# Separating overlapping echolocation

## An updated method for estimating the number of echolocating animals in high background noise levels

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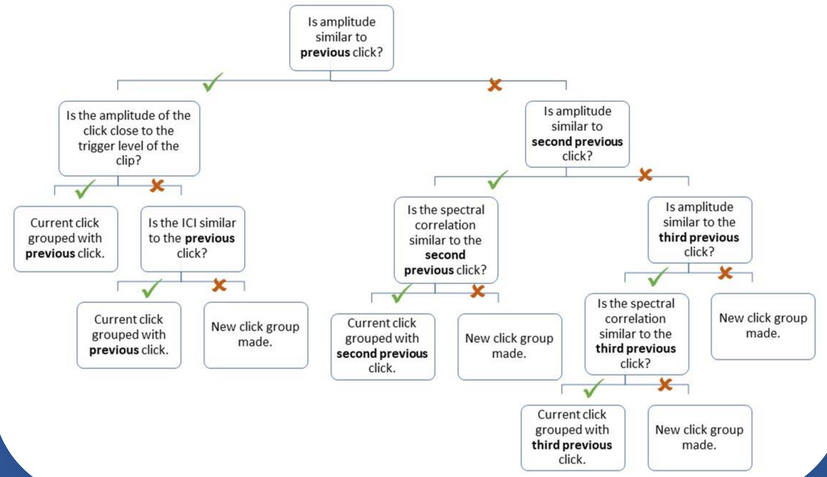
# Method

### Algorithm decision tree

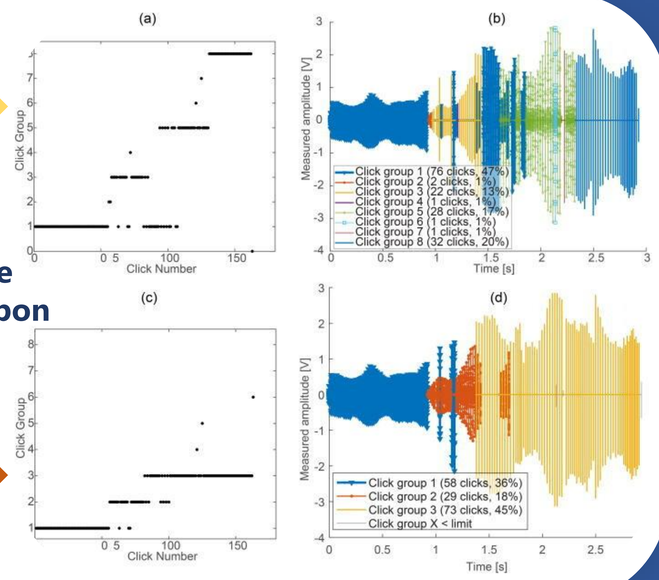



### Algorithm parameters

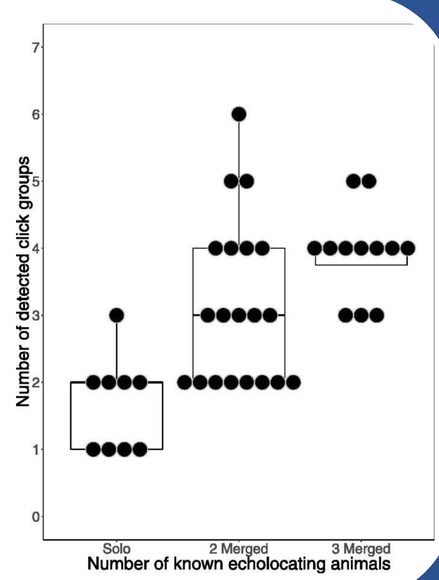
| Parameter | Description | Units |
|---|---|---|
| Trigger level | Minimum amplitude of clicks included in analysis, set per clip | Pascals/Volts |
| Peak-to-peak amplitude threshold | Maximum allowed amplitude difference between clicks grouped together. Calculated as a function of the chosen trigger level. | Pascals/Volts |
| Inter-click interval threshold | Maximum allowed ICI difference between clicks grouped together | Number of samples |
| Trigger level ICI tolerance | Minimum amplitude difference between trigger level and click for which ICI would be used to determine click similarity | Pascals/Volts |
| Spectral resolution threshold | Minimum correlation value of frequency spectrum content between clicks grouped together | Proportion |
| Low percentage removal limit | All detected peaks belonging to relatively unpopulated click groups (below this percentage value) are removed for data analysis | Percentage |
| Window taper parameter | Tapering parameter of the click windows, preventing false frequency components in the analysis | Unitless |
| Previous click comparison number | The number of clicks earlier in the sequence for which the algorithm compares parameters | Number of clicks |

# Results

**Original version performance improved upon in updated version.**




**The algorithm output never underestimated for clips of known numbers of echolocating animals.**




# Application

- **Estimate number of echolocating animals from recordings, even with high background noise and limited recording bandwidth.**
- **Analysis of detailed behavior during foraging and social interactions (e.g., how many animals echolocate during group foraging).**

# Acknowledgments

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