

# **Automatic Type Classification and Speaker Identification of African Elephant (*Loxodonta africana*) Vocalizations**

This paper presents a system for automatically classifying African elephant vocalizations based on systems used for human speech recognition and speaker identification. The experiments are performed on vocalizations collected from captive elephants in a naturalistic environment. Features used for classification include Mel-Frequency Cepstral Coefficients (MFCCs) and log energy which are the most common features used in human speech processing. Since African elephants use lower frequencies than humans in their vocalizations, the MFCCs are computed using a shifted Mel-Frequency filter bank to emphasize the infrasound range of the frequency spectrum. In addition to these features, the use of less traditional features such as those based on fundamental frequency and the phase of the frequency spectrum is also considered. A Hidden Markov Model with Gaussian mixture state probabilities is used to model each type of vocalization. Vocalizations are classified based on type, speaker and estrous cycle. Experiments on continuous call type recognition, which can classify multiple vocalizations in the same utterance, are also performed. The long-term goal of this research is to develop a universal analysis framework and robust feature set for animal vocalizations that can be applied to many species.