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APPLICATION

sᴏᴜɴᴅCʟᴀss: An automatic sound classification tool for biodiversity monitoring using machine learning

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Abstract

1. Passive acoustic monitoring, a non-invasive technique, is increasingly used to study animal populations and habitats at much larger spatial and temporal scales than standard methods. However, easy to apply tools for reliable detection and classification of signals of interest among hundreds or even thousands of hours of recording are still lacking.
2. We introduce the ʀ package sᴏᴜɴᴅCʟᴀss, a tool to train convolutional neural networks, and employ them to classify sound events in recordings. sᴏᴜɴᴅCʟᴀss provides a sound event classification pipeline, from annotating recordings to automating trained networks usage in real-life situations.
3. We illustrate the package functionality on bat echolocation calls, bird songs and whale echolocation clicks, showing that the package can be used to train networks for several types of sound events, taxonomic groups and environments; and exemplify its application.
4. This tool facilitates the creation and usage of trained networks and was developed with a strong focus on graphical user interfaces to be used by non-specialist scientists in statistics and programming.

KEYWORDS
biodiversity monitoring, convolutional neural networks, machine learning, passive acoustic monitoring, sound classification

1 | INTRODUCTION

Passive acoustic monitoring (PAM) is increasingly used to study animal populations and habitats (Browning et al., 2017). Concurrently, rapid technological advances are prompting the appearance of low-cost recording hardware, better storing and raw data management as well as extended battery life. These advances lead, for example, to the possibility of deploying multiple recording devices simultaneously in the field for progressively longer periods of time. PAM is a non-invasive technique enabling the detection of species presence and richness, the monitoring of population density and inferring several environmental metrics (acoustic diversity, acoustic entropy, etc.) at much larger spatial and temporal scales than standard methods (Merchant et al., 2015). However, it is important to note that the target species must make detectable sounds that can be identifiable to a useful class (a set of cases sharing common characteristics, e.g. taxonomic group, species, behaviour) for PAM to be effectively employed (Browning et al., 2017).

Adopting PAM over broad spatial and temporal scales, however, still faces a pressing issue: the reliable detection and classification