective flight.

2 Objectives

The aim of this research internship is to strengthen collaboration with Safran.

- Study the current state of the art in deep generative model and multivariate time series,
- By sequentially analyzing this collection of parameters flight after flight, akin to stringing together video frames, we can create a detailed and comprehensive depiction of the aircraft engine's life cycle, allowing for the identification of behavioral patterns, anomalies and providing predictive insights into the engine's performance and longevity.
- Based on previous studies [2, 3], implement one or more algorithms/architectures. The results obtained during the internship may lead to contributions to open-source software, or even a scientific publication, depending on the intern's skills and motivation.

3 Requirements and skills

End of engineering degree, M1/M2 in data science, statistics, artificial intelligence, or computer science. Excellent understanding of machine learning basics, particularly deep learning models. Excellent programming skills, especially with tensorflow/keras.

Internship location and duration

The internship will be in the DAVID Lab at the University of Versailles - Paris Saclay University. Duration: 5 months

Supervisor team

Abdellah Madane (PhD student at Safran Aircraft Engine). Mustapha Lebbah (PR at DAVID Lab, UVSQ, Paris-Saclay University) and collaboration with Sorbonne Paris Nord University.

How to apply

To apply, simply attach: your current Curriculum Vitae (CV). Your motivation for the position. Your latest university transcripts. Send it all by email to: mustapha.lebbah@uvsq.fr, abde.madane@gmail.com, with subject [internship MTS24]

References

- [1] P. Esser, R. Rombach, and B. Ommer. Taming transformers for high-resolution image synthesis, 2020.
- [2] F. Forest, Lebbah, Mustapha, H. Azzag, and J. Lacaille. Deep embedded self-organizing maps for joint representation learning and topology-preserving clustering. *Neural Computing and Applications*, 33(24):17439–17469, 2021.
- [3] A. Madane, M. D. Dilmi, F. Forest, H. Azzag, M. Lebbah, and J. Lacaille. Transformer-based conditional generative adversarial network for multivariate time series generation. In *International Workshop on Temporal Analytics. The Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD)*, 2023.<https://github.com/unsupervise/MTS-CGAN>.
- [4] A. van den Oord, O. Vinyals, and K. Kavukcuoglu. Neural discrete representation learning. In I. Guyon, U. von Luxburg, S. Bengio, H. M. Wallach, R. Fergus, S. V. N. Vishwanathan, and R. Garnett, editors, *Advances in Neural Information Processing Systems 30: Annual Conference on Neural Information Processing Systems 2017, December 4-9, 2017, Long Beach, CA, USA*, pages 6306–6315, 2017.
- [5] L. Yu, Y. Cheng, K. Sohn, J. Lezama, H. Zhang, H. Chang, A. G. Hauptmann, M.-H. Yang, Y. Hao, I. Essa, and L. Jiang. Magvit: Masked generative video transformer, 2023. <https://magvit.cs.cmu.edu>.