# DIRAC Training - Report

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The problem of knowledge transfer is well known in the cognitive systems community. Transfer of knowledge is an essential property for artificial cognitive systems to deal with rare events, e.g. when cues of low statistic are detected by the system; one possible solution is to consult knowledge across related concepts or platforms. However, not much work has been done on knowledge transfer due to its complexity: different ways of knowledge representation, differences in the parameters of the platforms, growing memory requirements, etc. As a first step towards this goal, we address the problem of transfer of knowledge across different agents with different characteristics, engaged in the same task. We proposed a SVM-based knowledge transfer framework. Our method exploits efficiently the transferred knowledge while updating incrementally the internal representation as new information is available. The system is adaptive and tends to privilege new data when it builds the representation. As an extension of my master thesis, where I worked on a vision-based place recognition system for robot localization, our main testing beds were two robot platforms performing the place recognition task [1]. Extensive experiments results show clearly the effectiveness and promise of our approach.

During the four month visit to IDIAP, we have focused on designing our knowledge transfer framework. The knowledge on place recognition is transfered from one robot platform to another. The model representation is the same for the SVM classifier on both robots, which make the transfer of knowledge possible. Once the knowledge from cross platform is loaded into the memory of the new platform, the system begins to update this support vector model using the data acquired by its own sensor. This update is based on incremental learning techniques [2]. We extended our previous investigated svm incremental learning techniques to the "online" incremental learning scenario: the system performs an update of the internal representation as soon as new data or new classes are available, which is at risk of unbalanced data with respect to the class being updated. We also implemented a method during the learning process to reduce the extra memory

cost from cross platform [3]. This method privileges information coming from the platform currently in use, and prevents knowledge from cross platform to be nested in the new model when the learning is finished. The system framework was thoroughly tested on the newly built IDOL2 database [4], and compared with the no knowledge transfer case. The result show that our method achieve better and balance performance than no knowledge transfer case.

A paper [5] describing the knowledge transfer framework and experimental results in details has been presented in the International Conference on Computer Vision System (ICVS07). Another paper about incremental learning is being prepared to the International Conference on Intelligent Robots and Systems (IROS07).

We are also working on pyramid match kernel [6] which reduce the computation complexity of matching local image features, and perform the recognition tasks much faster than the current kernel we are using. I will continues to work together with Francesco Orabona on online support vector machines, in which the solution is built online. This is especially evident in online settings for applications like place recognition and topological mapping for robot platforms. Future work will focus on transfer of transfer of knowledge across concepts, and use other popular representation such as probability model, not only discriminative model.

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## References

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