

INTRODUCTION

We detect and classify **Table Tennis** strokes in videos recorded in natural condition. The goal is to develop an intelligent computer environment where teachers and students can analyse their games for improving players performance.

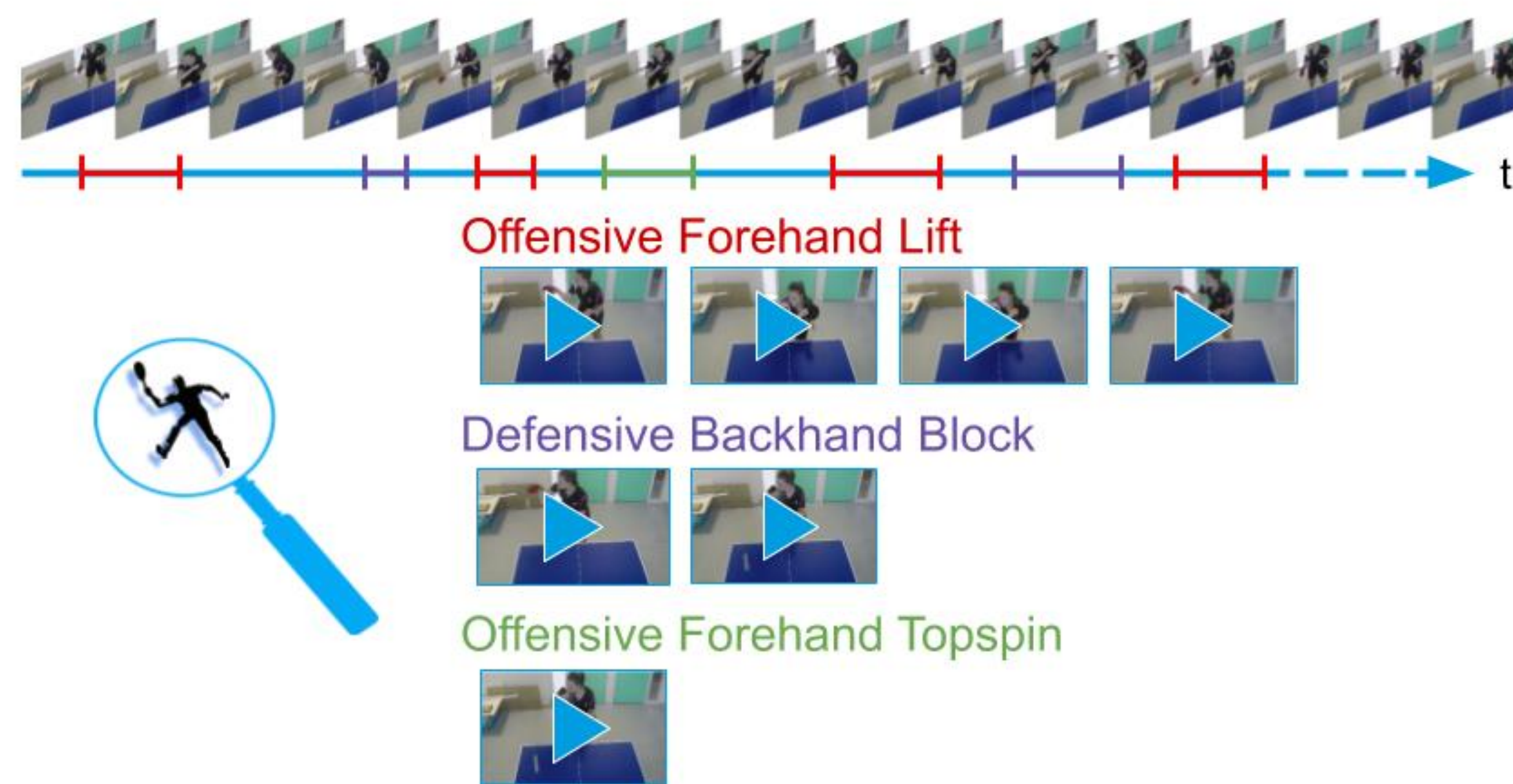


Figure 1: Intelligent computer framework proposal

TTSTROKE-21 & SSTCNN

In previous work^[1], a new dataset **TTStroke-21** focusing on Table Tennis games and a **Siamese Spatio-Temporal Convolutional Neural Network** so called **SSTCNN** have been introduced. Spatio-temporal data samples of size $(W, H, T) = (120, 120, 100)$ are classified over 20 stroke classes and a rejection class, using RGB video frames and their estimated motion vectors $V=(v_x, v_y)$.

