LVIS PREFORENSIC

LOQUENDO VOICE INVESTIGATION SYSTEM

Loquendo Voice Investigation System uses voice biometrics to ascertain the identity of any individual.

It supports Security Operators carrying out investigation activities involving the analysis of telephone traffic on any type of channel.

Enables efficient search and rapid identification of anonymous callers by matching their voice biometrics with a database of voiceprints belonging to target subjects.

The exploitation of innovative speech technologies combined with the inherent characteristics of the human voice, allows investigation time to be devoted only to those calls which are really relevant to the investigation.

From Voiceprint to Speaker Identity

Loquendo Voice Investigation System permits the creation of Voiceprints, each one representing a particular speaker, on the basis of telephone conversations where the specific target subject has been recognised.

Voiceprints can be transferred from one system to another, with or without the audio material used to generate them. Voiceprints can also be assigned tag names.

Voiceprints can be updated as new audio material is acquired during the course of an investigation.

Once the desired Voiceprints have been created, the speaker identification feature allows them to be compared with recorded audio files, returning a rankable table of probability scores for each 'Audio File - Voiceprint' pair.

A World of Advantages

Loquendo technology is the ideal solution for investigation challenges; it is powerful, flexible, language independent, objective and can be used time and time again.

The Voice Investigation System provides reliable results presented as expected by the forensic experts. Loquendo VIS is the fundamental component at the core of more complex architectures, especially tailored for real-time analysis.

How it Works

Speaker Identification is performed thanks to Loquendo patented solutions based on innovative algorithms that automatically distinguish the speakers involved in a telephone conversation, extract the specific voice parameters, independently of the spoken language, and compare the speech files to be analysed with the available Voiceprints.

Language Identification permits the identification of the language used in a telephone conversation, either for filtering the calls which match specific spoken language criteria or for an automatic dispatching of calls to the right interpreters.

Gender Identification allows a reduction of the number of incoming calls on the basis of gender, discriminating between male-male, male-female, female-female conversations.

DTMF Interpretation allows the dialled numbers of a telephone call to be identified as well as any other number dialled during the conversation.

SNR and Speech Amount allows the reliability of the results obtained to be evaluated with regard to the signal quality and the duration of the analysed speech.

Voice analysis processing time requires a fraction of the speech duration, even when comparing several Voiceprints. Loquendo VIS is available as a Desktop system for a single Operator working on a PC.

By means of the project import/export capability, it can easily exchange data between other Desktop systems equipped with the same software.

In addition, Loquendo VIS is able to act as a Master generator of signed Voiceprints. These can be used to feed systems

LVIS PREFORENSIC - Performance Analysis Tools

Rapid Calibration Check Function

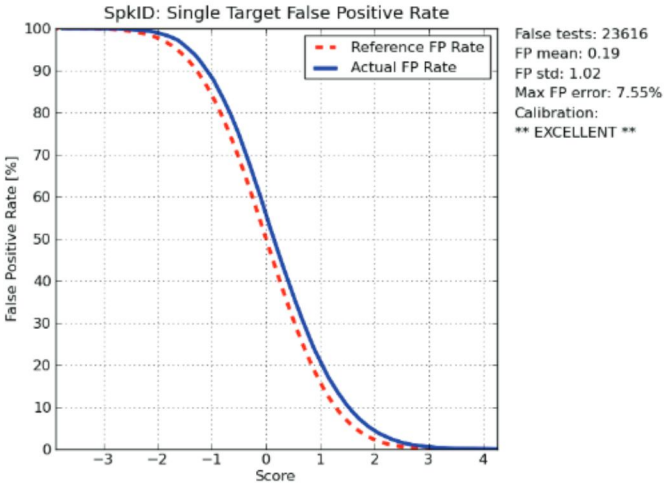
The Rapid Calibration Check is the quickest method for assessing how well speaker identification scores have been calibrated. The difference between the actual and the reference False Positive (FP) rate is represented by a potential horizontal-shift or curve stretching.

Moreover, this feature allows poorly calibrated applications to be offset, thanks to the estimation of the maximum false positive error (MAX FP Error) i.e. the maximum distance between the "actual FP rate" (blue line) and the "reference FP rate" (dashed red line).

