ABSTRACT

Fusing information from heterogeneous and dependent sources for binary hypotheses testing problems is a challenge. Data fusion techniques are used to combine several sources of information in order to achieve a robust and accurate result in the decision-making process, impossible to reach using each data source in a separate way. This thesis includes a complete review of the state-of-art in data fusion techniques used in detection problems.

Data fusion can be performed at different levels in a detection system: in the pre-detection stage, data from several sensors or different features obtained processing these raw data can be combined at sensor fusion level and feature fusion level; in the post-detection stage, a combination of individual decisions or continuous valuations (scores) from disparate detectors is carried out in the detector fusion level.

Data fusion can be spitted into two categories attending to data characteristics: in soft fusion, different continuous data streams are combined; hard fusion is related to the combination of the individual decision given by several detectors. Score fusion can be considered as a special case of soft fusion in which continuous data (commonly related to the event occurrence probability) given by several detectors are combined.

The use of **statistical theory of copulas** to model the joint distribution of data form heterogeneous and dependent sources in the **soft fusion** has been remarked due to its recently and useful applicability in binary hypotheses testing problems. Copulas are functions that couple multivariate joint distributions to their component marginal distribution functions. It allows one to construct a statistical model by considering, separately, the univariate behavior of the underlying marginal and the dependence structure specified by some copula function. This is well suited for modeling the joint behavior of the heterogeneous and dependent sources in a binary hypotheses testing problem.

As far as the **score fusion** is concerned, a new technique based on α-mean function is presented. We have called it **α-integration**. This technique overperforms other commonly used methods due to its higher grade of adaptation. A new **training method based on the partial area under ROC curve optimization** is proposed.

A multimodal biometric system integrates information from multiple biometric sources to compensate for the limitations in performance of each individual biometric system. We have done some experiments on several multibiometric public databases in order to test these fusion techniques.

This work also focuses on the improvement of a novelties detection system in a monitored acoustic environment by using data fusion methods. A new detector, named as **copula one-class detector *COCD*,** has been proposed to deal with the problem of unknown signal detection in presence of random non-Gaussian noise. Also, we have proposed the **fusion of several microphones** in order to improve the performance of the acoustic detection.