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Abstract

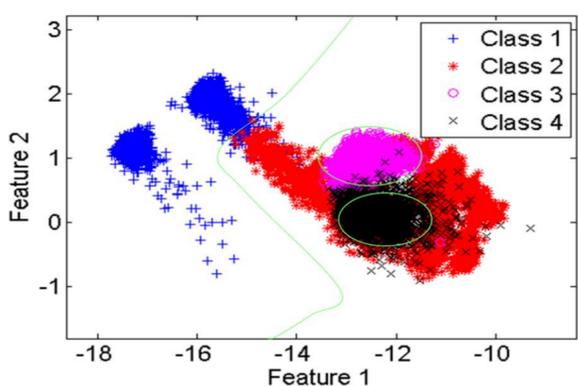
Acoustic signals are present almost in every process, every machine, every action. In many cases, we can only consider noise as an unwanted result, an unwanted sound that we would like to remove from a product or a process. But, we shouldn't forget that, as result of a process, noise and vibration are acoustic signals that contain information about it. Is it possible to extract that information from the acoustic signals? Signal processing and pattern recognition can be applied to classify sounds, inferring the information they provide. This is a research line that the I2A2 research group initiated in 2008, and that has achieved quite a good number publications in scientific journals, an three patents. Pattern recognition has been applied to the detection and classification of environmental noise sources, the detection of threats in a security system, the monitoring of water boiling stages, and the road estate detection in a vehicle.

Applications of sounds classification



WATER BOILING STAGES – The aim in this project was to use sound and vibration signals for monitoring the stages of boiling. An almost perfect classification was achieved on the pilot case, using a Mixture of Gaussians classifier. The following step towards an acoustic cooking assistant is under research.

A SOUND BASED SECURITY SYSTEM - The system is able to detect in real time individual sound events, and classify them of the basis of a previously defined threats (glass break, steps, door slam, shot ...). Impulsiveness of sounds (instead of their intensity) is used to capture the events, then, a GMM classifier is used for the classification stage.



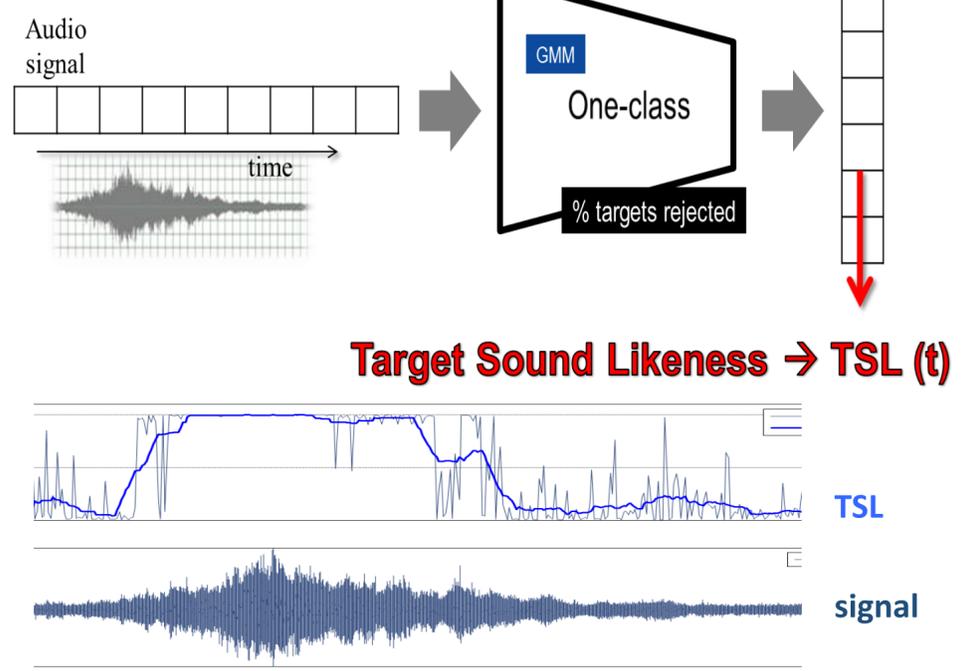
ROAD STATE – A pilot case was implemented to detect wet asphalt using the sound that tyre-road interaction generates. The final goal in this project is to extract further information to infer information from road maintenance status, grip of the vehicle, type of asphalts... This approach can be also applied to railway.

Anomalous sounds detection

ONE-CLASS CLASSIFIERS are trained when only one of the classes can be described properly. For instance, we have used this approach to detect aircraft sounds in an environmental noise monitoring system. One of the classes is aircraft sound, but the other class is composed by all the rest of sounds, and therefore we will always find sounds for which the system has not been previously trained. In this case, the detection model fits the "target class", and the system classifies as outliers those sounds that are not close enough to the target.

This is an approach that can be also applied for the identification of alerts, or outliers in a system (failures in a machine or anomalous conditions).

Dynamic classification



PAPERS IN JOURNALS

- Tarabini, M.; Moschini, G.; Asensio, C.; *Unattended acoustic events classification at the vicinity of airports. Applied Acoustics (2014)*
- Alonso, J.; López, J.M.; Pavón, I.; Recuero, M.; Asensio, C.; Arcas, G.; Bravo, A. *On-board wet road surface identification using tyre/road noise and Support Vector Machines. Applied Acoustics (2014)*
- Asensio, C.; Moschioni, G.; Ruiz, M.; Tarabini, M.; Recuero, M. *Implementation of a thrust reverse noise detection system for airports. Transportation research Part D (2013).*
- Tabacchi, M.; Asensio, C.; Pavón, I.; Recuero, M.; Mir, J.; Artal, M.C. *A statistical pattern recognition approach for the classification of cooking stages. The boiling water case. Applied Acoustics (2013).*
- Asensio, C; Ruiz, M; Recuero, M. *Real-time aircraft noise likeness detector. Applied Acoustics (2010)*