When the MAX FP Error is "moderate" the system can automatically offset speaker identification scores without retraining the normalization set.

Retraining is, however, recommended for "inadequate" calibrations.

MAX FP Error	Calibration Level	Auto Calibration
< 10 %	Excellent	--
> 10 % < 20 %	Moderate	YES
> 20 %	Inadequate	NO



Speaker Identification - Performance Analysis Function

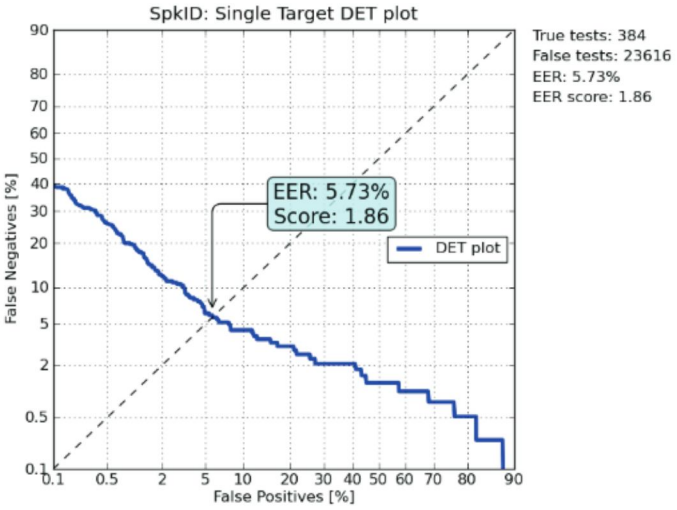
This is an extended tool which allows users to estimate speaker recognition accuracy using their own data. The Performance Analysis Function computes a set of statistics which are accepted as the standard way of assessing accuracy and calibration.

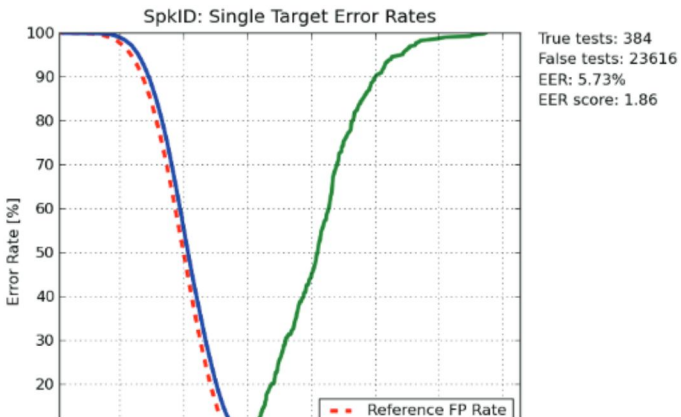
The tradeoff between the two error types (false positives and false negatives) is shown in the DET graph.

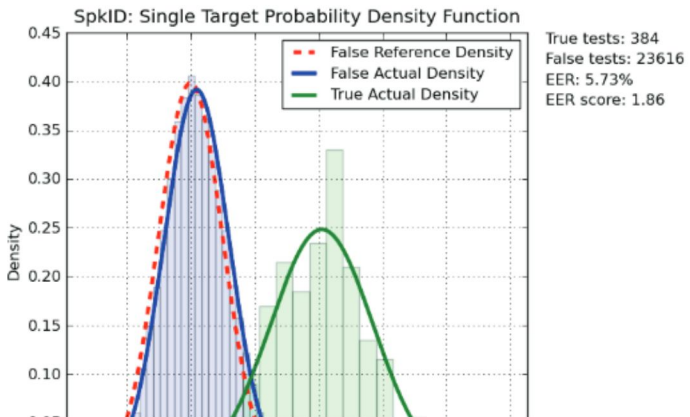
The intersection between the DET curve and the bisecting line represents the Equal Error Rate (EER) - where the false positive rate equals the false negative rate, often used as an overall performance measure for comparing systems and conditions.

In the "Single Target Error Rates" graph, users can measure error rates as a function of the recognition score.