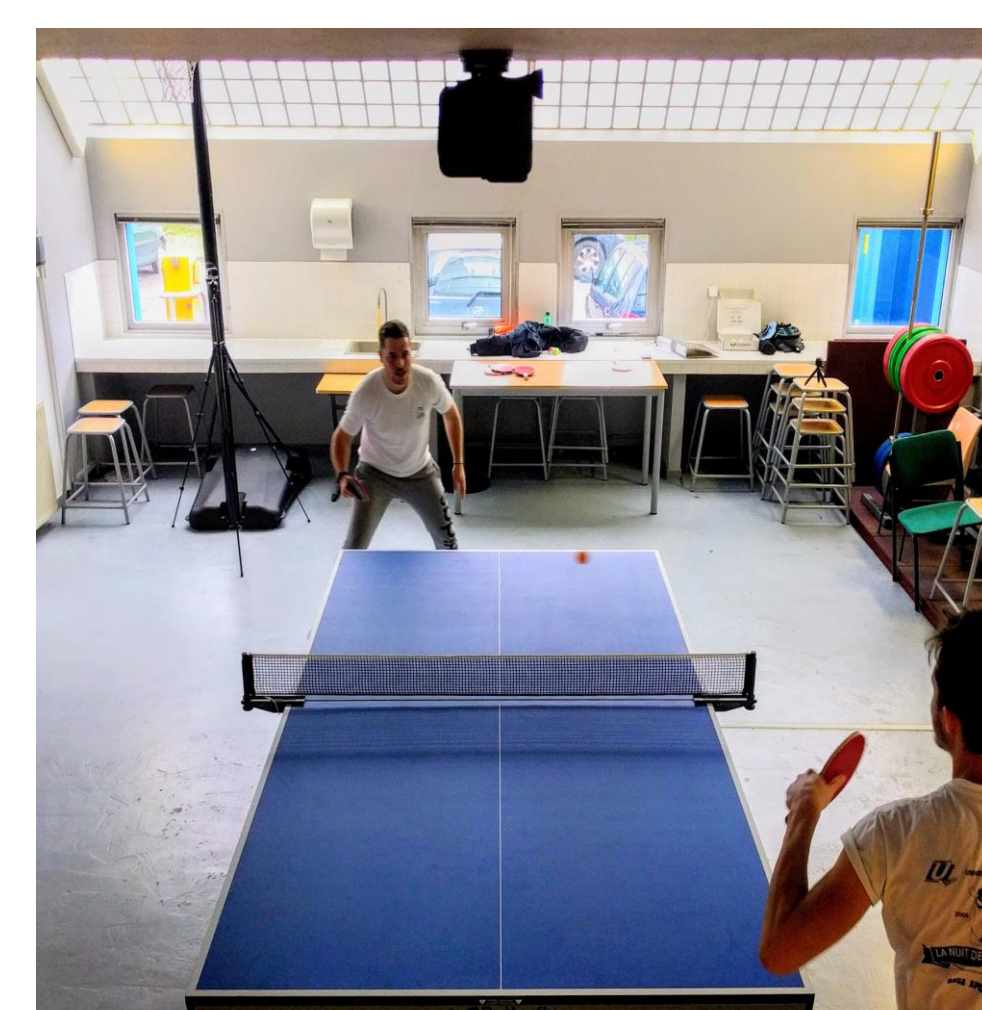


Figure 2: Acquisition

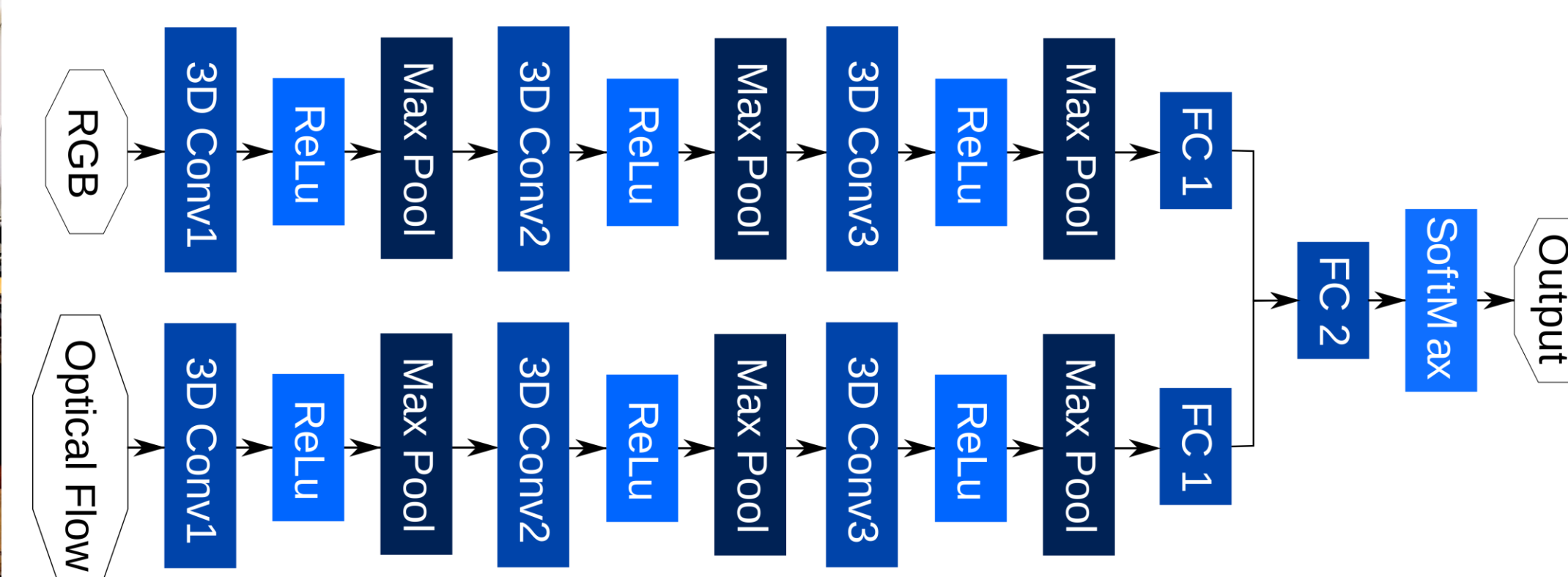


Figure 3: Siamese Architecture

FLOW METHODS

Different Optical flow methods are compared using **Sintel Benchmark**^[2] and **TTStroke-21** for different metrics.

