Matlab plotting tool for visualisation of DTAG data before/during/after a brief disturbance

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Motivation

This tool was developed as part of the MOCHA Pilot Whale Workshop in September 2013. The aim was to develop a plotting tool to allow fine-scale examination of DTAG data before/during/after exposure.

We developed the tool using data from a tagged pilot whale that was exposed to a killer whale playback, where there was an expectation of a noticeable behaviour change (change had been detected using Mahalanobis distance analysis at a coarser time resolution).

This visualisation tool should assist with identification of a "stop" reaction where the animal pauses its activity to determine whether it should react or not, or a flight response where it begins to swim rapidly away from the stimulus. In the former case, our expectation would be to see a decrease in acceleration, a decrease in fluke rate, a change in pitch towards zero, and possibly fluctuation in heading ("orienting" response); in the latter, a strong and sudden increase in acceleration and fluke rate and perhaps a change in depth (either a dive to depth, or a move to the surface).

Description of the tool

The tools plots DTAG data streams relevant to describe behaviour at short time scales. These include fluke rate, ODBA (overall dynamic body acceleration), flow noise, heading, depth profile, clicking and pitch angle. Any change in variables such as heading can be examined post-hoc to determine if the change is away or towards the sound source (The plots show whale-frame heading data from the tag, and no attempt has been made to integrate whale position and source position data and show heading-relative-to-source). The tool also overlays sound production data (e.g. clicking periods, feeding buzzes, calls, and whistles) from an acoustic audit on top of the dive profile, if an audit file is available.

By default, the tool plots 90 seconds of tag data: 30 second windows for before, during and after exposure. This time-frame can be customised, although if very long time-windows are specified, Matlab may crash because it will encounter memory limitations when it tries to read in long segments (more than several minutes) of high-frequency acoustic data. For easy operation, the tool includes default parameters for spectrogram settings, flow noise calculations, fluke rate detection, and ODBA calculation; the default settings should be relatively appropriate for analysis of data from pilot whales or similarly-sized species. All the parameters can also be customised by more advanced users via optional input arguments. The matlab script includes appropriate help to allow such customisation. Advanced users should also be able to modify the tool to plot other tag data streams relatively easily if desired.

The tool is primarily for data visualisation to identify potential behavioural change-points. Any observed changes can then be examined in more detail. Further statistical analysis could be carried out to determine whether the chance was unusual. One option for such analysis might be some kind of randomisation test, which would require comparison with many equal-duration snips from the tag record during baseline periods; in pursuing this approach, it would be important to make sure that these snips were from a comparable behavioural state. During design of the tool, it was agreed that it would be better to use baseline data from the same tagged individual rather than from other individuals, and that perhaps post-exposure data could also be included in the analysis after a certain duration since the tool aims to detect very fine-scale (and presumably relatively transient) changes.

Requirements for using the tool

The tool is freely available under a CC BY license (essentially, you can do whatever you like with it). You may contact Stacy DeRuiter for help or with questions. While we do not make any official or long-term promises of support outside the bounds of the MOCHA project, if MOCHA collaborators wish to have a custom version of the tool, or a support script to allow easy batch processing of a number of exposures/transmissions, the MOCHA team will be happy to help.

The tool is written as a Matlab (R2011b) function for easy compatibility with DTAG data and Mark Johnson's DTAG data analysis tools. It works with both DTAG2 and DTAG3 data. It follows the file naming conventions and data-storage architecture of the DTAG tool kit, and relies on some of the scripts in the kit. These dependencies probably make it simple to use for experienced DTAG technicians but relatively difficult to get working for others; the intended user is someone already familiar with the DTAG tool kit.