Time-frequency segmentation using a probabilistic contrast and local phase analysis

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Abstract

The characterization of time-frequency structures exhibiting non-linear instantaneous frequency law is a general topic, useful in a large number of applications. One of the greatest nowadays applications deal with the monitoring of species such as marine mammals and/or bats. This monitoring is of great interest in encountering, localizing, tracking and/or classifying these species in order to better understand their ecology and to evaluate the impact of anthropogenic pressures. The common way to remote sense these animals is to capture and analyze their acoustic emissions. These operations are obviously passive and a huge amount of data must be acquired while there is no way to predict the emissions times and places. Processing such data requires the definition of an appropriate representation space to extract the useful parameters such as the parameters of the time-frequency structures (i.e. the time-frequency trajectories characterizing the signal of interest).

The extraction of time-frequency tracks of signals components must face artifacts (measurement noise, acoustic perturbations coming from other sources, etc.) as well as the diversity and proximity of the components. In addition, the signals are materialized by a large number of samples and high sampling frequency, requiring not only accurate representation tools but also the ability to handle long signals. In this context, we propose a two stages methodology that will extract the time-frequency content of an acoustic signal. The first stage consists in detecting the time-frequency Regions of Interest (RoI) using a probabilistic contrast between the useful and the useless time-frequency parts of the signals. Once the RoI identified, a trajectory tracking procedure based on local phase continuity of the signal is applied. The representation space will be finally defined by the set of parameters of short-time cubic frequency modulations that matches the time-frequency components of the signal.

In our talk, we will present the two stages of our process and present successful applications on real data that demonstrate the ability of our process to cope with field constraints.