

## **Recognition of Sport Gestures with Hierarchical Deep NNs**

### **Research Internship proposal**

Tutors : J. Benois-Pineau, A. Zemmari

Artificial intelligence (AI) methods are currently used in all areas of societal activity. Its new tools, deep learning networks combined with sufficiently large and diversified learning data sets, generate performance that allows these methods to be used for concrete applications.

The consortium composed of LABRI (UMR 5800), IMS (UMR 5218)/Faculty of Sports of the University of Bordeaux and MIA (EA3165) of the University of La Rochelle is conducting research aimed at developing methods using deep learning networks for the recognition of sporting gestures. The field of application is the training of athletes and the training of students at the Faculty of Sports of the University of Bordeaux. The research is applied to a particular sport, table tennis, for which the University of Bordeaux is a centre of excellence at the national level. The methods already developed[1,2,3] concern the recognition of table tennis strokes in a series of exercises, performed by volunteer athletes. The AI methods used are 3D convolutional neural networks (2D+T).

On the methodological level, as far as AI methods are concerned, we are currently transcribing all our know-how in the analysis and classification of visual information from the perspective of deep learning: the recognition of objects, scenes, actions, and the analysis of movement. LABRI has extensive experience in these methods, which have already given rise to several publications (e.g.[4-6]). Recent developments in deep learning concern hierarchical networks[7-8], which, like previous multi-level and multi-scale approaches, allow visual scene representations to be combined in a single frame at different levels of detail, both spatial and temporal. We will be interested in both the estimation of player movement and the recognition of shots in situations of occultation and rapid movement of these players.

The theoretical work of designing new methods in AI will be accompanied by experimental work in the multidisciplinary team, in order to extend the registered corpus TTStroke21[1].

[1] P.-E. Martin, J. Benois-Pineau, R. Péteri, and J. Morlier, "Sport action recognition with siamese spatio-temporal cnns: Application to table tennis," in CBMI 2018. 2018, pp. 1–6, IEEE.

[2] P.-E. Martin, J. Benois-Pineau, R. Péteri, and J. Morlier, "Optimal choice of motion estimation methods for fine-grained action classification with 3d convolutional networks," in ICIP 2019. 2019, IEEE.

[3] P.-E. Martin, J. Benois-Pineau, R. Péteri, and J. Morlier, "Fine grained sport action recognition with siamese spatio-temporal convolutional neural networks," In: Submitted to MTAP 2019.

[4] Ph. Pérez de San Roman, J. Benois-Pineau, J.-Ph. Domenger, F. Paclet, D. Cattaert, A. de Ruyg: Saliency Driven Object recognition in egocentric videos with deep CNN: toward application in assistance to Neuroprostheses. Computer Vision and Image Understanding 164: 82-91 (2017)

[5] S. Chaabouni, J. Benois-Pineau, Ch. Ben Amar: ChaboNet : Design of a deep CNN for prediction of visual saliency in natural video. J. Visual Communication and Image Representation 60: 79-93 (2019)

[6] I. González-Díaz, J. Benois-Pineau, J.-Ph. Domenger, D. Cattaert, A. de Ruyg: Perceptually-guided deep neural networks for ego-action prediction: Object grasping. Pattern Recognition 88: 223-235 (2019)

[7] [J.-H. Jacobsen](#), [E. Oyallon](#), [S. Mallat](#), [A. W. M. Smeulders](#)

Hierarchical Attribute CNNs, In ICML Workshop on Principled Approaches to Deep Learning 2017.

[8] P. Bideau, A. Roy Chowdhury, R. R. Menon, E. Learned-Miller, "The Best of Both Worlds: Combining CNNs and Geometric Constraints for Hierarchical Motion Segmentation", CVPR'2018, Salt Lake City, UT, 2018, pp. 508-517