

International workshop. Cetacean echolocation and outer space neutrinos:
ethology and physics for an interdisciplinary approach to underwater
bioacoustics and astrophysical particles detection



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An algorithm to measure the size of sperm whales recorded by INFN deep-sea observatories in the Ionian Sea (Eastern Sicily)

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The Sperm whale continuously produces short acoustic signals, defined as “clicks”, to recognize the environment, to find food and to facilitate intraspecies communication. Each click has a multi-pulse structure, with a first variable pulse and a series of equally spaced pulses originating from multiple reflections inside the head of the whale. The measurement of the stable Inter Pulse Interval allows to acoustically assess the size of the animals. This work stemmed from the idea to automatically estimate the stable IPI through the average of cepstra computed on a large number of clicks. A new algorithm was developed to identify and extract the clicks and to carry out the analysis. Finally, the software searches for the peaks in the averaged cepstra and confirms the results with an automatic evaluation of reliability. The first results were produced analysing the dataset acquired during the years 2005-2006 by the NEMO OnDE (Ocean noise Detection Experiment) station. This was an INFN-LNS project, in cooperation with CIBRA, and consisted in an acoustic antenna, made of four large bandwidth hydrophones ($30\text{Hz} < f < 42\text{kHz}$), in operation at 2100 m of depth and connected in real-time to shore, through a submarine electro-optical cable. OnDE represented the first experiment performing acoustic noise monitoring in real-time over a long time in the Mediterranean deep sea. Using this automatic software tool, we processed the huge dataset acquired with OnDE and we now analyse new data coming from the SMO (Submarine Multidisciplinary Observatory) acoustic sensors, with minimal supervision. The developed software allows assessing the dimensional distribution of the specie, to hypothesize the sex, the maturity stage and to identify single whales present in consecutive recordings. Continuous data collection in real time will support an ecological study on sperm whales population structure in a strategic area of the Mediterranean Sea.

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