The "Single Target Probability Density Function" graph shows the actual histogram of the score distribution for the True/False tests and their Gaussian models.







LVIS PREFORENSIC – Probability Assessment Tools

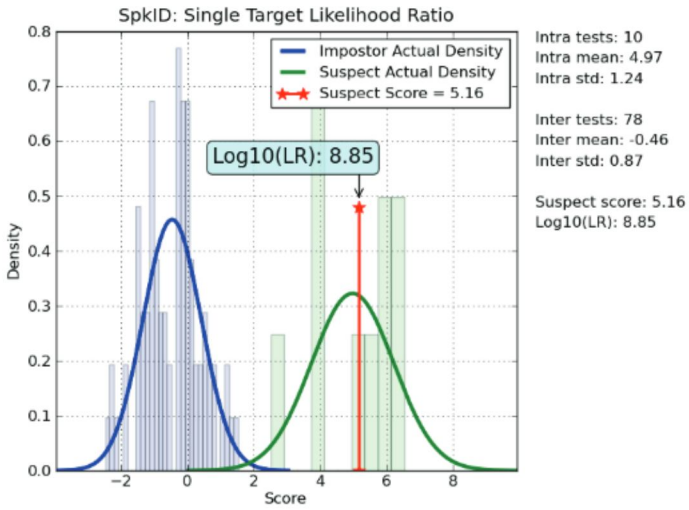
LLR Function
Speaker ID Log-Likelihood-Ratio (LLR) for a Single Target

The Likelihood Ratio is the standard index which is capable of converting a speaker verification score into a corresponding probability acceptable in a Court of Law. Such a measure is expressed within the framework of Bayesian theory:

"How much more likely is the given degree of similarity between samples if they were uttered by the same speaker than if they were uttered by different speakers?"

Positive Log10 Likelihood Ratios tend to support the prosecution hypothesis because they show that the degree of similarity between the test sample(s) and the samples of the suspect is greater than the similarity between test samples and different speaker (or impostor) samples.

The higher the LLR, the more reliable the recognition.



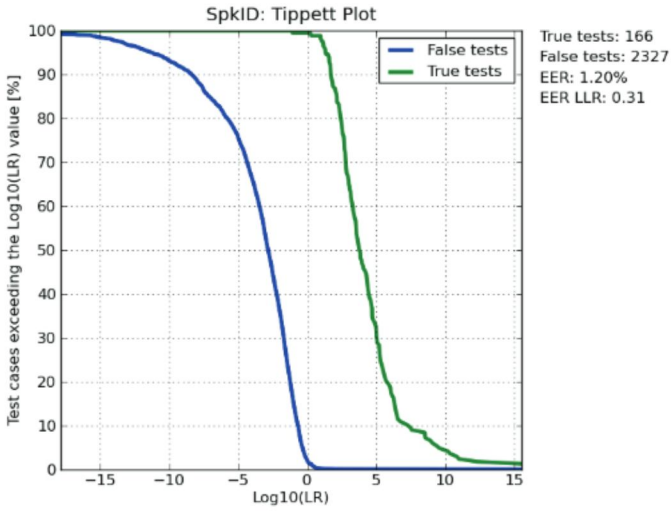
The value of the LLR Function thus gives substance and strength to the investigation hypothesis. LLR is calculated from the LVIS resulting scores and represents a reliable estimate of the manual forensic evaluations that experts may submit in a Court of Law, thus allowing investigators to pre-assess such forensic evaluations that could possibly become evidence at trial.

Results Reliability Function (Tippett Plot)

The Results Reliability Function can be used to estimate and prove the reliability of the actual likelihood ratio figures in a Court of Law, leveraging the success of LVIS in the field, and it therefore represents a measure of the strength of the current audio analysis.

The graph shows a "bootstrap" plot taken from real certified comparisons from NIST material which demonstrate how effective the Likelihood Ratio is at distinguishing same-speaker pairs (True Speaker Tests) from different-speakers pairs (Impostors Tests).

Given an LR value obtained from the LLR Function, the Tippett plot makes it possible to both estimate the residual proportion of Impostor Tests exceeding such a value and, similarly, the proportion of True Speaker Tests having an actual LR below that specific value.



