

# Mistral : open source biometric platform.

[AB-113] \*

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## ABSTRACT

Mistral is an open source software for biometrics applications. This software, based on the well-known UBM/GMM approach includes also the latest speaker recognition developments such as latent factor analysis, unsupervised adaptation or SVM supervectors. The software performance is highlighted in the framework of the NIST evaluation campaigns.

## Categories and Subject Descriptors

H.4 [Information Systems Applications]: Miscellaneous;  
D.2.8 [Software Engineering]: Metrics—*complexity measures, performance measures*

## Keywords

GMM, Biometric, Speaker recognition, Face recognition

## 1. INTRODUCTION

As the scientific competition is becoming intense in the biometric field, an isolated team of researcher would have difficulties to elaborate a biometric tool at a state-of-the-art

\*Mistral Project is funded by the French National Research Agency (ANR) - Programme Technologies Logicielles 2006

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SAC'10 March 22-26, 2010, Sierre, Switzerland.

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level. The Mistral project issues from this observation. Mistral is an high quality open-source, free biometric platform (distributed under LGPL license), supported by an efficient and active scientific community. The main originality of the Mistral project is to use a unique statistical engine for various modalities of biometric applications.

## 2. ARCHITECTURE OF MISTRAL

A complete biometric application often includes a statistical engine (*e.g.* GMM models) and a wide variety of pre/post processing tools like those dedicated to data preparation and score calculation. The Mistral platform offers a complete biometric tool performing at the state-of-the-art level in highly competitive tasks such as international evaluation campaigns like the NIST-SRE [2].

## Work environment

Mistral is a fully configurable scientific tool which can be used through a graphic user interface offering ergonomic facilities. In the perspective of Mistral use by student or novice users, a Java interface is also available. First visual interface, called *Mistral Config*, allows beginners to use a set of predefined parameters. This aims to decrease the risk of bad settings and to give a textual explanation of each parameter. This Java interface allows also automatic generation of experiments sets (scripts, folder configuration).

## 3. INTERNET PORTAL AND COMMUNITY

All Mistral applications and tools can be accessed through an Internet portal<sup>1</sup>. It includes also a set of engineering software applications to help developers community (UML tools for modelization, Doxygen for documentation, SVN for dissemination, ...). All those elements federate a community of users from numerous scientific laboratories, faculties and

<sup>1</sup><http://mistral.univ-avignon.fr>

companies around the world (mostly from Europe, North America, China).

## 4. MISTRAL FUNCTIONALITIES

Objective of Mistral is to give high level libraries (Alize and Mistral\_tools) and ready-to-use modules, for any user wishing to manage a task of speaker identification and verification, speaker diarization, face and language recognition. The architecture includes a set of tools, based on two software libraries: the Alize library dedicated to feature and model management, and the Mistral\_tools library providing useful functions mainly for post-processing.

### Statistical models of Mistral

For basic applications, Mistral proposes a complete GMM statistical engine (Gaussian Mixtures) fully configurable by user. The models can then be completed by the two main sets of functionalities included in libraries:

**The Alize library** allows data reading and synchronization, algorithms (EM/ML/MAP) for models training, score computation, discriminant classifiers, session variability modeling.

**The Mistral\_tools** provides ready to use functions for SVM classification, Latent Factor Analysis, features/scores normalization.

Alize library provides statistical engine, and feature server management of Mistral. The global architecture of Alize divides the various tasks of the biometric modelization and classification processes: [The feature server] manages access to acoustic or raw features. [The model server] manages representations of mixtures and their parameters. [The statistical server] is in charge of calculations for models training, likelihood estimation, score normalization.

### 4.1 Mistral applications

Mistral provides ready to use applications to create a complete biometric experience, based on Alize and Mistral\_tools libraries.

### Speaker verification - SpkDet

Automatic speaker recognition experiments are achieved with the SpkDet tool. This complete application allows user to manage a complete experiment of speaker recognition, from acoustic features preparation to modelization and score calculation.

All those tools give and easy access to configuration options, allowing to select available options from the Alize and Mistral\_tools libraries, including SVM configuration, Factor Analysis or NAP.

SpkDet includes some complementary tools like energy Detector (speech and non-speech detection in signal), GMM visualization, histogram generation, and score fusion.

### Segmentation and classification of speakers:

Segmentation application, called hSeg, allows segmentation and hierarchical classification of speakers from a speech signal. Signal segments are low enough to allow classification even in difficult conditions, like multiple speakers intervention. The available methods include plain or diagonal Gaussian with various evaluation metrics.

## Langage detection - LangDet:

The LangDet application is a set of tools derived from SpkDet. Those tools allow to build a complete language detection system, fully compatible with the NIST-LRE evaluation campaign datas.

### Facial biometrics:

Several modules of Mistral are dedicated to facial biometrics. Local features approaches have been shown to be more robust than holistic ones in terms of pose variations or translations due to face localization. The use of such parameters in the GMM/UBM paradigm has provided good performance [3]. Local Principal Component Analysis (LPCA), eigenfaces and 2D DCT extraction tools as well as some normalization tools are part of the Mistral platform and could be easily combined to the statistic tools.

## 5. MISTRAL PERFORMANCES

Mistral performances are evaluated on regular basis throughout national and international scientific evaluation campaigns. During the last 3 years, Mistral has been deployed by Mistral Consortium members in NIST-SRE 2006-08 (speaker detection), ESTER 2 (speaker segmentation).

Mistral is regularly evaluated with participation to several national/international campaign like NIST-SRE. During the NIST-SRE 2006 campaign, Mistral achieved an EER of 5%, what placed this system close to the state-of-the-art systems (*cf.* [1]). During NIST6SRE 2008 evaluations, Mistral was at the state-of-the-art level (*cf.* [2]).

Mistral had been deployed in the ESTER 2 campaign: speaker diarization task. The segmentation module of Mistral obtained a 13 % error rate on the test corpus. *cf.* [4]

## 6. CONCLUSIONS

The aim of Mistral project is to develop a state-of-the-art biometric system. The performance of Mistral platform is highlighted during several national and international campaigns.

The major originality of Mistral is to propose a single recognition engine for multiple modalities: primarily voice and face. Mistral is also available on different operating systems (Linux / Windows / Mac OS). For users of Mistral, adoption of a unique and free recognition engine allows to focus on research and development efforts on specific aspects of the studied modality, rather than on the development and monitoring of complex low level software engines.

## 7. REFERENCES

- [1] J.-F. Bonastre, N. Scheffer, D. Matrouf, C. Fredouille, A. Larcher, A. P. G. Pouchoulin, N. Evans, B. Fauve, and J. S. Mason. Alize/spkdet: a state-of-the-art open source software for speaker recognition. 2008.
- [2] D. Matrouf, J.-F. Bonastre, C. Fredouille, A. Larcher, S. Mezaache, M. McLaren, and F. Huenupan. LIA GMM-SVM system description: NIST SRE. In *NIST SRE*, Montreal (Canada), april 2008.
- [3] C. McCool and S. Marcel. Parts-Based Face Verification Using Local Frequency Bands. *IEEE IAPR International Conference on Biometrics (ICB)*, page 72, 2009.
- [4] NIST. Dn4.2: Report on benchmark-based evaluations, 2008. Muscle, European Project no. FP6-507752.