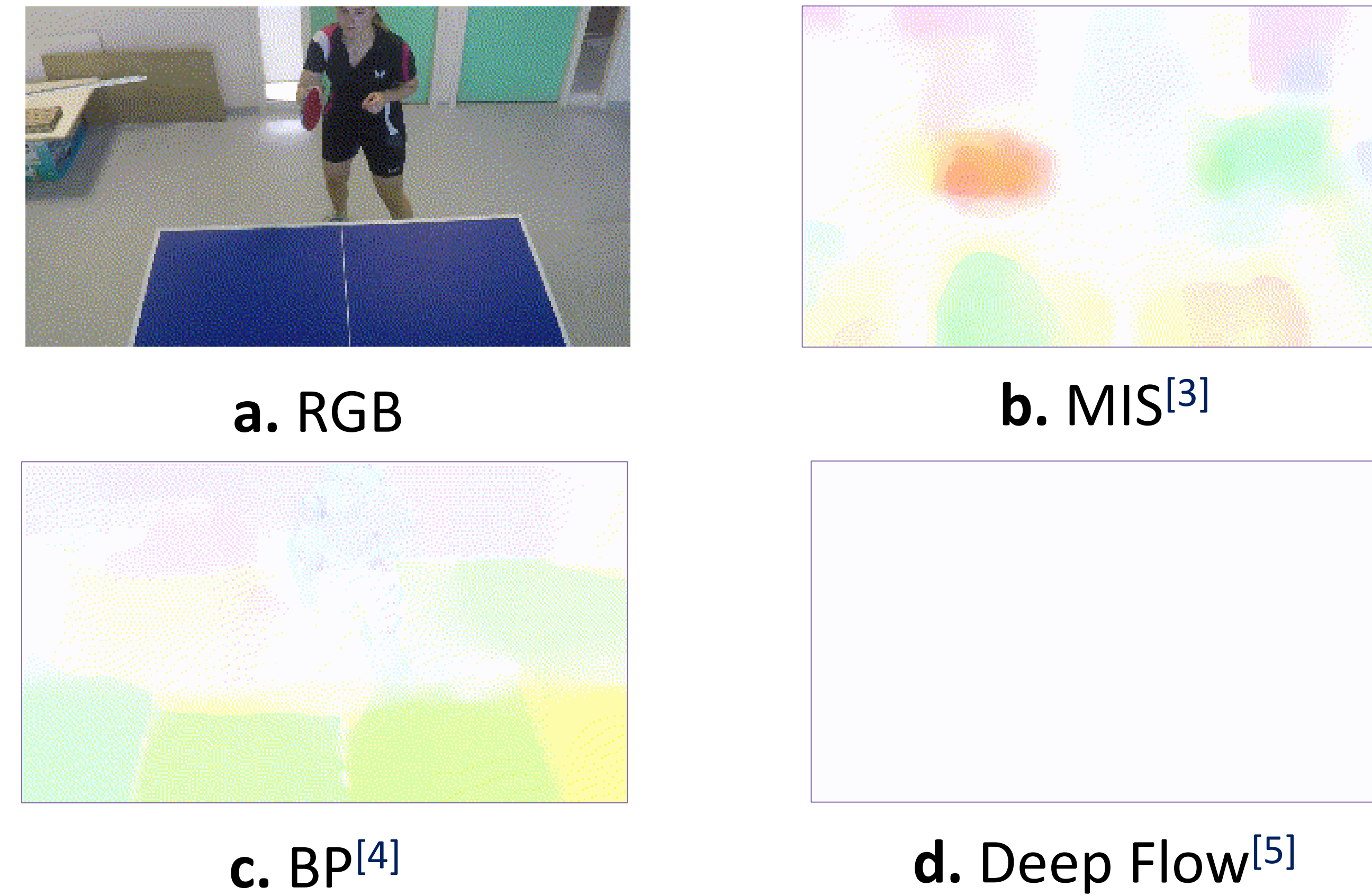


Figure 4: Comparison of estimated flows

FLOW NORMALIZATION

Three normalization methods have been tested. They all take into account the absolute values of the motion vectors computed over the whole dataset. They have been compared using classification accuracy on **TTStroke-21**.