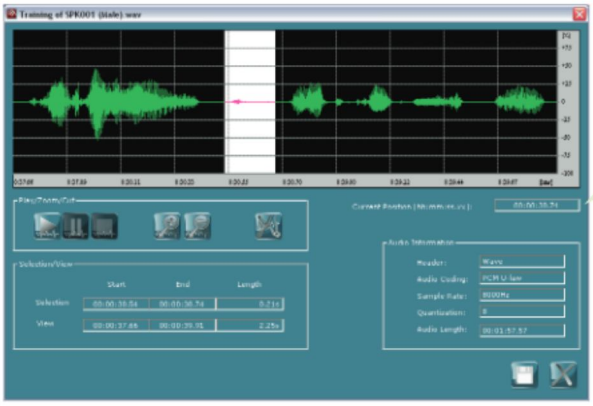
The Results Reliability Function allows each user to re-plot the Tippett graph on the basis of his/her own certified comparison results, demonstrating the real value of LVIS PREFORENSIC.

Finally, the renowned Loquendo Voice Investigation System becomes available to LEA investigators and forensic voice experts along with brand new features and graphic tools.

Voice System Features

- Speaker Identification
  - Rapid Calibration Check Function
  - Performance Analysis Function
  - Log-Likelihood-Ratio (LLR) Function
  - Results Reliability Function (Tippett Plot)
- Speaker Segmentation
- Language Identification
- Gender Identification
- DTMF Interpretation
- SNR and Speech Amount Measurements

Direct Access to the Audio Information



, OQUENDO6)3 INCLUDES A VWAVEFORM EDITOR 4H SIS AN OPTION FOR DELETING PARTS OF UNCLEAN SIGNALS AND GENERATING THE RIGHT AUDIO TRACK FOR BUILDING 6 OICEPRINTS

LVMS waveform editor

Technical Specifications

$ISTRBUTION	Release 7 - Stand Alone Application for Windows
/ PERATING3 YSTEM	32 bit Windows O.S. (Win 2000/XP Pro & Home/Win 2003/ Win Vista/ Win 7/ Win 2008)
, ANGUAGE - ODE	Language Independent
! VAILABLE ! UDIO#ODINGS	PCM A-law 8 bit 8 kHz Mono PCM µ-law 8 bit 8 kHz Mono PCM Linear 16 bit 8 kHz Mono Without Header (RAW) or with Header (RIFF/Wav) from 8 kHz to 48 kHz
)NTEROPERABILITY	Import / Export of Projects - Voiceprints - Normalization Set
4RAINING2EQUIREMENTS	
6OICEPRINT3IZE	13 kB
- INIMUM $URATON OF#ONVERSATIONAL 3PEECH $ATA FOR4RAINING	30 sec (Recommended 60 sec)
3PEAKER3EGMENTATON #APABILITIES	
- AXIMUM . UMBEROF$ETECTABLE 3PEAKERS WITHIN A #ALL	3
3PEAKER)DENTI CATON#APABILITIES	
3UPPORTED 3PEECH - ODE	Mono and multi-Speaker Support
, ANGUAGE)DENTI CATON#APABILITIES	
! VAILABLE , ANGUAGES ON DEMAND	Arabic (Egyptian, Gulf, Iraqi, Levantine), Bulgarian, German, American English, Latin American Spanish, Persian (Farsi, Dari), Canadian French, Hebrew, Hindi, Croatian, Italian, Japanese, Korean, Dutch, Pashto, Portuguese, Romanian, Russian, Tamil, Turkish, Vietnamese, Mandarin Chinese, Other.
' ENDER$ETECTON #APABILITIES	
3PEAKERS' ENDER	Male, Female, Both (M + F)
4ONE $ETECTON 3UPPRESSION	
3UPPRESSION $ETECTION	DTMF Tones, Dial, Ring and Busy Tones
! UDIO 1UALITY ! TRIBUTES	
1UALITY - EASUREMENTS	SNR, Speech Amount

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Loquendo - Vocal Technology and Services