Internship opprtunity : AI and sports

Cautious Neural Networks for Return To Play Prediction

Context :

Machine Learning (ML) algorithms are increasingly being used in sensitive fields such as finance, education, and healthcare. Neural networks are no exception, being used for object detection in autonomous vehicles [1,2] as well as to assist physicians [3]. Consequently, more and more research is emerging in the area of trustworthy AI, particularly concerning uncertainty quantification. It is especially important to quantify the uncertainty of neural networks since they have been shown to suffer from overconfidence [3,4] (they often assign confidence levels that are too high relative to the ground truth). Indeed, neural networks output scores (softmax) between 0 and 1 that look like probabilities but are not, and can therefore be poorly calibrated. To address this issue, several methods have been developed to approximate neural network uncertainty, including deep ensembles, Monte Carlo dropout, and Bayesian neural networks [5].

Objectives :

In this context, the first goal of the project is to understand these methods in depth in order to identify their respective strengths and weaknesses, and then explore a new approach to cautious neural networks, possibly using more advanced uncertainty quantification techniques (imprecise probabilities, mass functions, fuzzy logic, etc.) [6].

The second goal of the internship is applied research: studying the specific case of sports injuries and Return To Play (RTP). RTP refers to the period during which an athlete is unavailable due to injury and is a key element for decision-makers (rehabilitation planning, return to competition, potential recruitment, etc.).
This study will use data from injured players gathered from *Transfermarkt*, including:

- Injury-related information: type of injury, duration of unavailability, number of matches missed, etc.
- Player-related information: position, dominant foot, height, age, nationality.

This cross-sectional study complements an ongoing longitudinal study.
From a statistical perspective, these data are highly valuable as they may help identify trends in professional football injuries. For example, one might verify the increase in hamstring injuries, which has already been shown to be rising sharply [7]. In addition, correlations with player characteristics can be explored (e.g., *Are defenders more likely than midfielders to suffer hamstring injuries? Are right-footed players more prone to right-leg injuries?*).
Finally, the collected data will be used to predict a player's unavailability duration using the cautious neural networks previously developed and implemented.

Profile sought :

We are looking for a M2 student or equivalent with strong skills in mathematics, machine learning, and data analysis. An interest in sports and experience in this field is strongly recommended. The candidate should also have a good command of English to read research articles and communicate their results effectively.

Practical information :

- **Duration** : 6-month internship starting early 2026
- **Location** : EuroMov DHM, 700 Av. du Pic Saint-Loup, 34090 Montpellier, France
- **Salary** : approximately €650/month (the legal public-sector rate is €4.35/hour)

- **Supervisors** : Théo Dupuy (IMT Mines Alès, EuroMov DHM) and Abdelhak Imoussaten (IMT Mines Alès, SyCoIA)

Application :

Applications should be sent to theo.dupuy@mines-ales.fr and abdelhak.imoussaten@mines-ales.fr.
They must include:

- A CV
- A motivation letter describing your interest and ideas for the project
- Transcripts from the last two academic years
- Optionally, recommendation letters from former professors or supervisors

Bibliography :

[1] Badue, C., Guidolini, R., Carneiro, R.V., Azevedo, P., Cardoso, V.B., Forechi, A., Jesus, L., Berriel, R., Paixão, T.M., Mutz, F., de Paula Veronese, L., Oliveira-Santos, T., De Souza, A.F.: *Self-driving cars: A survey.* Expert Systems with Applications 165, 113816 (2021).
[2] Grigorescu, S., Trasnea, B., Cocias, T., Macesanu, G.: *A survey of deep learning techniques for autonomous driving.* Journal of Field Robotics 37 (2019).
[3] Lundervold, A.S., Lundervold, A.: *An overview of deep learning in medical imaging focusing on mri.* Zeitschrift für Medizinische Physik 29(2) (2019)
[4] Nguyen, A., Yosinski, J., Clune, J.: *Deep neural networks are easily fooled: High confidence predictions for unrecognizable images.* In: Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. IEEE (2015).
[5] Wang, C.: *Calibration in Deep Learning: A Survey of the State-of-the-Art* (May 2024).
[6] Wang, K., Cuzzolin, F., Manchingal, S.K., Shariatmadar, K., Moens, D., Hallez, H.: *Credal Deep Ensembles for Uncertainty Quantification.* In: Advances in Neural Information Processing Systems. Curran Associates, Inc. (2024).
[7] Ekstrand, J., Bengtsson, H., Waldén, M., Davison, M., Khan, K.M., Hägglund, M.: *Hamstring injury rates have increased during recent seasons and now constitute 24% of all injuries in men's professional football: the UEFA Elite Club Injury Study from 2001/02 to 2021/22.* British Journal of Sports Medicine 57(5), 292–298 (2023).