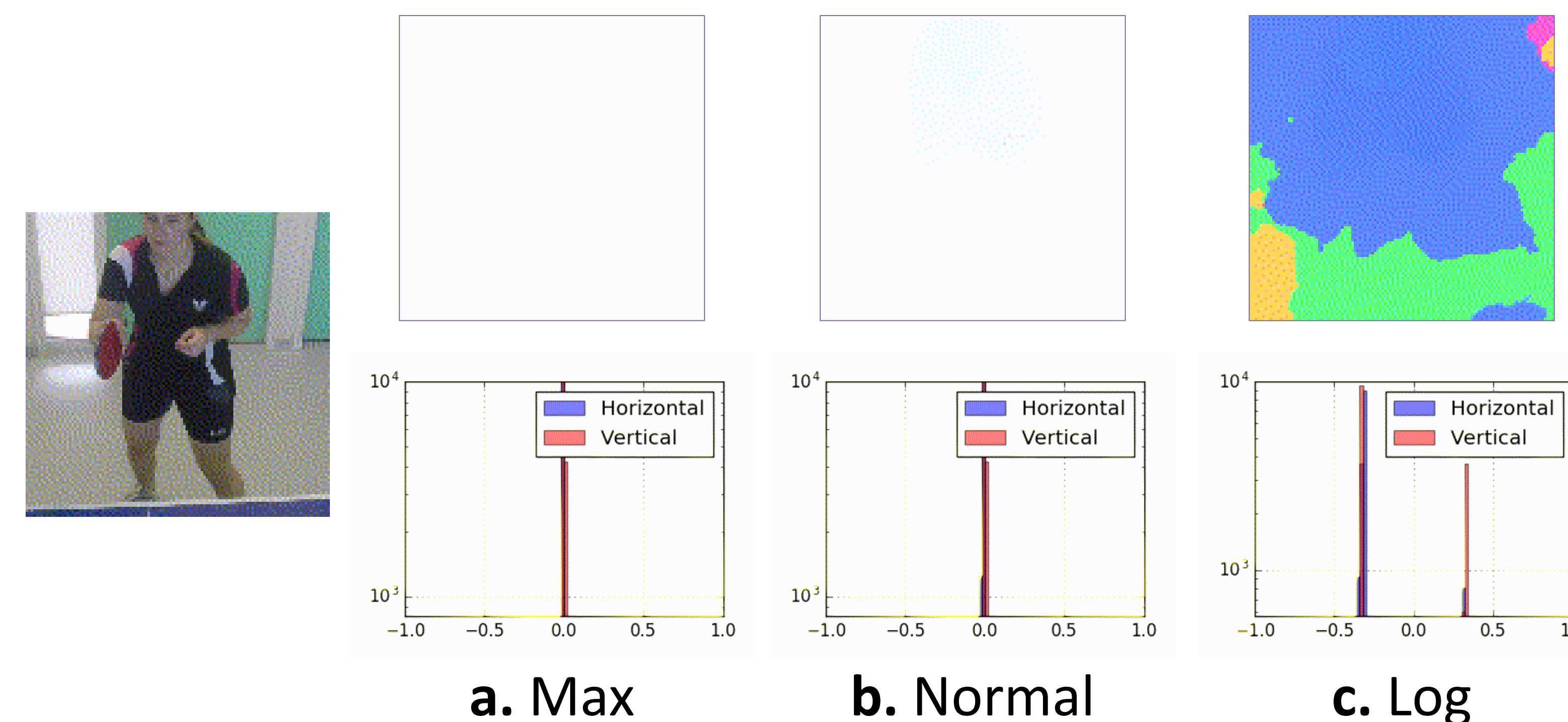


Figure 5: Flow normalization

RESULTS

Flow Methods	Sintel Benchmark			TTStroke-21
	aEPE	aAE	aMSE	aMSE
Ground Truth	-	-	407	-
BP	6.4	.42	316	20 ± 3.9
Deep Flow	2.6	.3	348	25 ± 5.2
DIS	4.8	.44	218	20 ± 4.6

Best flow methods are **DIS** and **Deep Flow**. Only **Deep Flow** was compared with **BP** since it does not generate false flow on flat regions contrary to **DIS**. 'Normal' normalization has obtain the best result with **BP** estimator boosting the score of 30%.

Normalizations	Accurcies - BP / Deep Flow		
	Train	Validation	Test
Max	53.5 / 38.5	44.4 / 36.5	44 / 27.6
Normal	88.5 / 34	73.5 / 35.7	74.1 / 26.7
Log	97.8 / 45.3	75.7 / 37	68.1 / 41.4

CONCLUSION

- Better flow estimator did not improve the classification.
- aMSE seems to be a good metric to evaluate the flow estimator for classification.
- The normalization has a strong influence on the classification score.

[1] P.-E. Martin et al., "Sport action recognition with siamese spatio-temporal cnns: Application to table tennis," in IEEE CBMI, 2018.

[2] D. J. Butler et al., "A naturalistic open source movie for optical flow evaluation," in IEEE ECCV, 2012.

[3] T. Kroeger et al., "Fast optical flow using dense inverse search," in ECCV. 2016, vol. 9908 of LNCS, Springer.

[4] Ce Liu, Beyond Pixels: Exploring New Representations and Applications for Motion Analysis, Ph.D. thesis, MIT, May 2009.

[5] P. Weinzaepfel et al., "Deepflow: Large displacement optical flow with deep matching," in IEEE ICCV, 2013.